UNITED STATES ENVIRONMENTAL PROTECTION AGENCY
REGION 7
11201 Renner Boulevard
Lenexa, Kansas 66219

Mar 9, 2023

MEMORANDUM

SUBJECT: Dubuque Brownfields Multipurpose Project Data Quality Objectives and Generic Quality Assurance Project Plan Version 1.0 City of Dubuque, Iowa – Approved

FROM: Diane Harris, Regional Quality Assurance Manager
Laboratory Services and Applied Sciences Division

DIANE HARRIS
Digitally signed by DIANE HARRIS
Date: 2023.03.09 10:27:52 -06'00'

TO: Deborah Kennedy, EPA Project Manager
Brownfields, SMM, P2, and Redevelopment Branch
Land, Chemical and Redevelopment Division

The request to review the revised subject document prepared by Blackstone Environmental, Inc. for City of Dubuque, dated January 26, 2023, has been completed according to "EPA Requirements for Quality Assurance Project Plans for Environmental Data Operations," EPA QA/R-5 March 2001. The document is a revision to the previously submitted document associated with the QA review memo dated January 23, 2023 (R7QAO Document No. 2023024) and comments addressed in the EPA project manager's email received February 10, 2023.

The document is approved. It complies with R-5 and addresses the key issues satisfactorily.

If you have any questions, please contact Rebecca Estep, Lead Reviewer, at x7598 or me at x7258.

R7QAO Document Number: 2023060

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SECTION A - ADMINISTRATION

A1. TITLE AND APPROVAL PAGE

UNITED STATES ENVIRONMENTAL PROTECTION AGENCY (EPA) BROWNFIELDS MULTIPURPOSE GRANT - REGION 7
CITY OF DUBUQUE, DUBUQUE COUNTY, IOWA

TITLE: PROJECT PLAN— **Dubuque Brownfields Multipurpose Project Data Quality Objectives and Generic Quality Assurance Project Plan Version 1.0, January 26, 2023**
EPA ID No. CAG# BF 97768801-2 – Project Period 10/01/2019 to 09/30/2024

PREPARED BY:

Blackstone Environmental, Inc.
16200 Foster St.
Overland Park, KS 66085
(913) 495-9990

PROJECT DIRECTOR/MANAGER:

1-26-23

(Signature) Steve Sampson Brown (Date)
Project Director/Manager

BLACKSTONE ENVIRONMENTAL, INC. REVIEWER:

1/26/23

(Signature) Emily Smart (Date)
Project Manager

1/26/23

(Signature) Lindsay E. James (Date)
QA/QC Reviewer

U.S. EPA PROJECT MANAGER APPROVAL:

DEBORAH KENNEDY Digitally signed by DEBORAH KENNEDY Date: 2023.02.10 12:24:43 -06'00'

(Signature) Deborah Kennedy (Date)
Brownfields Project Manager

U.S. EPA QA MANAGER APPROVAL:

DIANE HARRIS Digitally signed by DIANE HARRIS Date: 2023.03.09 10:34:20 -06'00'

(Signature) Diane Harris (Date)
Region 7 Quality Assurance Manager

RECEIVED 02/10/2023
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APPENDICES:

A Project Location Map

B QAPP Amendment Template

C Iowa Land Recycling Program & Statewide Response Action Standards (IAC 137) Iowa Administrative Code (455H) Chapter 137

D IDNR Land Recycling Program and Summary of Simplified Risk-Based Formula for Determining Groundwater and Soil Response Action Standards

E Laboratory Quality Assurance / Quality Control Manual

F Standard Operating Procedures

G EPA Method 6200

A3. DISTRIBUTION LIST

Digital copies of *Project Plan: Multipurpose Cooperative Agreement Project Data Quality Objectives and Quality Assurance Project Plan, Version 1.0, April 13, 2022* will be distributed as follows. These persons will also receive copies of routine report distributions as set forth in section C2.

A3.1 United States Environmental Protection Agency, Region 7
11201 Renner Boulevard
Lenexa, Kansas 66219
Ms. Deborah Kennedy, Brownfields Project Manager

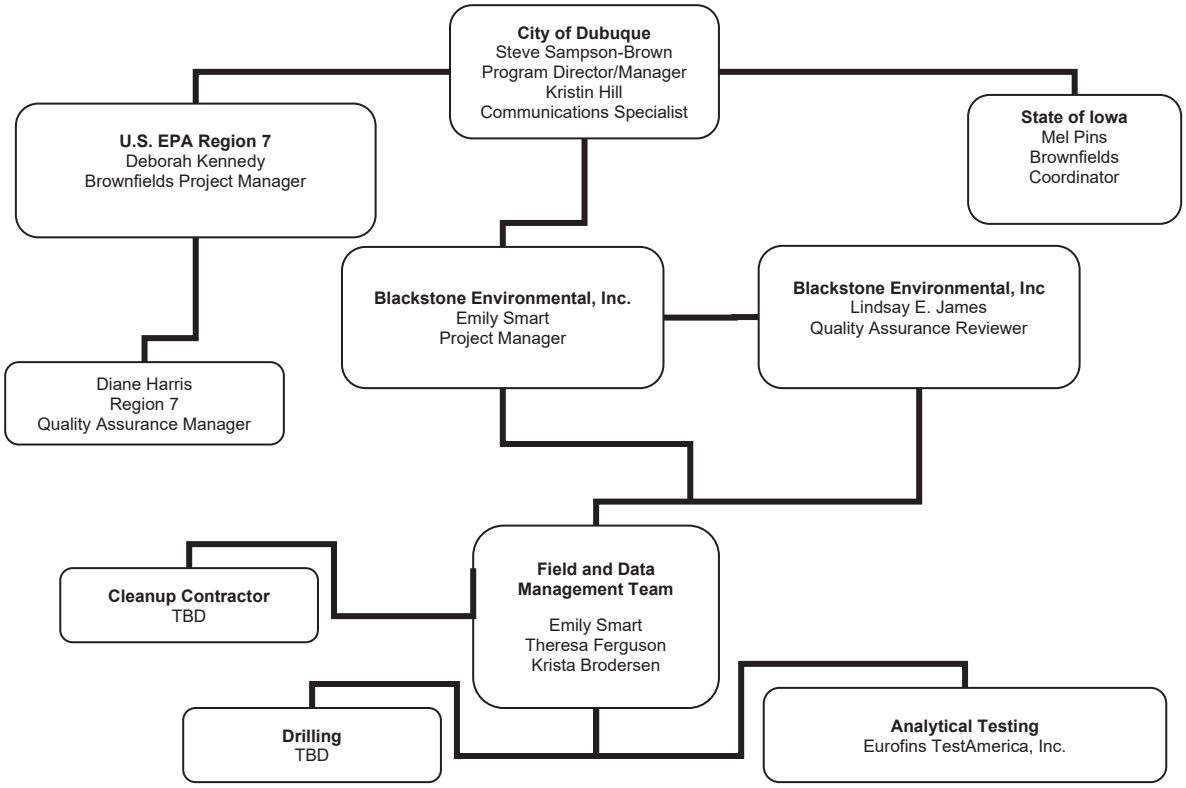
A3.2 City of Dubuque
50 West 13th Street
Dubuque, Iowa 52001
Mr. Steve Sampson-Brown, Engineering Department

A3.3 Project File
Blackstone, Inc.
16200 Foster St.
Overland Park, KS 66085
Ms. Emily Smart, Project Manager

A3.4 Eurofins **TestAmerica Incorporated**
704 Enterprise Drive
Cedar Falls, Iowa 50613
Mr. Christopher A. Deimerly, Quality Assurance Coordinator

A3.5 Iowa Department of Natural Resources
Contaminated Sites Section / Iowa Brownfield Redevelopment Program
Henry A. Wallace Building
502 East 9th Street
Des Moines, Iowa 50319-0034
Mr. Mel Pins, Iowa Brownfields Coordinator

A4. PROJECT ORGANIZATION



Representing the City of Dubuque (City) as issuing agency is Mr. Steve Sampson-Brown, Program Director/Manager. Mr. Sampson-Brown is charged with directing project activities, approving final documents, and coordinating efforts between the consultant, state, and federal reviewers. Kristin Hill is the City of Dubuque's Communications Specialist. She will be assisting with Community Engagement.

The EPA Brownfields Project Manager is the point of contact for the Multipurpose Grant. The Brownfields Project Manager is responsible for reviewing and providing comments on the Quality Assurance Project Plan (QAPP), responding to questions regarding the grant process, and other project submittals.

The Project Manager for Blackstone, Inc. (Blackstone) is Ms. Emily Smart. Ms. Smart oversees the consultant activities including planning, monitoring, and evaluating project field activities; resolving technical issues and providing guidance; and reviewing reports and documents. Ms. Smart reports to the City's Project Director/Manager.

The Quality Assurance Reviewer for Blackstone is Ms. Lindsay E. James. Ms. James will perform quality assurance/quality control (QA/QC) audits, check and assist in document and project reviews relative to the project plan, and review the QAPP annually for updates.

Site investigation, cleanup activities, and evaluation are overseen by the Blackstone Environmental Activities Field Coordinator, Ms. Smart will conduct investigations and coordinate other Blackstone employees who perform the intrusive investigation assessment and cleanup portion of the Project. Ms. Smart will be working with Eurofins TestAmerica analytical laboratory services and a certified drilling service to be determined at the time of the investigation. Ms. Smart will coordinate cleanup activities involving soil and groundwater remediation, analytical laboratories, and drilling professionals who hold necessary state and federal certifications and licenses to complete work planned on the Project.

The Iowa Department of Natural Resources (IDNR) Brownfields Coordinator oversees the Brownfield Redevelopment Program and coordinates with the Land Recycling Program (LRP). Mr. Mel Pins will provide project oversight and guidance activities as a result of enrolling the properties into the LRP.

A5. PROBLEM DEFINITION AND BACKGROUND

The primary objective is to design and implement assessment and remediation of target areas in the downtown district including the South Port, the Washington Neighborhood, and the North End. Phase I (5 Sites) and Phase II Environmental Site Assessment (5 Sites, ESA) activities will be conducted to determine the extent of contaminants in the soil and groundwater prior to redevelopment and/or cleanup. Cleanup of these areas will assist the City of Dubuque in managing redevelopment projects in the downtown district and in these target areas.

To meet the primary objective, activities to be conducted pursuant to this generic QAPP and its amendments, include successful delineation via further assessment and cleanup of impacted sites in accordance with the IDNR LRP requirements. The City of Dubuque must fully evaluate the extent of identified contamination at the target areas, prior to the cleanup activities as required by the IDNR LRP and for redevelopment. This project plan is intended to provide an overview of EPA Brownfields Assessment and Cleanup activities as part of the Multipurpose Cooperative Agreement (CA) and performed in support of the City of Dubuque's EPA Brownfields Redevelopment Initiative and to help ensure the reliability of data generated from those activities.

Manufacturing and industrial uses mix through the South Port, Washington Neighborhood, and North End areas. It is common for automotive repair shops, junkyards and abandoned factories be located adjacent to low-income housing in these areas. Brownfields are interwoven throughout the community and potentially affect the health and welfare of residents. Previous assessments completed across the target areas have identified environmental contaminants in soil and groundwater, including volatile organic compounds (VOCs), semi-volatile organic compounds (SVOCs), polycyclic aromatic hydrocarbons (PAHs), polychlorinated biphenyls (PCBS), and heavy metals. Activities performed as part of this plan will provide the City of Dubuque with the flexibility to manage several important redevelopment projects. Contaminated building materials may also be assessed and cleaned up, including asbestos contaminated building materials, lead based paint, and PCBs.

Assessment and cleanup at the target areas will also be completed in conjunction with the existing City of Dubuque Brownfields Area-Wide Plan, the Iowa Economic Development Authority, and a National Park Service Outdoor Recreation Legacy Partnership Grant. Assessment and remediation at the above referenced target areas will also be conducted to aid in further redevelopment under the *Imagine Dubuque 2037* comprehensive plan.

This generic QAPP covers activities associated with the assessment and cleanup of the sites performed by the City and its consultants pursuant to the Small Business Liability Relief and Brownfields Revitalization Act of 2002. The assessment and cleanup activities addressed in this generic QAPP will be pursuant to the:

- Iowa Land Recycling Program and Statewide Response Action Standards Iowa Administrative Code (IAC) Chapter 137 (Appendix C).

The State of Iowa has programs for environmental impairment assessments in place through the Iowa Administrative Code (IAC) and rules. These programs include risk-based corrective action programs and a voluntary LRP administered by the IDNR. The appropriate programs overlap in some instances regarding regulation of environmental impairment and releases to soil, groundwater, and air. The Project involves a number of properties having potential environmental issues that overlap regulatory programs. For this Project, soil and groundwater evaluation completed will be conducted in general accordance with Iowa Administrative Code (455H) Chapter 137: *Iowa Land Recycling Program and Statewide Response Action Standards* (IAC 137). An overview of the Iowa LRP is included in Appendix C.

It is the purpose of the generic QAPP to provide a program of decision that produces data of sufficient quantity and quality, balancing between the requirements of the EPA Grant and state programs (IAC 137). This must be done with limited funds and still provide sufficient value to the City with regard to its redevelopment initiative. The following strategies are to be implemented to achieve this balance:

- Use data collected during previous environmental assessments when possible;
- Minimize the number of sample locations where feasible;
- Minimize the number of site visits; and
- Collect only the data needed to evaluate and remediate the site appropriately.

These goals will be attained while meeting IAC 137 (Appendix C) requirements.

This generic QAPP is in effect for the duration of the Multipurpose CA project period as indicated on the signature page. The Blackstone QA Reviewer will review the generic QAPP periodically during this time for applicability. Further, if an extension of the Multipurpose CA is necessary and subsequently approved by EPA, or if site conditions change, this generic QAPP will be internally reviewed and amended as required. Project-specific activities will be covered by individual QAPP Amendments and any project outside the scope of this generic QAPP will require a separate, stand-alone QAPP. The QAPP amendments will be submitted to the EPA for concurrence and approval.

A6. PROJECT DESCRIPTION

The Project intends to make use of this Data Quality Objectives (DQO) and QAPP to design and implement assessment, cleanup and remediation of target areas in the downtown district including the South Port, the Washington Neighborhood, and the North End. Phase I (5 Sites) and Investigation and Phase II Environmental Site Assessment (5 Sites, (ESA) activities will be conducted to determine the extent of contaminants in the soil and groundwater prior to redevelopment and/or cleanup. Assessments may expand upon contamination identified in previous assessments through further delineation, and by designing and implementing an

assessment and cleanup approach to meet the standards identified in IAC 137: *Iowa Land Recycling Program and Response Action Standards* (Appendix C). Contaminants of concern (COCs) include VOCs, SVOCs, petroleum hydrocarbons, heavy metals, and PAHs. Contaminated building materials may also be assessed and cleaned up, including asbestos contaminated building materials, lead based paint, and PCBs. Site-Specific COCs for assessments will be identified via SSQAPs (QAPP Amendments).

Where appropriate, additional assessment will be completed to fully delineate the horizontal and vertical extent of soil and groundwater contamination identified during previous assessment activities (See Section B). Additional sampling for complete delineation at each site/target area will include collecting soil and groundwater samples to be analyzed for VOCs, SVOCs, PAHs, PCBs, petroleum hydrocarbons, and metals. Contaminant delineation sampling activities will be presented as part of the LRP Site Assessment Report and will include soil and groundwater data. This data will then be utilized for evaluating exposure risks, developing a design for cleanup or remediation, and completing the final response action plan discussed below.

The Analysis of Brownfields Cleanup Alternatives (ABCA) update will be completed in conjunction with the Risk Evaluation and Response Action (RE/RA) Plan. The ABCA and RE/RA will evaluate contaminant exposure risks and corrective remedies to determine the most efficient and effective method to manage the soil and groundwater contamination with respect to proposed future land use and will be submitted to EPA and IDNR for approval. After approval of the cleanup approach proposed in the ABCA and RE/RA, a public notice summarizing the ABCA and RE/RA will be issued to adjoining property owners and to the public at large. Upon completion of the public notice process, the RA plan will be implemented. If implementation of the RA plan includes removal of contaminated soils, confirmation samples will be field screened, where applicable, using X-Ray Fluorescence (XRF) and/or a Photoionization Detector (PID), as applicable. Samples selected for fixed-base lab confirmation testing will be collected and analyzed following excavation activities to determine the effectiveness of the remedy. The results of the confirmation sampling and the effectiveness of the selected remedy will be summarized in the RA Implementation Report and submitted to IDNR for review and concurrence. At the completion of the cleanup project, a Final Report will be submitted to IDNR for approval with a copy to EPA.

A project work schedule will be incorporated into each QAPP Amendment.

Figure 1 - Brownfields Assessment Process

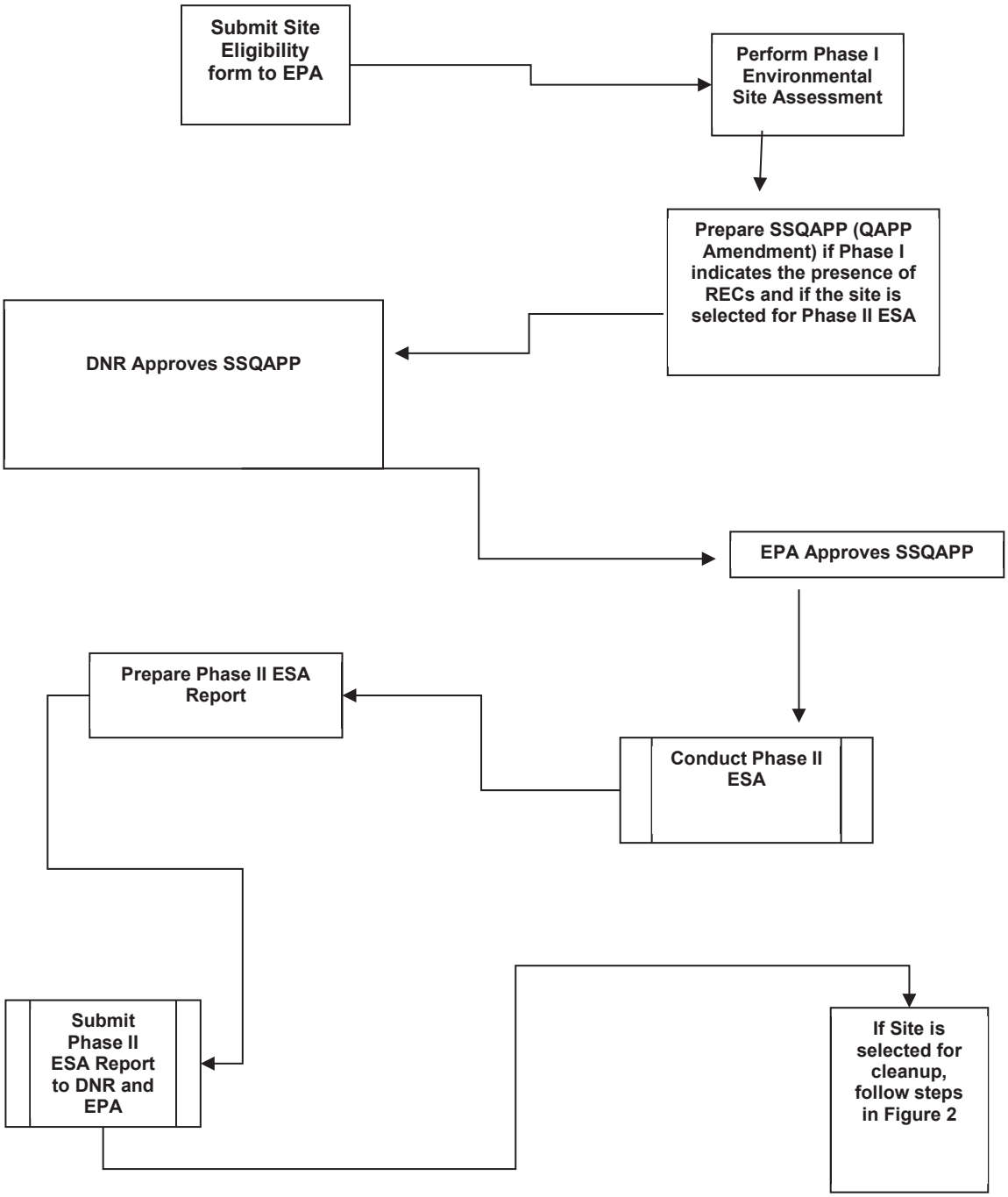
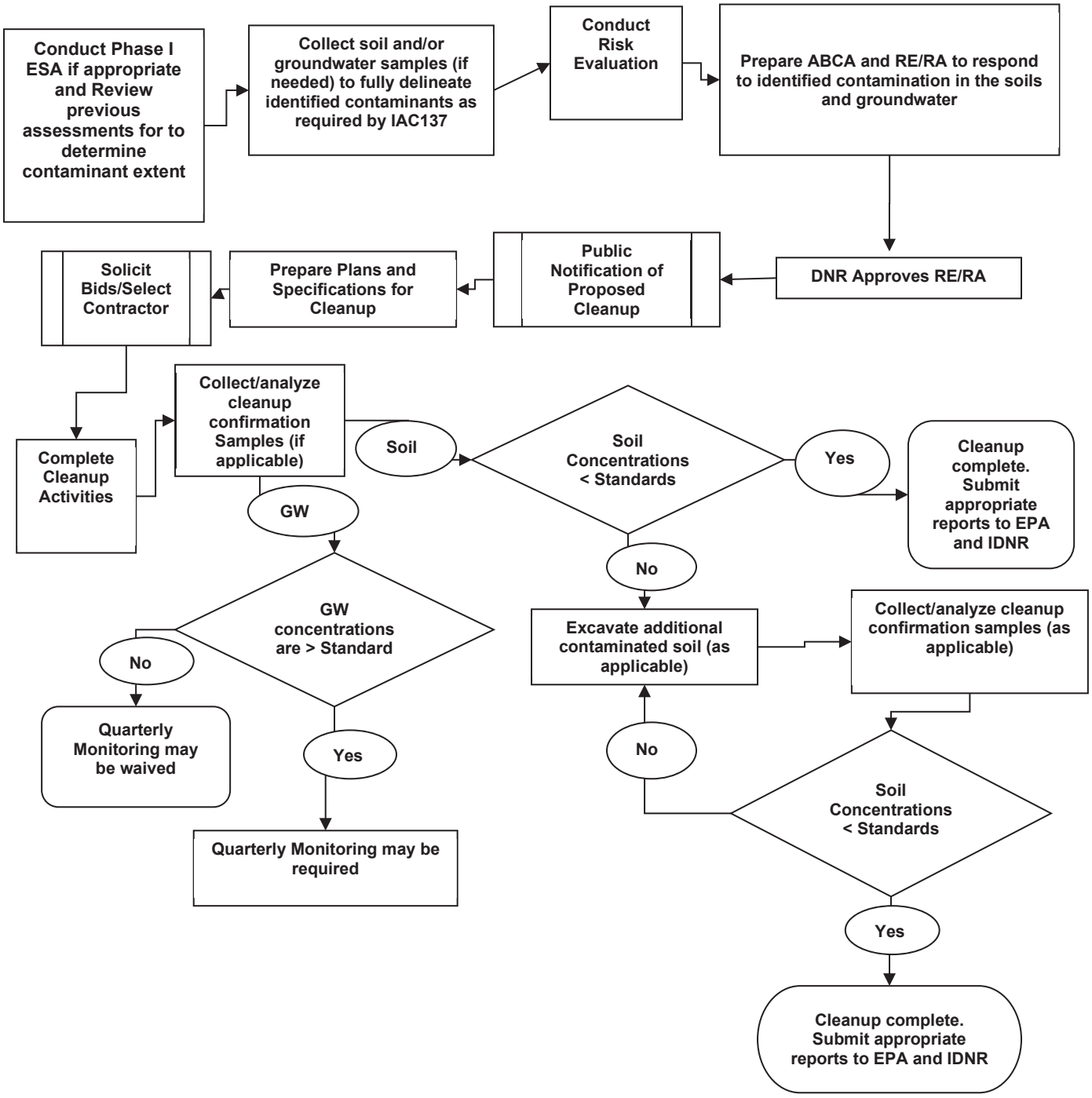


Figure 2 - Brownfields Cleanup Process



A7. QUALITY OBJECTIVE AND CRITERIA FOR MEASUREMENT DATA

DQOs for activities performed under this project should ensure environmental data obtained meet the needs of the study and can be used with confidence to support specific decisions (both administrative and regulatory) pertaining to the sites. DQOs specify the quality of data required from a particular activity to support specific decisions. Specific DQOs used from the list of those outlined under this QAPP will be specified in the QAPP Amendment. For exposure route comparison, the LRP offers evaluation of Site Resident, Site Worker, and Construction Worker via soil, groundwater, and indoor air. A QAPP Amendment template including a DQO specification section for exposure routes and standards is attached in Appendix B.

In IAC 137 one of three sets of standards may be used to evaluate contaminant concentrations:

- **Background standards** represent concentrations of contaminants that are naturally occurring or generally present and not related to a readily identifiable release. Background standards provide a baseline for assessing impacts of contaminant releases from within the affected area.
- **Statewide Standards** address what are considered to be the most likely, normal exposure situations. Statewide Standards (SWS) for soil address direct exposure to soil via ingestion and dermal contact.
- **Site-specific standards** may involve development of target levels for contaminants of concern based on site-specific exposure assumptions for use in lieu of background or SWS. Site-specific standards may also include consideration of the actual or potential location where exposure to contaminants occurs or may occur, the likelihood of an exposure occurring, and the overall magnitude and extent of contamination. Site-specific standards may involve use of site-specific target levels for contaminants of concern alone or in conjunction with other site-specific criteria, such as the location where the standard is applied.

For site characterization and contaminant delineation, different types of data may be necessary depending upon the findings in the previous assessments completed for each of the target areas.

For example, petroleum contamination from an underground storage tank (UST) evaluated according to IAC 135 (TECHNICAL STANDARDS AND CORRECTIVE ACTION REQUIREMENTS FOR OWNERS AND OPERATORS OF UNDERGROUND STORAGE TANKS) requires soil samples to be analyzed for benzene, toluene, ethyl benzene, and xylenes (BTEX) by Iowa Method OA-1 and for total extractable hydrocarbons (TEH) by Iowa Method OA-2. The evaluation is not dependent upon the depth at which the contamination is found. These standards will be applied to Sites that fall under the IAC 135 regulatory framework as determined by the DNR.

In the LRP, for contaminated sites evaluated according to IAC 137, samples may be analyzed by a variety of methods according to the Site's identified RECs. Evaluation of the data for IAC 137 may be dependent upon the depth at which the sample was collected. Confirmation sampling will also be conducted as a part of the LRP process, if applicable to the RA (see Figure 2). Methods specific to each Site will be specified in the QAPP Amendments.

Chemical parameters in groundwater will not be measured in the field and will only be measured in a laboratory setting and compared to Iowa SWS as identified in the DQO. Chemical parameters in soil will be measured in both a field and laboratory setting. Field measurements will be made using XRF and/or a PID, as applicable to the COCs, to help direct the selection of samples for fixed-base laboratory testing. Aliquots for which field screening indicate contamination are chosen preferentially for fixed-base laboratory testing. These field measurements will not be used except as qualitative indicators in the evaluation with the possible exception of using field portable XRF using EPA Method SW-846-6200 (Appendix G) in lieu of some laboratory analytical testing during confirmation sampling as allowed by the DNR. Specific plans for field screening will be outlined in each QAPP Amendment.

Specific data to be assessed and obtained during Phase II activities based on the applicable state programs are summarized in Tables 2, 3, and 4. Indoor air is not represented in the tables below as it is evaluated via Johnson Ettinger forward modeling from groundwater results.

Off-site soil and groundwater sampling is not included in site investigations but may be necessary to determine the extent of contamination and would be completed during site characterization and contaminant delineation if a source of identified contamination appears to be located on the site. This generic QAPP will be used to define contamination sufficiently to begin cleanup planning and will allow for site characterization and contaminant delineation to be conducted in order to prepare sites for enrollment into state voluntary cleanup programs and to execute them. The specific sampling design information details and rationale will be included in the QAPP Amendment for each additional assessment and each cleanup.

Table 2
EPA Brownfields General Site Assessment - LRP

Samples	Approach	Rationale
Source	IAC 137—Identify hazardous conditions at the site through composite or discrete samples.	Assess risk to human health and the environment.
Soil and groundwater samples with other indicators*	Key indicators for sampling areas include the following: stressed or absent vegetation; lagoons or pits; drums; tanks; abandoned or leaking containers; container labels with corrosive, explosive, flammable, radioactive, toxic or biologically pathogenic material; stained or damaged buildings or concrete; stained soil; dead animals or birds; sumps; septic systems; etc.	Assess risk to human health and the environment. Sample source and target areas (indicating possible exposure to surficial contamination) within two feet of the surface.
QC Samples	Trip blank (VOC), Duplicate, Rinsate Blank, Field Blank	To ensure precision and accuracy of sample results.

*Not all possibilities could be practically conceived or listed. Any additional indicators or deviations from this list would be cited in the field records and the trip report.

Table 3 – Soil - LRP

Samples	Approach	Rationale
Site soil samples	IAC 137—On-site samples collected.	Soil samples collected off-site are outside the scope of the Project.
Background samples	IAC 137—One for each matrix with an identified upgradient REC.	Sample to determine relative concentration of petroleum and hazardous substances potentially migrating onto the site.
Sources	IAC 137—Identify hazardous substances present at the site through composite or discrete samples.	Identified contamination exists. Source identification allows for comparison with any off-site contamination.
QC Samples	Trip blank (VOC), Duplicate*, Rinsate Blank, Field Blank	To ensure precision and accuracy of sample results.

*There is routinely a high degree of heterogeneity of soil samples and variability of soil types in an area. Extra care will be taken to collect duplicates from the same soil type as the original sample. Duplicate sampling needed for statistical purposes would be beyond the scope of this generic QAPP.

Table 4 – Groundwater – LRP		
Samples	**Approach**	**Rationale**
Protected Groundwater Source	IAC 137—On-site samples collected.	Sample to determine relative concentration of petroleum and hazardous substances on or potentially migrating onto or off the site.
Non-protected Groundwater source	IAC 137—On-site samples collected.	Sample to determine relative concentration of petroleum and hazardous substances on or potentially migrating onto or off the site.
Sources	IAC 137—Identify hazardous substances present at the site.	Identified contamination exists. Source identification allows for comparison with any off-site contamination.
QC Samples	Trip blank (VOC), Duplicate*, Rinsate Blank, Field Blank	To demonstrate precision and accuracy of sample results.

*Duplicate sampling needed for statistical purposes would be beyond the scope of this generic QAPP.

A7.1 Data Categories

Two categories of data will be collected during this Project: 1) screening data with or without definitive confirmation results, and 2) definitive data. These categories segregate environmentally related measurement data into two groups which are based primarily on increasing levels of confidence in the precision and accuracy of the analytical results. Screening data with definitive confirmation results comprise data of known quality that are quantitatively “verified” and for which the analyte identification is “definitively” confirmed. Definitive data include measurements performed using analyte-specific, EPA-approved laboratory methodologies that definitively identify and quantify the analytes of interest. Screening results will be used to select the type and location of fixed-base laboratory analytical samples, including those to be used for definitive confirmation. The data quality available from current field screening technologies is acceptable for this purpose.

For cleanup activities, either of the data categories may be used to determine the necessity for further action. However, only definitive data will be used to demonstrate that cleanup activities are complete and meet the standards outlined in IAC 137.

A7.1.1 Screening Data With and Without Confirmation Results

The screening category is a broad classification including non-quantitative to semi-quantitative measurements, or involving only probable identification of a compound class, such as total VOCs with a flame or photoionization detector. This category will be appropriate for data collection activities involving rapid, non-rigorous measurement or analytical procedures and limited QA/QC requirements. The screening methods will be used to make quick evaluations of the types and concentration of pollutants. Screening will often be employed during assessment and cleanup activities and may be used for a preliminary evaluation of cleanup success.

Definitive confirmation refers to the analysis of samples by a technique that can unequivocally detect the specific analyte in question and can produce verifiable documentation that the analyte identification is correct. Quantification of a parameter of interest is considered to be valid if the precision and accuracy of the data is determined to

be within the control limits established in this document. For the assessment and cleanup activities, flame or photoionization detector will be used to screen soil. If screening indicates that the excavation extent has satisfactorily removed the impacted media, then the actual number of samples required by IAC 137 will be collected from the sidewalls and bottom of the excavation area. The number of samples collected will not be related to the number of samples screened.

A7.1.2 Definitive Data

The most exhaustive category is definitive data, which is appropriate when rigorous, EPA-approved methods of analysis and comprehensive QA/QC procedures are necessary. This category will be applied when a highly significant cost or risk is associated with an incorrect decision. Definitive data are analyte-specific with confirmation of analyte identities and concentrations. Data may be generated at the site or at an off-site location, as long as the QA/QC requirements are satisfied. For the data to be definitive, either analytical or total measurement error must be determined. See Section B5 for quantitative DQOs.

A8. SPECIAL TRAINING REQUIREMENTS AND CERTIFICATIONS

All site sampling personnel will have successfully completed the 40-hour health and safety (Hazardous Waste Operations and Emergency Response [HAZWOPER]) training course and annual refreshers. Familiarity with sampling equipment and procedures will also be necessary for the sampling team.

IDNR maintains a list of registered drillers who drill water supply and monitoring wells into groundwater in the State of Iowa. This registration requires that the driller demonstrate proficiency in drilling and sampling wells and the methods necessary under Iowa Code for abandoning wells. This project may require drilling for soil sample collection and sampling of groundwater from temporary or permanent monitoring wells and will utilize state-registered drillers to complete this work.

Personnel certified in asbestos containing materials and lead based paint inspection in the State of Iowa will be employed when assessment of ACM and/or LBP is required. Certifications are not provided with this Generic QAPP as appropriate certifications will be attached to relevant QAPP Amendments as the are submitted to the EPA for review on a project – and personnel specific basis.

A9. DOCUMENTATION AND RECORDS

Field personnel will maintain a field logbook to record pertinent activities, including difficulties encountered in the field, associated with the sampling event. Appropriate documentation pertaining to photographs taken by field personnel will also be recorded in the field logbook. Information pertaining to samples (i.e., sampling dates and times, locations, etc.) collected during this event will be recorded on sample field sheets. Sample labels will be affixed to sample containers, identifying sample numbers, dates collected, and requested analyses.

Eurofins TestAmerica, Inc. have prepared the related fixed-base laboratory quality assurance portions of the generic DQO/QAPP.

- Sample data for the laboratory as discussed in Appendix E: Eurofins TestAmerica, Inc. Quality Assurance Manual (March 9, 2022).
- Sample management records and documentation for the laboratory as discussed in Appendix E: Eurofins TestAmerica, Inc. Quality Assurance Manual (March 9, 2022).
- Test methods for the laboratory as discussed in Appendix E: Eurofins TestAmerica, Inc. Quality Assurance Manual (March 9, 2022).
- Quality assurance and control reports for the laboratory as discussed in Appendix E: Eurofins TestAmerica, Inc. Quality Assurance Manual (March 9, 2022).
- Data handling records for the laboratory as discussed in Appendix E: Eurofins TestAmerica, Inc. Quality Assurance Manual (March 9, 2022).

The final product (i.e., deliverable report) for the Project and individual sites will be a report describing the implementation of the ABCA and RE/RA as required in IAC 137 (Appendix C). The report will provide:

- A narrative of field activities
- A Site map
- Laboratory Analytical Reports and summaries of analytical data
- Manifests for hauling of contaminated soil, if any
- Documentation of completed proper disposal of contaminated soil, if any
- Documentation of completed proper disposal or treatment of contaminated groundwater, if any
- Recommendations

The Blackstone Project Manager, in conjunction with the Eurofins TestAmerica QA Manager, has the primary responsibility for defining site-specific data reporting requirements and relating them to the Environmental Activities Field Coordinator. These requirements, the turnaround time for receipt of deliverables specified, and site-specific requirements for retention of samples and laboratory records, should be clearly defined in requests for analytical services. The Eurofins TestAmerica QA Manager is responsible for ensuring that all laboratory data reporting requirement in the QAPP Amendment and the QAPP are met. It is also the responsibility of the Blackstone Project Manager to provide the Environmental Activities Field Coordinator with the most recent version of the EPA-approved QAPP.

SECTION B - MEASUREMENT AND DATA ACQUISITION

B1. SAMPLING PROCESS DESIGN

B1.1 Sampling Methodologies

Procedures for the sampling process design are part of an overall DQO process completed during project planning. The factors to be considered in the design include possible sources, migration pathways, potential receptors, contaminants of concern, state programs likely involved, future land use, and the consequences of the use of false negative or false positive data points.

For EPA Brownfields assessment and cleanup activities, a non-probabilistic sampling (judgmental) approach may be used to provide subjective information to fully delineate the horizontal and vertical extent of soil contamination identified in previous assessment activities. In addition, the non-probabilistic sampling approach will be used to determine the project decision of whether the site has been sufficiently cleaned up for future land use. Judgmental sampling is the basic sampling approach to be used.

- Judgmental Sampling—Judgmental sampling is the subjective selection of sampling locations based on historical information, visual inspection, and the best professional judgment of the sampler.

The above approach can be combined with composite sampling in which two or more sample aliquots are mixed together. Compositing is useful when the degree of variability in a concentration is not a concern or when the samples are collected in a phased approach.

B1.2 Management of Investigation-Derived Waste and Decontamination Procedures

Investigation-derived waste (IDW) may consist of decontamination fluids, drill cuttings, purge/development water, excess sampled media (e.g., soil, sediment, water, etc.), disposable sampling supplies, and personal protective equipment (PPE) (e.g., gloves, respirators, etc.). As outlined in the EPA/540/G-91/009 document titled "Management of Investigation-Derived Wastes During Site Inspections," water containing contaminants, but not free product, may be disposed onto the ground provided the contaminated water is contained on the property, the discharge does not endanger public health or safety, and the discharge does not enter any surface water or tributary. IDW water will be disposed of in this manner. Water accumulating in bermed areas where contaminated soil is stockpiled will be containerized, tested, and properly disposed of. The following goals pertain to IDW management:

- Leave the site in no worse condition than it existed prior to the site activity.
- Remove wastes that pose an immediate threat to human health or the environment.
- Leave wastes on site that do not require off-site disposal or extended containerization.
- Comply with state and federal requirements.
- Minimize the quantity of wastes generated.

Decontamination of personnel and equipment will be conducted in accordance with the site-specific health and safety plan and the Investigative Derived Waste SOP (Appendix F).

B2. SAMPLING METHOD REQUIREMENTS

Samples will be collected and handled in accordance with the following SOPs provided in Appendix F which were developed from state and national guidance:

- Standard Operating Procedure for Groundwater Sampling
- Standard Operating Procedure for Soil Sampling
- Standard Operating Procedure for Soil Screening with the Portable XRF Device
- Standard Operating Procedure for Soil Screening with a PID
- Standard Operating Procedure for Chain of Custody
- Standard Operating Procedure for Equipment Decontamination
- Standard Operating Procedure for Investigative Derived Waste

Additional SOPs that address specialized sample collection and screening techniques may also be incorporated, if approved by the EPA Brownfields Project Manager. An amendment to this QAPP will specify any sampling methodologies used that are not listed above.

The Blackstone Project Manager will be responsible for identifying and taking corrective actions in accordance with Section C1.2 of this QAPP.

B3. SAMPLE HANDLING AND CUSTODY REQUIREMENTS

The samples will be handled in accordance with the Blackstone Chain of Custody (COC) SOP, (Appendix F) which was developed following state and federal guidance. Deviations from COC procedures will be noted in the report.

B4. ANALYTICAL METHODS REQUIREMENTS

Field measurements will be obtained in accordance with applicable SOPs and/or manufacturers' guidance and user manuals for the parameters being measured.

Eurofins TestAmerica, Inc. has provided the QA Manuals for the fixed-base laboratory, dated March 9, 2022 found in Appendix E. The preparation and analysis of fixed-base laboratory samples is described in general in Appendix E, Section 19 of Eurofins TestAmerica, Inc.'s QA manual. Specific method protocols will be within recommended procedures of standard methods. Samples will be analyzed within standard turnaround time unless the Blackstone Project Manager deems "rush" analyses are necessary to meet project goals.

B5. QUALITY CONTROL REQUIREMENTS

QC samples will be required to verify the validity of analytical results and, where QC issues arise, to assess whether samples were contaminated as a result of improper decontamination procedures, use of contaminated containers or preservatives, and/or introduction of contaminants during transportation of the samples to the laboratory. Field QC samples may include trip blanks, rinsate samples, and duplicates as appropriate. Duplicate samples may be collected to assess the reproducibility of the sampling procedures and analytical methods. Temperature blanks are included to verify sample preservation. Required field QC samples will be identified in the QAPP Amendment.

Trip blanks will be prepared by Eurofins TestAmerica, Inc. and will be taken into the field by the sampling team to determine whether any field-related activities resulted in the introduction of VOCs that would jeopardize the validity of analytical results. Field blanks are samples prepared in the field to assess whether any contaminants were introduced by sample containers and/or preservatives. Rinsate samples are used to determine if decontamination procedures are being performed adequately to prevent cross-contamination between samples. The Blackstone Project Manager, in conjunction with the QA Reviewer, will evaluate the results of the trip, rinsate, and field blanks to determine if they are acceptable. If sample results indicate contamination of blank samples (detections above method reporting limits), sampling and analysis may be performed again for the associated target analytes. The Project Manager, in conjunction with the QA Reviewer, will make this decision.

Laboratory QC samples include duplicates, spikes, laboratory blanks, and performance evaluation (PE) samples as appropriate. Pertinent SOPs and guidance documents referenced in this QAPP will be followed to ensure QA objectives are met. Fixed-base laboratory QC procedures will be performed in accordance with the SOPs for the applicable analytical methods, Eurofins TestAmerica, Inc. Quality Assurance Manual (March 9, 2022), (Appendix E).

The following QA/QC guidance documents will be implemented as appropriate to ensure QA/QC elements are adequately addressed:

- *Guidance for the Data Quality Objectives Process* - EPA QA/G-4, OSWER. USEPA, February 2006.
- *EPA Requirements for Quality Assurance Project Plans* - EPA QA/R-5, March 2001.

- *Guidance for Quality Assurance Project Plans* - EPA QA/G-5, OSWER, USEPA, December 2002.

B5.1 Representativeness

Samples will be collected in such a manner (and at suitable locations) to accurately reflect the contaminant concentrations in the media from which they were taken at the time of sampling. Sample or measurement locations may be biased (judgmental) or unbiased (random or systematic), depending on the desired data use. The biased sampling will be performed for LRP delineation activities per IAC137, while unbiased sampling will represent the extent of contamination throughout the site.

Representativeness of the data is partially ensured by avoiding cross-contamination, adherence to standard sample handling and analysis procedures, and use of proper COC and documentation procedures. Representativeness may be assessed by comparing repeated analysis from the same sampling point over a period of time.

B5.2 Comparability

In order for one set of data to be compared with another, analyses will be performed by accepted EPA or state methods and analytical results will be reported in similar concentration units and format. Further, to ensure that subsequent samples are collected from the previous sampled locations for comparison purposes, specific sampling points will be documented using recognizable descriptions and identifiers or by Global Positioning System (GPS) methodologies.

B5.3 Completeness

In order for a set of data to be used with confidence to make a decision, the data must be complete (i.e., there must be enough valid data from analyses to support the decision). An integral part of obtaining adequate valid data will be to design the sampling network in such a manner that enough data are obtained to enable site decisions to be made, even if some of the data are determined to be invalid or cannot be collected due to unexpected field conditions. If an adequate degree of completeness is represented by the data set allowing site decisions to be made, as determined by the Blackstone Project Manager, the data will be considered complete. The Blackstone Project Manager will determine if invalid or missing data is critical to the decisions being made about the site, or if a decision can be made without the data. The Blackstone Project Manager will determine this on a case-by-case basis according to specific data missing, rather than determining completeness based on percentage of proposed samples collected. If an inadequate degree of completeness is represented by the data set, corrective actions (including resampling) may be necessary before an appropriate decision can be made.

B5.4 Sensitivity

Detection and quantification limits for sample data must be below the action levels specified in the SWS as calculated according to IAC 137 (Appendix C). When the list contains more than one action level, the lowest level is chosen. Sensitivity can be affected by contamination as reflected in the method blank results. High method blank results are cause for reruns in sample preparation or sample analysis. Method detection limits for laboratory analyses are specified in Eurofins TestAmerica, Inc.'s Quality Assurance Manual (March 9, 2022).

It is possible the action level for certain constituents, such as certain PAHs (e.g. benzo(a)pyrene, dibenzo(a,h)anthracene) may still be lower than the method detection limit. In these instances, the method detection limit for the analyte may be used as the action level.

B5.5 Precision

Precision describes the variability of a measurement system. Precision is typically an estimate by means of duplicate and replicate measurements and is expressed in terms of RPD. For field sampling, precision is increased by following SOPs and by collecting samples using the same sampling procedures. Field QC samples collected to measure precision include field duplicate samples (i.e. transport and field handling bias) and include collocated samples (i.e. sampling and measurement precision). Field measurement precision is monitored by taking duplicate measurements at a frequency of 10% of the samples collected and is increased through proper operation and maintenance of field equipment.

Precision for VOCs is evaluated using the RPD between the results of the matrix spike (MS) and matrix spike duplicate (MSD) samples. This precision evaluation can also be performed using the RPD between a blank spike (BS) and blank spike duplicate (BSD). The spiked samples are laboratory samples that have been fortified. Precision for laboratory analysis will be measured as described in Eurofins TestAmerica, Inc.'s Quality Assurance/Quality Control Manual (March 9, 2022) (Appendix E).

Precision for field work is evaluated by calculating the RPD between the results for the field duplicate samples. RPDs will only be calculated for results which are detected at a value greater than 5x the reporting limit. A RPD goal of +/- 50% for soils and +/- 35% for aqueous samples will be used for both field and lab analyses and will be included in the task assignment. Precision determined using RPD would be calculated as follows:

$$RPD = \left[\frac{2x(X_1 - X_2)}{(X_1 + X_2)}\right] x100$$

where: X_1 = analyzed concentration in the samples

X_2 = analyzed concentration in the duplicate

If RPDs greater than 50% for soils and 35% for aqueous samples are encountered, corrective action procedures will be implemented. Corrective actions would include evaluation of the sampling procedures, inspection of the sample matrix, and review of field screening results. Laboratory quality control statistics will be calculated per methods specified in Appendix E.

B5.6 Accuracy

Field blanks may be used to evaluate the purity of sample containers and chemical preservatives. In most cases, one field blank per sampling event will be sufficient. No other measures will be taken to evaluate accuracy that are directly associated with sampling and field procedures. For samples analyzed by Eurofins TestAmerica, Inc. accuracy will be assessed and evaluated by laboratory personnel in accordance with Eurofins TestAmerica, Inc.'s Quality Assurance Manual (March 9, 2022) (Appendix E).

B6. INSTRUMENT AND EQUIPMENT TESTING, INSPECTION AND MAINTENANCE REQUIREMENTS

Field equipment will be calibrated, tested, and inspected in accordance with the manufacturers' specifications and applicable Blackstone SOPs. Calibration and maintenance documents will be stored in the case alongside the associated field equipment or in a field logbook as appropriate. Laboratory equipment will also be calibrated and maintained in accordance with the manufacturers' specifications and applicable analytical SOPs and applicable Eurofins TestAmerica SOPs. Depending on the type of field equipment, critical spare parts such as tape, paper, pH probes, electrodes, batteries, and battery chargers will be kept within the associated field equipment case to minimize equipment downtime. Backup instruments, equipment, and additional spare parts will be available on site or within a 1-day shipping period to avoid delays in the field schedule.

B7. INSPECTION AND ACCEPTANCE REQUIREMENTS FOR SUPPLIES AND CONSUMABLES

Blackstone maintains centralized control of field sampling expendables, supplies, and materials for conducting environmental sampling through the position of Environmental Activities Field Coordinator. Supplies and consumables that are of adequate quality to sustain confidence in the sample collection, processing, and laboratory analysis will be used. Purchased supplies and consumables will not be used until they have been inspected, calibrated, or otherwise verified to be in compliance with any standard specifications relevant to calibrations or tests being performed and will be dedicated to that project. When possible, certified contaminant free sampling supplies and consumables (e.g. Voss® disposable bailers, Best® nitrile gloves) will be used and dedicated for one use at one location.

Eurofins TestAmerica Inc. offers pre-cleaned sampling containers for use by field sampling personnel. Cleaning is verified by the companies' QA Managers. These containers are obtained from reputable container manufacturers and are cleaned to EPA specifications (Specifications and Guidance for Contaminant-Free Sample Containers OSWER Directive #9240.0-05A Dec 92). In addition, the Blackstone Environmental Activities Field Coordinator will visually inspect containers for gross contamination, necessary preservatives, appropriate size, number, and material for the required analyses.

B8. DATA ACQUISITION REQUIREMENTS

Data from other sources, except the EPA Brownfields ESAs and prior Blackstone initiated Hazardous Materials Surveys, will not be used for decision-making purposes. Any secondary (non-EPA Brownfields) information, including other analytical data, reports, photographs, maps, etc. from additional sources referenced in reports compiled by Blackstone, may not have been verified by Blackstone. This information is mentioned for informational purposes only and will be addressed as supplemental information. It is not to be used for decision-making purposes without verification by an independent professional who is qualified to verify such data or information.

B9. DATA MANAGEMENT

Data management will include data format preservation, allowing the City to compare information to IAC 137. Blackstone's Project Manager will be responsible for supervising the administrative support personnel in maintaining the project files for the duration of the project and shall not exceed five years without resubmission of a QAPP and approval thereof by EPA. The project files will be kept in Blackstone's Iowa City office while the project remains active. After completion of the project, project files will be transferred to the City's Engineering Department. Project files will also be available on the City's website during and after project completion.

Blackstone will use desktop and portable laptop computers along with data loggers to record, process, and manage project data. The following software potentially will be used to process data: Access®, ArcGIS®, Aqtesolv®, AutoCad®, AutoDesk®, DQO/DEFT®, Excel®, Surfer®, VSP®, Word®, and IDNR's Tier 1 and Tier 2 software.

Laboratory data management will focus on a level requisite of EPA protocols and the standard methods. These procedures are set forth in Appendix E.

SECTION C - ASSESSMENT AND OVERSIGHT

C1. ASSESSMENT AND RESPONSE ACTIONS

C1.1 Performance and System Audits

Both internal performance and system audits may be conducted during field operations. Performance audits include verification that field sampling activities and measurements and laboratory analyses of performance evaluation samples are being conducted in accordance with the requirements of this generic QAPP and any QAPP Amendment. System audits involve a qualitative examination of an environmental data collection system including records, personnel, and QA management activities.

This section describes the selection of audit personnel, the scope of field and laboratory audits, audit frequencies, and typical audit reports for internal audits initiated by the Blackstone QA Reviewer.

The fixed-base laboratory performance and system audits will be as outlined in Eurofins TestAmerica, Inc.'s Quality Assurance Manual (March 9, 2022) (Appendix E).

C1.1.1 Audit Personnel

The QA/QC Reviewer has the lead role in directing and executing internal audit activities during an investigation. The QA/QC Reviewer is responsible for preparing an audit plan; coordinating and scheduling the audit with the project team or subcontractor; participating in the audit; coordinating the preparation and issuance of audit reports and corrective action request forms; and evaluating audit responses and resulting corrective actions.

C1.1.2 Audit Scope of Work

Performance audits of field activities will be conducted to evaluate compliance with the requirements of the generic QAPP and QAPP Amendment. Field system audits may include an examination of the following items:

- Sample collection records.
- Sample collection, handling, preservation, packaging, shipping, and custody records.
- Equipment operation, maintenance, and calibration records.

The laboratory performance and system audits by Eurofins TestAmerica Inc. will be completed as outlined in Eurofins TestAmerica, Inc.'s Quality Assurance Manual (March 9, 2022) (Appendix E).

C1.1.3 Audit Frequencies

As necessary, the generic QAPP and QAPP Amendment will provide a schedule for planned audits to be conducted during the investigation. These audits may be required by EPA or planned by QA/QC Reviewer. Audit frequency will depend on several factors. In selecting

investigations for auditing, the QA/QC Reviewer will consider investigations with a large volume of work or those on which EPA has placed a high level of importance. The QA/QC Reviewer may also randomly select investigations for auditing.

Unscheduled follow-up audits may occur if any deficiencies are discovered during an audit or review. Follow-up audits serve to verify that necessary corrective actions have been properly implemented to address deficiencies.

C1.1.4 Audit Reports

Audit reports will be prepared for performance and system audits of field and laboratory activities and laboratory evaluation studies conducted under this Cooperative Agreement. Reports will be prepared by the QA/QC Reviewer. Audit reports will identify participants, describe the activity audited, summarize audit findings, and detail deficiencies or deviations from protocol discovered during the audits, as well any corrective actions proposed. Field or laboratory analytical data generated during performance evaluation must be validated. Validated dates will be included in the audit reports.

Audit reports are distributed to the Blackstone Project Manager and the Field Captain or laboratory QA manager, as appropriate. The QA/QC Reviewer has primary responsibility for ensuring audits are conducted thoroughly and properly. The Blackstone Project Manager and Field Captain or laboratory QA Manager is responsible for implementing corrective actions resulting from the audit. The QA/QC Reviewer is responsible for verifying recommended corrective actions have been implemented.

C1.2 Corrective Action

Corrective actions will be taken whenever problems appear to be adversely affecting data quality and/or when the resulting decisions may affect future response actions pertaining to the site. When such conditions are identified, the following corrective actions will be taken:

- Document that suspect data have been obtained.
- Review the system in question to ensure procedures were properly performed.
    - If procedures were not carried out properly, then document errors and repeat the procedures in accordance with proper methodologies, including applicable quality control checks.
    - If control checks gave out-of-control results, advise the project supervisor, and do not continue until the problem has been resolved.
    - If the control checks gave satisfactory results after corrective actions have been taken, document the corrective actions and continue.

C2. REPORTS TO MANAGEMENT

Reports describing the project activities, status, results of audits, corrective actions, needs for resolution among participating parties, and schedule changes will be distributed electronically and in writing. Quality Assurance problems will be noted in the reports as needed. These are summarized below in the following table.

Table 4 - Routine Reports				
Document	**Party**	**Preparer**	**Distribute**	**Frequency**
Grant Reports	City	Project Manager	Section A3.1-3	Quarterly throughout Grant and as determined by the City
Daily Job Reports	Blackstone	Environmental Activities Field Coordinator	Project Manager	Daily when field work in progress with logbook copies
Project Status Meetings	Blackstone	Project Manager	Section A3.1-3	Weekly during field activities otherwise monthly
Website for Community Outreach	City	Communications Specialist	Section A3.1-3, 5 Public PC	Updated at final report for project activities or as desired by the City
Project Closeout Report	Blackstone / City	Project Manager	Section A3.1-3	End of Project

SECTION D - DATA VALIDATION AND USABILITY

D1. DATA REVIEW, VERIFICATION, AND VALIDATION

Data review and verification will be performed by a qualified laboratory analyst and the laboratory's operations manager as described in Section 19.14 of Eurofins TestAmerica, Inc.'s Quality Assurance Manual (March 9, 2022) (Appendix E).

Verification of the data shall be the responsibility of the Blackstone Project Manager, who will review the data for completeness and obvious discrepancies. Field notes, COCs, activity summary forms, and soil boring logs will be compared for consistency and any anomalies documented by the Blackstone Project Manager. The Blackstone Project Manager will also inspect the data to provide final review and approval to ensure that the data meet the sampling requirements.

D2. VALIDATION AND VERIFICATION METHODS

The Brownfields assessment and cleanup demonstration of compliance with IAC 137 is the final step prior to redevelopment. The data will engage in an IAC 137 comparison with either one or a combination of background, statewide, or site-specific cleanup standards to be determined during the cancer and non-cancer health risk evaluation for the site and developed in the RE/RA Plan.

The Blackstone Project Manager will be responsible for validation of project implementation, conducting a direct comparison of the project records to the QAPP for the assessment or cleanup prior to writing the cleanup implementation report required by IAC 137. This will be initiated immediately upon completion of the field sampling activities on the property to be cleaned up. The assessment or cleanup implementation report will contain a section designated for data validation and verification. The data users will be provided with copies of the report.

Due to the limited nature of the validation, the QA Reviewer will conduct a minimum of one review per year, or as needed, of the Blackstone Project Manager's validation of project implementation. The QA Reviewer will evaluate the implementation of the following relative to field and management procedures as they apply to the Brownfields project. Data resulting from grant activities will be reviewed to evaluate conformance with the quality criteria set forth in the DQO/QAPP. These evaluations will include, but are not limited to:

- Conformance to the QAPP's data quality objectives.
- Conformance of the proposed sampling plan as detailed in Appendix B.
- Conformance with sample handling protocols and holding times.
- Results of quality control checks as they relate to field influences on data quality.
- Results of calibration of instruments at bench mobilization and in the field from instrument records and field logbooks specific to the property enrolled and assessed.

The Blackstone Project Manager will rely on standard methods conformance according to the Eurofins TestAmerica laboratory SOP and their system of flagging data in the laboratory data packages to support valid analytical data.

D2.1 Field and Management

The review will specifically evaluate implementation of the sampling plan in Appendix B relative to field and management procedures as they apply to the Brownfields assessment or cleanup activity. The quality of the resultant data will be evaluated in accordance with of the following:

- IAC 137
- Generic conformance to design parameters of the QAPP and DQOs.
- Sampling design as detailed in Appendix B.
- Sample collection procedures as prescribed in soil and groundwater sampling protocols of Appendix F and compared to field documentation and corrective audits of Section C1.2.
    - Sampling will be considered complete if an adequate degree of completeness is represented by the data set allowing site decisions to be made, as determined by the Blackstone Project Manager.
    - Sampling will be considered accurate if ninety-five percent (95%) of the soil and groundwater sampling protocols stipulated were used and documentation supports proper use.
    - Sampling will be considered representative if seventy percent (70%) of the sample interval for soil was recovered and submitted.
- Sample handling protocols and chain-of-custody will be reviewed. Holding and transport times must be met for the sample to be considered valid.
- Quality control checks conducted as they relate to field influences on data quality.
- Calibration of instruments at bench mobilization and in the field from instrument records and field logbooks specific to the property enrolled and assessed.

D3 RECONCILIATION WITH USER REQUIREMENTS

The Blackstone Project Manager will evaluate data for the completeness needed to achieve the project's goal. If the data quality indicators do not meet the project requirements outlined in the QAPP, the data may be discarded and re-sampling may occur. In case of a failure, the project team will evaluate the cause. If the failure is due to laboratory procedures or equipment, necessary corrective measures will be taken by the Eurofins TestAmerica QA Manager and Blackstone Project Manager. If failure is associated with sampling, field procedures will be re-evaluated with any changes documented by the Blackstone Project Manager and included in the Assessment Report.

The primary purpose of the QA system is to define a process for collecting data that is of known quality, is scientifically valid, is legally defensible, and fully supports the decisions that will be based on the data. To achieve this purpose, this QAPP requires the DQOs be fully defined in Section A7. Other parts of the QA system must then be planned and implemented in a manner

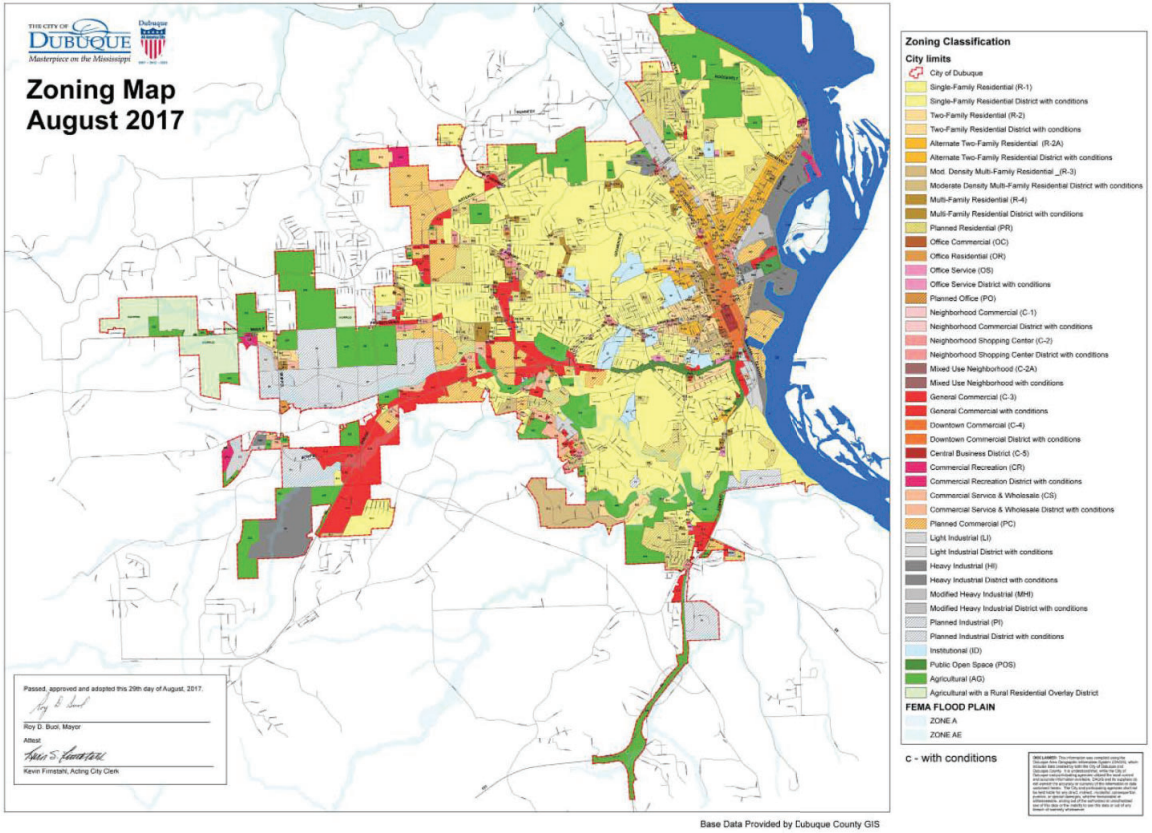
consistent with the DQOs. The QA system components that follow directly from the DQOs include documentation and reporting requirements (Section A9); sample network design and sampling methods (Sections B1, B2, and B3); analytical methods requirements (Section B4); QC requirements (Section B5); and data reduction, validation, and reporting methods (Sections D1 and D2).

Once environmental data have been collected, reviewed, and validated, the data must be further evaluated to determine whether the DQOs identified in the QAPP Amendments and the QAPP have been met. Blackstone will follow EPA's data quality assessment (DQA) process to verify that the type, quality, and quantity of data collected are appropriate for their intended use. The DQA process involves first verifying that the assumptions under which the data collection design and DQOs were developed have been met or taking appropriate corrective action if the assumptions have not been met. The DQA process then evaluates how well the data collected support the decision that must be made so scientifically valid and meaningful conclusions can be drawn from the data. These conclusions may be based upon a statistical evaluation, as allowed in IAC 137, of the data collected. To the extent possible, Blackstone will follow DQA methods and procedures outlined in EPA's *Guidance for Data Quality Assessment: A Reviewer's Guide* (EPA QA/G-9R) (February 2006) and *Data Quality Assessment: Statistical Methods for Practitioners* (EPA QA/G-9S) (February 2006).

If data quality indicators do not meet the Project's requirements as outlined in the QAPP, the data may be discarded and re-sampling and/or re-analysis may be required.

APPENDIX A

PROJECT LOCATION MAP



Base Data Provided by Dubuque County GIS

North End Boundary

Washington Neighborhood Boundary

South Port Boundary

N

0 3,000 6,000 Feet

FIGURE 1	Project Mgr. ES	Date: 10/27/2022	BLACKSTONE ENVIRONMENTAL	CLIENT NAME City of Dubuque
	Designed By: ME	Rev.:		SHEET NAME Target Area Approximate Boundaries
	Drawn By: ME	Rev.:		PROJECT NAME Multipurpose Grant
	Checked by: ES	Rev.:		
	Job No.: 3228	Rev.:		

APPENDIX B

QAPP AMENDMENT TEMPLATE

QAPP Amendment
For
Quality Assurance Project Plan
SITE ADDRESS
As Adapted from
DATE City of Dubuque Multipurpose Grant

EPA Region 7
BROWNFIELDS MULTIPURPOSE GRANTS
CITY OF DUBUQUE, IA
BF 97768801-2

DATE

I. APPROVALS

Ia. BLACKSTONE PROJECT MANAGER	_____	_____ Date
Ib. BLACKSTONE QA/QC REVIEWER	_____	_____ Date
Ic. CITY OF DUBUQUE PROJECT DIRECTOR/MANAGER	_____	_____ Date
Id. USEPA REGION 7 PROJECT MANAGER	_____	_____ Date
Ie. USEPA REGION 7 QUALITY ASSURANCE MANAGER	_____	_____ Date

II. THIS QAPP AMENDMENT TO BE USED WITH:

Project Plan: Multipurpose Cleanup Grant

Data Quality Objectives and Generic Quality Assurance Project Plan EPA Brownfield Multipurpose Grant
City of Dubuque
Dubuque, Iowa
DATE

Attachments to the XXXXX Sampling Plan:

1. Contractor Certifications
2. Contractor SOP
3. Planned Disposal Facility
4. Anticipated Schedule of Activities

III. IN-PROCESS ADJUSTMENTS, CLARIFICATIONS & CORRECTIVE ACTIONS

		Checklist Modification Location		Adjuster		Approval	
Date	QA/QC Notation No.	Section	Page	Initials	Date	Initials	Date

IV. PROPERTY IDENTIFICATION

1. Facility (Property) Name: _____
2. Parcel Numbers: _____
3. Common Address: _____
4. Project ID Number: _____
5. Access Agreement Signed by Owner (s) and Attached: No Pending Yes
6. Have Property Conditions changed since Phase I ESA? No Yes, discuss and attach

Primary Land Use Categories: The Subject Property is currently owned by XXXXX and consists of a XXXX.

V. PREVIOUS ACTIVITIES

Insert summary of previous activities

VI. PROPERTY-SPECIFIC SAMPLING DESIGN(S) DQOs and EXPOSURE PATHWAY EVALUATION

Insert Design

VII. CHEMICAL ANALYSES SAMPLE PARAMETERS/BOTTLES

Identify per site specific design and laboratory SOP

VIII. SAMPLE PRESERVATION AND HOLDING TIMES

Identify per site specific design and laboratory SOP

IX. EQUIPMENT LIST

Identify per site specific design

X. HEALTH AND SAFETY (A8.2.5, Default Approval Limited to D&D Modified Levels

See Attachment Insert

XI. UNANTICIPATED DEVIATIONS FROM DQO/QAPP REFERENCED

Variance:

Necessity to Brownfields Study: The proposed efforts are consistent with the approved Data Quality Objectives and Quality Assurance Project Plan (DQO/QAPP) objectives to evaluate the risk and feasibility of redevelopment options for the target property.

XII. FIELD OPERATIONS

Identify and insert SOP and according to site specific design

XIII. QUALITY CONTROL CHECKS

Insert SOP and per site specific design.

ATTACHMENT 1

CONTRACTOR CERTIFICATIONS

ATTACHMENT 2

CONTRACTOR HASP

ATTACHMENT 3

CONTRACTOR SOP

ATTACHMENT 4

PLANNED DISPOSAL FACILITY

ATTACHMENT 5

ANTICIPATED SCHEDULE OF ACTIVITIES

APPENDIX C

IOWA LAND RECYCLING PROGRAM &
STATEWIDE RESPONSE ACTION STANDARDS (IAC 137)
IOWA ADMINISTRATION CODE (455H) CHAPTER 137
AND
TECHNICAL STANDARDS AND CORRECTIVE ACTION REQUIREMENTS FOR OWNERS AND OPWEATORS OF UNDERGROUND STORAGE TANKS (IAC 135)

CHAPTER 135
TECHNICAL STANDARDS AND CORRECTIVE ACTION REQUIREMENTS FOR OWNERS AND OPERATORS OF UNDERGROUND STORAGE TANKS

[Prior to 12/3/86, Water, Air and Waste Management[900]]

567—135.1(455B) Authority, purpose and applicability.

135.1(1) *Authority.* Iowa Code chapter 455B, division IV, part 8, authorizes the department to regulate underground tanks used for storage of regulated substances, and to adopt rules relating to detection, prevention and correction of releases of regulated substances from such tanks, maintenance of financial responsibility by owners or operators of such tanks, new tank performance standards, notice and reporting requirements, and designation of regulated substances.

135.1(2) *Purpose.* The purpose of these rules is to protect the public health and safety and the natural resources of Iowa by timely and appropriate detection, prevention and correction of releases of regulated substances from underground storage tanks (UST).

135.1(3) *Applicability.*

a. The requirements of this chapter apply to all owners and operators of a UST system as defined in rule 567—135.2(455B) except as otherwise provided in paragraphs 135.1(3)*"b"* and *"c."*

(1) Previously deferred UST systems. Airport hydrant fuel distribution systems, UST systems with field-constructed tanks, and UST systems that store fuel solely for use by emergency power generators must meet the requirements of these rules as follows:

1. Airport hydrant fuel distribution systems and UST systems with field-constructed tanks must meet the requirements in rule 567—135.21(455B).

2. UST systems that store fuel solely for use by emergency power generators installed on or before November 28, 2007, must meet the requirements in rule 567—135.5(455B) by October 13, 2021.

3. UST systems that store fuel solely for use by emergency power generators installed after November 28, 2007, must meet all applicable requirements of this chapter at installation.

(2) Any UST system listed in paragraph 135.1(3)*"c"* must meet the requirements of subrule 135.1(4).

b. Exclusions. The following UST systems are excluded from the requirements of this chapter:

(1) Any UST system holding hazardous wastes listed or identified under Subtitle C of the Solid Waste Disposal Act, or a mixture of such hazardous waste and other regulated substances.

(2) Any wastewater treatment tank system that is part of a wastewater treatment facility regulated under Section 402 or 307(b) of the federal Clean Water Act.

(3) Equipment or machinery that contains regulated substances for operational purposes such as hydraulic lift tanks and electrical equipment tanks.

(4) Any UST system whose capacity is 110 gallons or less.

(5) Any UST system that contains a de minimis concentration of regulated substances.

(6) Any emergency spill or overflow containment UST system that is expeditiously emptied after use.

c. Partial exclusions. Rules 567—135.3(455B), 567—135.4(455B), 567—135.5(455B), 567—135.6(455B), 567—135.15(455B) and 567—135.21(455B) do not apply to any of the following types of UST systems:

(1) Wastewater treatment tank systems;

(2) Any UST systems containing radioactive material that are regulated under the federal Atomic Energy Act of 1954 (42 U.S.C. 2011 and following);

(3) Any UST system that is part of an emergency generator system at nuclear power generation facilities regulated by the Nuclear Regulatory Commission under 10 CFR 50 Appendix A;

(4) Aboveground storage tanks associated with:

1. Airport hydrant fuel distribution systems regulated under rule 567—135.21(455B); and

2. UST systems with field-constructed tanks regulated under rule 567—135.21(455B).

d. Nonpetroleum underground storage tank systems. Rules 567—135.8(455B) to 567—135.12(455B) do not apply to any nonpetroleum underground storage tank system except as otherwise provided for by the department.

135.1(4) *Installation requirements for partially excluded UST systems.*

a. Owners and operators must install a UST system listed in subparagraphs 135.1(3)*"c"*(1) to 135.1(3)*"c"*(3) storing regulated substances (whether of single- or double-wall construction) that meets the following requirements:

(1) Will prevent releases due to corrosion or structural failure for the operational life of the UST system;

(2) Is cathodically protected against corrosion, constructed of noncorrodible material, steel clad with a noncorrodible material, or designed in a manner to prevent the release or threatened release of any stored substance; and

(3) Is constructed or lined with material that is compatible with the stored substance.

b. Notwithstanding paragraph 135.1(4)*"a,"* a UST system without corrosion protection may be installed at a site that is determined by a corrosion expert not to be corrosive enough to cause it to have a release due to corrosion during its operating life. Owners and operators must maintain records that demonstrate compliance with the requirements of this paragraph for the remaining life of the tank.

NOTE: The following codes of practice may be used as guidance for complying with this subrule.

- NACE International Standard RP-02-85, Practice SP 0285, "External Corrosion Control of Underground Storage Tank Systems by Cathodic Protection";
- NACE International Standard Practice SP 0169, "Control of External Corrosion on Metallic Buried, Partially Buried, Underground or Submerged Metallic Piping Systems";
- American Petroleum Institute Recommended Practice 1632, "Cathodic Protection of Underground Petroleum Storage Tanks and Piping Systems"; or
- Steel Tank Institute Recommended Practice R892, "Recommended Practice for Corrosion Protection of Underground Piping Networks Associated with Liquid Storage and Dispensing Systems."

[**ARC 5625C**, IAB 5/19/21, effective 6/23/21]

567—135.2(455B) Definitions.

"Aboveground release" means any release to the surface of the land or to surface water. This includes, but is not limited to, releases from the aboveground portion of a UST system and aboveground releases associated with overfills and transfer operations as the regulated substance moves to or from a UST system.

"Active remediation" means corrective action undertaken to reduce contaminant concentrations by other than passive remediation or monitoring.

"Airport hydrant fuel distribution system" or *"airport hydrant system"* means a UST system which fuels aircraft and operates under high pressure with large diameter piping that typically terminates into one or more hydrants (fill stands). The airport hydrant system begins where fuel enters one or more tanks from an external source such as a pipeline, barge, rail car, or other motor fuel carrier.

"Ancillary equipment" means any devices including, but not limited to, such devices as piping, fittings, flanges, valves, and pumps used to distribute, meter, or control the flow of regulated substances to and from a UST.

"Appurtenances" means devices such as piping, fittings, flanges, valves, dispensers and pumps used to distribute, meter, or control the flow of regulated substances to or from an underground storage tank.

"Asbestos-cement pipe" (AC refers to asbestos-cement) means a pipe or conduit constructed of asbestos fiber and Portland cement, which can be used to transport water.

"ASTM" means the American Society of Testing and Materials.

"Backflow preventer" means a check valve used to ensure water flows in one direction and designed to prevent contamination from an end user, such as a home, from getting into the general water supply. An approved backflow preventer shall be a reduced-pressure backflow preventer or an antisiphon device which complies with the standards of the American Water Works Association and has been approved by the Foundation for Cross-Connection Control and Hydraulic Research.

"Bedrock" means the rock, usually solid, underlying soil or any other unconsolidated surficial cover.

"Below-ground release" means any release to the subsurface of the land and to groundwater. This includes, but is not limited to, releases from the below-ground portions of an underground storage tank system and below-ground releases associated with overfills and transfer operations as the regulated substance moves to or from an underground storage tank.

"Beneath the surface of the ground" means beneath the ground surface or otherwise covered with earthen materials.

"Best available technology" means those practices which most appropriately remove, treat, or isolate contaminants from groundwater, soil or associated environment, as determined through professional judgment considering actual equipment or techniques currently in use, published technical articles, site hydrogeology and research results, engineering and groundwater professional reference materials, consultation with experts in the field, capital and operating costs, and guidelines or rules of other regulatory agencies.

"Best management practices" means maintenance procedures, schedule of activities, prohibition of practices, and other management practices, or a combination thereof, which, after problem assessment, is determined to be the most effective means of monitoring and preventing additional contamination of the groundwater and soil.

"Biodiesel" means a renewable fuel comprised of mono-alkyl esters of long-chain fatty acids derived from vegetable oils or animal fats, that is blended with petroleum-based diesel fuel, which meets the standards provided in Iowa Code section 214A.2.

"Carcinogenic risk" means the incremental risk of a person developing cancer over a lifetime as a result of exposure to a chemical, expressed as a probability such as one in a million (10^{-6}). For carcinogenic chemicals of concern, probability is derived from application of certain designated exposure assumptions and a slope factor.

"Cast iron pipe" means a pipe or conduit used as a pressure pipe for transmission of water, gas, or sewage or as a water drainage pipe. It comprises predominantly a gray cast iron tube historically used uncoated, with newer types having various coatings and linings to reduce corrosion and improve hydraulics.

"Cathodic protection" is a technique to prevent corrosion of a metal surface by making that surface the cathode of an electrochemical cell. For example, a tank system can be cathodically protected through the application of either galvanic anodes or impressed current.

"Cathodic protection tester" means a person who can demonstrate an understanding of the principles and measurements of all common types of cathodic protection systems as applied to buried or submerged metal piping and tank systems. At a minimum, such persons must have education and experience in soil resistivity, stray current, structure-to-soil potential, and component electrical isolation measurements of buried metal piping and tank systems.

"CERCLA" means the Comprehensive Environmental Response, Compensation, and Liability Act of 1980 as amended.

"Certified groundwater professional" means a person certified pursuant to Iowa Code section 455B.474 and 567—Chapter 134, Part A.

"Change-in-service" means changing the use of a tank system from a regulated to a nonregulated use.

"Chemicals of concern" means the compounds derived from petroleum-regulated substances which are subject to evaluation for purposes of applying risk-based corrective action decision making. These compounds are benzene, ethylbenzene, toluene, and xylenes (BTEX) and naphthalene, benzo(a)pyrene, benz(a)anthracene, and chrysene. (NOTE: Concentration values for these last four constituents are determined by a conversion method from total extractable hydrocarbons, see subrule 135.8(3).)

"Class A operator" means the individual who has primary responsibility to operate and maintain the UST system in accordance with applicable requirements. The Class A operator typically manages resources and personnel, such as establishing work assignments, to achieve and maintain compliance with regulatory requirements under this chapter.

"Class B operator" means the individual who has day-to-day responsibility for implementing applicable regulatory requirements established by the department. The Class B operator typically implements in-field aspects of operation, maintenance, and associated record keeping for the UST systems.

"Class C operator" means the individual responsible for initially addressing emergencies presented by a spill or release from a UST system. The Class C operator typically controls or monitors the dispensing or sale of regulated substances.

"Compatible" means the ability of two or more substances to maintain their respective physical and chemical properties upon contact with one another for the design life of the tank system under conditions likely to be encountered in the UST.

"Conduit" means underground structures which act as pathways and receptors for chemicals of concern, including but not limited to gravity drain lines and sanitary or storm sewers.

"Connected piping" means all underground piping including valves, elbows, joints, flanges, and flexible connectors attached to a tank system through which regulated substances flow. For the purpose of determining how much piping is connected to any individual UST system, the piping that joins two UST systems should be allocated equally between them.

"Consumptive use" with respect to heating oil means consumed on the premises.

"Containment sump" means a liquid-tight container that protects the environment by containing leaks and spills of regulated substances from piping, dispensers, pumps and related components in the containment area. Containment sumps may be single-walled or secondarily contained and located at the top of the tank (tank top or submersible turbine pump sump), underneath the dispenser (under-dispenser containment sump), or at other points in the piping run (transition or intermediate sump).

"Corrective action" means an action taken to reduce, minimize, eliminate, clean up, control or monitor a release to protect the public health and safety or the environment. Corrective action includes, but is not limited to, excavation of an underground storage tank for the purpose of repairing a leak or removal of a tank, removal of contaminated soil, disposal or processing of contaminated soil, cleansing of groundwaters or surface waters, natural biodegradation, institutional controls, technological controls and site management practices. Corrective action does not include replacement of an underground storage tank. Corrective action specifically excludes third-party liability.

"Corrective action meeting process" means a series of meetings organized by department staff with owners or operators and other interested parties such as certified groundwater professionals, funding source representatives, and affected property owners. The purpose of the meeting process is to develop and agree on a corrective action plan and the terms for implementation of the plan.

"Corrective action plan" means a plan which specifies the corrective action to be undertaken by the owner or operator in order to comply with requirements in this chapter and which is incorporated into a memorandum of agreement or other written agreement between the department and the owner or operator. The plan may include but is not limited to provisions for additional site assessment, site monitoring, Tier 2 revisions, Tier 3 assessment, excavation, and other soil and groundwater remedial action.

"Corrosion expert" means a person who, by reason of thorough knowledge of the physical sciences and the principles of engineering and mathematics acquired by a professional education and related practical experience, is qualified to engage in the practice of corrosion control on buried or submerged metal piping systems and metal tanks. Such a person must be accredited or certified as being qualified by the National Association of Corrosion Engineers or be a registered professional engineer who has certification or licensing that includes education and experience in corrosion control of buried or submerged metal piping systems and metal tanks.

"Department" means Iowa department of natural resources.

"Dielectric material" means a material that does not conduct direct electrical current. Dielectric coatings are used to electrically isolate UST systems from the surrounding soils. Dielectric bushings are used to electrically isolate portions of the UST systems (e.g., tank from piping).

"Dispenser" means equipment located above ground that dispenses regulated substances from the UST system.

"Dispenser system" means the dispenser and the equipment necessary to connect the dispenser to the underground storage tank system.

"Drinking water well" means any groundwater well used as a source for drinking water by humans and groundwater wells used primarily for the final production of food or medicine for human consumption.

"Ductile iron pipe" means a pipe or conduit commonly used for potable water distribution and for the pumping of sewage. The predominant wall material is ductile iron, a spheroidized graphite cast iron, and commonly has an internal cement mortar lining to inhibit corrosion from the carried water and various types of external coatings to inhibit corrosion from the environment.

"Electrical equipment" means underground equipment that contains dielectric fluid that is necessary for the operation of equipment such as transformers and buried electrical cable.

"Enclosed space" means space which can act as a receptor or pathway capable of creating a risk of explosion or inhalation hazard to humans and includes "explosive receptors" and "confined spaces." Explosive receptors means those receptors designated in these rules which are evaluated for explosive risk. Confined spaces means those receptors designated in these rules for evaluation of vapor inhalation risks.

"Ethanol" means ethyl alcohol that is to be blended with gasoline if it meets the standards provided in Iowa Code section 214A.2.

"Excavation zone" means the volume containing the tank system and backfill material bounded by the ground surface, walls, and floor of the pit and trenches into which the UST system is placed at the time of installation.

"Existing tank system" means a tank system used to contain an accumulation of regulated substances or for which installation has commenced on or before January 14, 1987. Installation is considered to have commenced if:

The owner or operator has obtained all federal, state, and local approvals or permits necessary to begin physical construction of the site or installation of the tank system; and if,

1. Either a continuous on-site physical construction or installation program has begun; or,
2. The owner or operator has entered into contractual obligations, which cannot be canceled or modified without substantial loss, for physical construction at the site or installation of the tank system to be completed within a reasonable time.

"Farm tank" is a tank located on a tract of land devoted to the production of crops or raising animals, including fish, and associated residences and improvements. A farm tank must be located on the farm property. "Farm" includes fish hatcheries, rangeland and nurseries with growing operations.

"Field-constructed tank" means a tank constructed in the field. For example, a tank constructed of concrete that is poured in the field or a steel or fiberglass tank primarily fabricated in the field is considered field-constructed.

"Flow-through process tank" is a tank that forms an integral part of a production process through which there is a steady, variable, recurring, or intermittent flow of materials during the operation of the process. Flow-through process tanks do not include tanks used for the storage of materials prior to their introduction into the production process or for the storage of finished products or by-products from the production process.

"Free product" refers to a regulated substance that is present as a light nonaqueous phase liquid (e.g., liquid not dissolved in water).

"Gasket" means any type of pipe seals made of a variety of rubbers including but not necessarily limited to styrene-butadiene rubber (SBR), nitrile-butadiene rubber (NBR or nitrile), ethylene propylene diene monomer (EPDM), neoprene (CR), and fluoroelastomer rubber (FKM), which are used to seal pipe connections.

"Gathering lines" means any pipeline, equipment, facility, or building used in the transportation of oil or gas during oil or gas production or gathering operations.

"Groundwater ingestion pathway" means a pathway through groundwater by which chemicals of concern may result in exposure to a human receptor as specified in rules applicable to Tier 1, Tier 2 and Tier 3.

"Groundwater plume" means the extent of groundwater impacted by the release of chemicals of concern.

"Groundwater to water line pathway" means a pathway through groundwater which leads to a water line.

"Groundwater vapor to enclosed space pathway" means a pathway through groundwater by which vapors from chemicals of concern may lead to a receptor creating an inhalation or explosive risk hazard.

"Hazardous substance UST system" means an underground storage tank system that contains a hazardous substance defined in Section 101(14) of the Comprehensive Environmental Response, Compensation and Liability Act of 1980 (but not including any substance regulated as a hazardous waste under subtitle C) or any mixture of such substances and petroleum, and which is not a petroleum UST system.

"Hazard quotient" means the ratio of the level of exposure of a chemical of concern over a specified time period to a reference dose for that chemical of concern derived for a similar exposure period. Unless otherwise specified, the hazard quotient designated in these rules is one.

"Heating oil" means petroleum that is No. 1, No. 2, No. 4-light, No. 4-heavy, No. 5-light, No. 5-heavy, and No. 6 technical grades of fuel oil; other residual fuel oils (including Navy Special Fuel Oil and Bunker C); and other fuels when used as substitutes for one of these fuel oils. Heating oil is typically used in the operation of heating equipment, boilers, or furnaces.

"Highly permeable soils" means for the purpose of UST closures: fractured bedrock, any soils with a hydraulic conductivity rate greater than 0.3 meters per day, or any soil material classified by the Unified Soil Classification System as published by the United States Department of the Interior or ASTM designation as (1) GW - well graded gravel, gravel-sand mixtures, little or no fines, (2) GP - poorly graded gravel, gravel-sand mixtures, little or no fines, (3) SW - well graded sands, gravelly sands, little or no fines, or (4) SP - poorly graded sands, gravelly sands, little or no fines.

"Hydraulic conductivity" means the rate of water movement through the soil measured in meters per day (m/d) as determined by the following methods. For a saturated soil, the Bouwer-Rice method or its equivalent shall be used. For unsaturated soil, use a Guelph permeameter or an equivalent in situ constant-head permeameter in a boring finished above the water table. If an in situ method cannot be used for unsaturated soil because of depth, or if the soil is homogeneous and lacks flow-conducting channels, fractures, cavities, etc., laboratory measurement of hydraulic conductivity is acceptable.

If laboratory methods are used, collect undisturbed soil samples using a thin-walled tube sampler in accordance with American Society of Testing and Materials (ASTM) Standard D1587. Samples shall be clearly marked, preserved and transported to the laboratory. The laboratory shall measure hydraulic conductivity using a constant-head permeameter in accordance with ASTM Standard D2434 or a falling-head permeameter in accordance with accepted methodology.

"Hydraulic lift tank" means a tank holding hydraulic fluid for a closed-loop mechanical system that uses compressed air or hydraulic fluid to operate lifts, elevators, and other similar devices.

"Institutional controls" means the restriction on use or access (for example, fences, deed restrictions, restrictive zoning) to a site or facility to eliminate or minimize potential exposure to a chemical(s) of concern. Institutional controls include any of the following:

1. A law of the United States or the state;
2. A regulation issued pursuant to federal or state laws;
3. An ordinance or regulation of a political subdivision in which real estate subject to the institutional control is located;
4. A restriction on the use of or activities occurring at real estate which are embodied in a covenant running with the land which:

- Contains a legal description of the real estate in a manner which satisfies Iowa Code section 558.1 et seq.;
- Is properly executed, in a manner which satisfies Iowa Code section 558.1 et seq.;
- Is recorded in the appropriate office of the county in which the real estate is located;
- Adequately and accurately describes the institutional control; and

- Is in the form of a covenant as set out in Appendix C or in such a manner reasonably acceptable to the department.

5. Any other institutional control the owner or operator can reasonably demonstrate to the department which will reduce the risk from a release throughout the period necessary to ensure that no applicable target risk is likely to be exceeded.

"Light, nonaqueous-phase liquid" or *"LNAPL"* refers to an organic compound that is immiscible with, and lighter than water (e.g., crude oil, gasoline, diesel fuel, heating oil).

"Liquid trap" means sumps, well cellars, and other traps used in association with oil and gas production, gathering, and extraction operations (including gas production plants), for the purpose of collecting oil, water, and other liquids. These liquid traps may temporarily collect liquids for subsequent disposition or reinjection into a production or pipeline stream, or may collect and separate liquids from a gas stream.

"Maintenance" means the normal operational upkeep to prevent an underground storage tank system from releasing product.

"MCLs" means the drinking water primary maximum contaminant levels set out in 567—41.3(455B).

"Memorandum of agreement" means a written agreement between the department and the owner or operator which specifies the corrective action that will be undertaken by the owner or operator in order to comply with requirements in this chapter and the terms for implementation of the plan. The plan may include but is not limited to provisions for additional site assessment, site monitoring, Tier 2 revisions, Tier 3 assessment, excavation, and other soil and groundwater remedial action.

"Motor fuel" means a complex blend of hydrocarbons typically used in the operation of a motor engine, such as motor gasoline, aviation gasoline, No. 1 or No. 2 diesel fuel, or any blend containing one or more of these substances (for example, motor gasoline blended with alcohol).

"New tank system" means a tank system that will be used to contain an accumulation of regulated substances and for which installation has commenced after January 14, 1987. (See also "Existing Tank System.")

"Noncarcinogenic risk" means the potential for adverse systemic or toxic effects caused by exposure to noncarcinogenic chemicals of concern, expressed as the hazard quotient.

"Noncommercial purposes" with respect to motor fuel means not for resale.

"Non-drinking water well" means any groundwater well (except an extraction well used as part of a remediation system) not defined as a drinking water well including a groundwater well which is not properly plugged in accordance with department rules in 567—Chapters 39 and 49.

"Nonresidential area" means land which is not currently used as a residential area and which is zoned for nonresidential uses.

"On the premises where stored" with respect to heating oil means UST systems located on the same property where the stored heating oil is used.

"Operational life" refers to the period beginning when installation of the tank system has commenced until the time the tank system is properly closed under rule 567—135.15(455B).

"Operator" means any person in control of, or having responsibility for, the daily operation of the UST system.

"Overexcavation" refers to the excavation of subsurface materials outside the excavation zone for the purpose of removing contaminated substances.

"Overfill release" is a release that occurs when a tank is filled beyond its capacity, resulting in a discharge of the regulated substance to the environment.

"Owner" means:

1. In the case of a UST system in use on July 1, 1985, or brought into use after that date, any person who owns a UST system used for storage, use, or dispensing of regulated substances; and

2. In the case of any UST system in use before July 1, 1985, but no longer in use on that date, any person who owned such UST immediately before the discontinuation of its use.

Owner does not include a person or institution, who, without participating in the management or operation of the underground storage tank or the tank site or engaging in petroleum production,

refining or marketing, holds indicia of ownership primarily to protect that person's security interest in the underground storage tank or the tank site property, prior to obtaining ownership or control through debt enforcement, debt settlement, or otherwise.

"Pathway" means a transport mechanism by which chemicals of concern may reach a receptor(s) or the location(s) of a potential receptor.

"Permanent closure" means removing all regulated substances from the tank system, assessing the site for contamination, and permanently removing tank and piping from the ground or filling the tank in place with a solid inert material and plugging all piping. Permanent closure also includes partial closure of a tank system such as removal or replacement of tanks or piping only.

"Person" means an individual, trust, firm, joint stock company, federal agency, corporation, state, municipality, commission, political subdivision of a state, or any interstate body. "Person" also includes a consortium, a joint venture, a commercial entity, and the United States government.

"Person who conveys or deposits a regulated substance" means a person who sells or supplies the owner or operator with the regulated substance and the person who transports or actually deposits the regulated substance in the underground tank.

"Petroleum UST system" means an underground storage tank system that contains petroleum or a mixture of petroleum with de minimis quantities of other regulated substances. Such systems include those containing motor fuels, jet fuels, distillate fuel oils, residual fuel oils, lubricants, petroleum solvents, and used oils.

"Pipe" or *"piping"* means a hollow cylinder or tubular conduit that is constructed of nonearthen materials and that routinely contains and conveys regulated substances.

"Pipeline facilities (including gathering lines)" are new and existing pipe rights-of-way and any associated equipment, facilities, or buildings.

"Point of compliance" means the location(s) at the source(s) of contamination or at the location(s) between the source(s) and the point(s) of exposure where concentrations of chemicals of concern must meet applicable risk-based screening levels at Tier 1 or other target level(s) at Tier 2 or Tier 3.

"Point of exposure" means the location(s) at which an actual or potential receptor may be exposed to chemicals of concern via a pathway.

"Polybutylene pipe" (PB refers to polybutylene) means a water supply pipe comprised of a form of plastic resin that was used extensively from 1978 until 1995. The piping systems were used for underground water mains and as interior water distribution piping. Polybutylene mains are usually blue in color, but may be gray, black, or white. The pipe is usually ½ inch or 1 inch in diameter, and it may be found entering a residence through the basement wall or floor, concrete slab or through the crawlspace; frequently it enters the residence near the water heater.

"Polyethylene pipe" (PE refers to polyethylene) means a water supply pipe comprised of thermoplastic material produced from the polymerization of ethylene. PE pipe is manufactured by extrusion in sizes ranging from ½ inch to 63 inches. PE pipe is available in rolled coils of various lengths or in straight lengths of up to 40 feet. PE pipe is available in many forms and colors, including single-extrusion colored or black pipe, black pipe with co-extruded color striping, and black or natural pipe with a co-extruded colored layer. PE pipe has been demonstrated to be very permeable to petroleum while still retaining its flexible structure.

"Polyvinyl chloride pipe" (PVC refers to polyvinyl chloride) means a pipe made from a plastic and vinyl combination material. The pipes are durable, hard to damage, and long-lasting. A PVC pipe is very resistant and does not rust, nor is it likely to rot or wear over time. PVC piping is most commonly used in water systems, underground wiring, and sewer lines.

"Portland cement" means hydraulic cement (cement that not only hardens by reacting with water but also forms a water-resistant product) and is produced by pulverizing clinkers consisting essentially of hydraulic calcium silicates, usually containing one or more forms of calcium sulfate as an inter ground addition.

"Potential receptor" means a receptor not in existence at the time a Tier 1, Tier 2 or Tier 3 site assessment is prepared, but which could reasonably be expected to exist within 20 years of the preparation of the Tier 1, Tier 2 or Tier 3 site assessment or as otherwise specified in these rules.

"Preferential pathway" means conditions which act as a pathway permitting contamination to migrate through soils and to groundwater at a faster rate than would be expected through naturally occurring undisturbed soils or unfractured bedrock including but not limited to wells, cisterns, tile lines, drainage systems, utility lines and envelopes, and conduits.

"Protected groundwater source" means a saturated bed, formation, or group of formations which has a hydraulic conductivity of at least 0.44 meters per day (m/d) and a total dissolved solids of less than 2,500 milligrams per liter (mg/l) or a bedrock aquifer with total dissolved solids of less than 2,500 milligrams per liter (mg/l) if bedrock is encountered before groundwater.

"Public water supply well" means a well connected to a system for the provision to the public of piped water for human consumption, if such system has at least 15 service connections or regularly serves an average of at least 25 individuals daily at least 60 days out of the year.

"Receptor" means enclosed spaces, conduits, protected groundwater sources, drinking and non-drinking water wells, surface water bodies, and public water systems which when impacted by chemicals of concern may result in exposure to humans and aquatic life, explosive conditions or other adverse effects on health, safety and the environment as specified in these rules.

"Reference dose" means a designated toxicity value established in these rules for evaluating potential noncarcinogenic effects in humans resulting from exposure to a chemical(s) of concern. Reference doses are designated in Appendix A.

"Regulated substance" means an element, compound, mixture, solution or substance which, when released into the environment, may present substantial danger to the public health or welfare or the environment. Regulated substance includes:

1. Substances designated in Table 302.4 of 40 CFR Part 302 (September 13, 1988),

2. Substances which exhibit the characteristics identified in 40 CFR 261.20 through 261.24 (May 10, 1984) and which are not excluded from regulation as a hazardous waste under 40 CFR 261.4(b) (May 10, 1984),

3. Any substance defined in Section 101(14) of the Comprehensive Environmental Response, Compensation and Liability Act (CERCLA) (but not including any substance regulated as a hazardous waste under subtitle C), and

4. Petroleum, including crude oil or any fraction thereof that is liquid at standard conditions of temperature and pressure (60 degrees Fahrenheit and 14.7 pounds per square inch absolute). The term "regulated substance" includes but is not limited to petroleum and petroleum-based substances comprised of a complex blend of hydrocarbons such as motor fuels, jet fuels, distillate fuel oils, residual fuel oils, lubricants, petroleum solvents, and used oils.

"Release" means any spilling, leaking, emitting, discharging, escaping, leaching or disposing of a regulated substance, including petroleum, from a UST into groundwater, surface water or subsurface soils.

"Release detection" means determining whether a release of a regulated substance has occurred from the UST system into the environment or a leak has occurred into the interstitial space between the UST system and its secondary barrier or secondary containment around it.

"Repair" means to restore to proper operating condition a tank, pipe, spill prevention equipment, overfill prevention equipment, corrosion protection equipment, release detection equipment or other UST system component that has caused a release of product from the UST system or has failed to function properly.

"Replace" or *"replacement"* means the installation of a new underground tank system or component, including dispensers, in substantially the same location as an existing tank system or component.

"Replaced" means:

1. For a tank: to remove a tank and install another tank.

2. For piping: to remove 50 percent or more of piping and install other piping, excluding connectors, connected to a single tank. For tanks with multiple piping runs, this definition applies independently to each piping run.

"Residential area" means land used as a permanent residence or domicile, such as a house, apartment, nursing home, school, child care facility or prison, land zoned for such uses, or land where no zoning is in place.

"Residential tank" is a tank located on property used primarily for dwelling purposes.

"Risk-based screening level (RBSL)" means the risk-based concentration level for chemicals of concern developed for a Tier 1 analysis to be met at the point(s) of compliance and incorporated in the Tier 1 Look-up Table in Appendix A.

"SARA" means the federal Superfund Amendments and Reauthorization Act of 1986.

"Secondary containment" or *"secondarily contained"* means a release prevention and release detection system for a tank or piping. This system has an inner and outer barrier with an interstitial space monitored for leaks. This term includes containment sumps when used for interstitial monitoring of piping.

"Secondary containment tank" or *"secondary containment piping"* means a tank or piping which is designed with an inner primary shell and a liquid-tight outer secondary shell or jacket which extends around the entire inner shell, and which is designed to contain any leak through the primary shell from any part of the tank or piping that routinely contains product, and which also allows for monitoring of the interstitial space between the shells and the detection of any leak.

"Septic tank" is a watertight covered receptacle designed to receive or process, through liquid separation or biological digestion, the sewage discharged from a building sewer. The effluent from such receptacle is distributed for disposal through the soil and settled solids and scum from the tank are pumped out periodically and hauled to a treatment facility.

"Service line" means a pipe connected to a business or residence from a water main, typically of a size not exceeding 6 inches in diameter, and including its gaskets and other appurtenances. For purposes of this chapter, service lines refer to pipes specifically used for drinking water transmission.

"Site assessment investigation" means an investigation conducted by a certified groundwater professional to determine relevant site historical data, the types, amounts, and sources of petroleum contaminants present, hydrogeological characteristics of the site, full vertical and horizontal extent of the contamination in soils and groundwater, direction and rate of flow of the contamination, ranges of concentration of the contaminants by analysis of soils and groundwater, the vertical and horizontal extent of the contamination exceeding department standards, and the actual or potential threat to public health and safety and the environment.

"Site cleanup report" means the report required to be submitted by these rules and in accordance with department guidance which may include the results of Tier 2 or Tier 3 assessment and analysis.

"Site-specific target level (SSTL)" means the risk-based target level(s) for chemicals of concern developed as the result of a Tier 2 or Tier 3 assessment which must be achieved at applicable point(s) of compliance at the source to meet the target level(s) at the point(s) of exposure.

"Soil leaching to groundwater pathway" means a pathway through soil by which chemicals of concern may leach to groundwater and through a groundwater transport pathway impact an actual or potential receptor.

"Soil plume" means the vertical and horizontal extent of soil impacted by the release of chemicals of concern.

"Soil to water line pathway" means a pathway which leads from soil to a water line.

"Soil vapor to enclosed space pathway" means a pathway through soil by which vapors from chemicals of concern may lead to a receptor creating an inhalation or explosive risk hazard.

"Storm water or wastewater collection system" means piping, pumps, conduits, and any other equipment necessary to collect and transport the flow of surface water run-off resulting from precipitation, or domestic, commercial, or industrial wastewater to and from retention areas or any areas where treatment is designated to occur. The collection of storm water and wastewater does not include treatment except where incidental to conveyance.

"Surface impoundment" is a natural topographic depression, constructed excavation, or diked area formed primarily of earthen materials (although it may be lined with manufactured materials) that is not an injection well.

"Surface water body" means general use segments as provided in 567—paragraph 61.3(1)*"a"* and designated use segments of water bodies as provided in 567—paragraph 61.3(1)*"b"* and 567—subrule 61.3(5).

"Surface water criteria" means, for chemicals of concern, the Criteria for Chemical Constituents in Table 1 of rule 567—61.3(455B), except that "1,000 ug/L" will be substituted for the chronic levels for toluene for Class B designated use segments.

"Surface water pathway" means a pathway which leads to a surface water body.

"Tank" is a stationary device designed to contain an accumulation of regulated substances and constructed of nonearthen materials (e.g., concrete, steel, plastic) that provide structural support.

"Target level" means the allowable concentrations of chemicals of concern established to achieve an applicable target risk which must be met at the point(s) of compliance as specified in these rules.

"Target risk" refers to an applicable carcinogenic and noncarcinogenic risk factor designated in these rules and used in determining target levels (for carcinogenic risk assessment, target risk is a separate factor, different from exposure factors, both of which are used in determining target levels).

"Technological controls" means a physical action which does not involve source removal or reduction, but severs or reduces exposure to a receptor, such as caps, containment, carbon filters, point of use water treatment, etc.

"Temporary closure" means a regulated tank or UST system that has been out of operation for three months or more.

"Tier 1 level" means the groundwater and soil levels in the Tier 1 Look-up Table set out in rule 135.9(455B) and Appendix A.

"Tier 1 site assessment" means the evaluation of limited site-specific data compared to the Tier 1 levels established in these rules for the purpose of determining which pathways do not require assessment and evaluation at Tier 2 and which sites warrant a no further action required classification without further assessment and evaluation.

"Tier 2 site assessment" means the process of assessing risk to actual and potential receptors by using site-specific contaminant concentrations and designated Tier 2 exposure and fate and transport models to determine the applicable target level(s).

"Tier 3 site assessment" means a site-specific risk assessment utilizing more sophisticated data or analytic techniques than a Tier 2 site assessment.

"Training program" means any program that provides information to and evaluates the knowledge of a Class A, Class B, or Class C operator through testing, practical demonstration, or another approach acceptable to the department regarding requirements for UST systems that meet the requirements of subrules 135.4(6) to 135.4(12).

"Under-dispenser containment (UDC)" means containment underneath a dispenser system designed to prevent leaks from the dispenser and piping within or above the UDC from reaching soil or groundwater.

"Underground area" means an underground room, such as a basement, cellar, shaft or vault, providing enough space for physical inspection of the exterior of the tank situated on or above the surface of the floor.

"Underground release" means any below-ground release.

"Underground storage tank" or *"UST"* means any one or combination of tanks (including underground pipes connected thereto) that is used to contain an accumulation of regulated substances, and the volume of which (including the volume of underground pipes connected thereto) is 10 percent or more beneath the surface of the ground. This term does not include any:

a. Farm or residential tank of 1100 gallons or less capacity used for storing motor fuel for noncommercial purposes. Iowa Code section 455B.473(4) requires those tanks existing prior to July 1, 1987, to be registered. Tanks installed on or after July 1, 1987, must comply with all 567—Chapter 135 rules;

b. Tank used for storing heating oil for consumptive use on the premises where stored;

c. Septic tank;

d. Pipeline facility (including gathering lines):

(1) Which is regulated under 49 U.S.C. Chapter 601, or

(2) Which is an intrastate pipeline facility regulated under state laws as provided in 49 U.S.C. Chapter 601 and which is determined by the Secretary of Transportation to be connected to a pipeline, or to be operated or intended to be capable of operating at pipeline pressure or as an integral part of a pipeline;

e. Surface impoundment, pit, pond, or lagoon;

f. Storm-water or wastewater collection system;

g. Flow-through process tank;

h. Liquid trap or associated gathering lines directly related to oil or gas production and gathering operations; or

i. Storage tank situated in an underground area (such as a basement, cellar, mineworking, drift, shaft, or tunnel) if the storage tank is situated upon or above the surface of the floor.

The term "underground storage tank" or "UST" does not include any pipes connected to any tank which is described in paragraphs *"a"* through *"i"* of this definition.

"Underground storage tank professional" or *"UST professional"* means an individual licensed by the department under 567—Chapter 134, Part C. The licensing program includes underground storage tank system installation, installation inspection, UST system testing, tank lining, cathodic protection installation/inspection, and UST removal. The license issued will list the type of work the individual is licensed to perform.

"Underground utility vault" means any constructed space accessible for inspection and maintenance associated with subsurface utilities.

"Unreasonable risk to public health and safety or the environment" means the Tier 1 levels for a Tier 1 site assessment, the applicable target level for a Tier 2 site assessment, and the applicable target level for a Tier 3 site assessment.

"Upgrade" means the addition or retrofit of some systems such as cathodic protection, lining, or spill and overfill controls to improve the ability of an underground storage tank system to prevent the release of product.

"UST system" or *"tank system"* means an underground storage tank, connected underground piping, underground ancillary equipment, and containment system, if any.

"Utility envelope" means the backfill and trench used for any subsurface utility line, drainage system and tile line.

"Wastewater treatment tank" means a tank that is designed to receive and treat an influent wastewater through physical, chemical, or biological methods.

"Water line" means a hollow cylinder or tubular conduit that routinely contains and conveys potable water and is constructed of nonearthen materials, including but not limited to asbestos-cement, copper, high-density polyethylene (HDPE), polybutylene, polyethylene, and wood. Such piping includes any elbows, couplings, unions, valves, or other in-line fixtures, as well as the gaskets, which contain and convey potable water.

"Water main pipe" means a main line to the water distribution system with feeder lines or service lines connected to it and which typically is 6 inches or greater in diameter, and includes its gaskets and other appurtenances.

[**ARC 7621B**, IAB 3/11/09, effective 4/15/09; **ARC 8124B**, IAB 9/9/09, effective 10/14/09; **ARC 9011B**, IAB 8/25/10, effective 9/29/10; **ARC 5625C**, IAB 5/19/21, effective 6/23/21]

567—135.3(455B) UST systems—design, construction, installation and notification.

135.3(1) *Performance standards for new UST systems.* In order to prevent releases due to structural failure, corrosion, or spills and overfills for as long as the UST system is used to store regulated substances, all owners and operators of new UST systems must meet the following requirements. The UST system must be secondarily contained in accordance with subrule 135.3(9).

a. *Tanks.* Each tank must be properly designed and constructed, and any portion underground that routinely contains product must be protected from corrosion, in accordance with a code of practice developed by a nationally recognized association or independent testing laboratory as specified below:

(1) The tank is constructed of fiberglass-reinforced plastic; or

NOTE: The following codes of practice may be used to comply with subparagraph 135.3(1)*"a"*(1): Underwriters Laboratories Standard 1316, "Glass-Fiber-Reinforced Plastic Underground Storage Tanks for Petroleum Products, Alcohols, and Alcohol-Gasoline Mixtures" or Underwriters Laboratories of Canada S615, "Standard for Reinforced Plastic Underground Tanks for Flammable and Combustible Liquids."

(2) The tank is constructed of steel and cathodically protected in the following manner:

1. The tank is coated with a suitable dielectric material;

2. Field-installed cathodic protection systems are designed by a corrosion expert;

3. Impressed current systems are designed to allow determination of current operating status as required in paragraph 135.4(2)*"c."* This shall be accomplished by providing the rectifier with ampere and voltage meters that can be read by the owner and operator for comparison to the design standard set by the corrosion expert or a device that can warn the owner and operator when changes in ampere and voltage occur outside the design standard set by the corrosion expert;

4. Cathodic protection systems are operated and maintained in accordance with subrule 135.4(2) or according to guidelines established by the department; and

5. Impressed current systems must be designed not to cause stray current that can damage other underground structures (metal electrical conduits, water lines, gas lines, etc.); or

NOTE: The following codes of practice may be used to comply with subparagraph 135.3(1)*"a"*(2):

- Steel Tank Institute "Specification STI-P3® Specification and Manual for External Corrosion Protection of Underground Steel Storage Tanks";
- Underwriters Laboratories Standard 1746, "External Corrosion Protection Systems for Steel Underground Storage Tanks";
- Underwriters Laboratories of Canada S603, "Standard for Steel Underground Tanks for Flammable and Combustible Liquids," and S603.1, "Standard for External Corrosion Protection Systems for Steel Underground Tanks for Flammable and Combustible Liquids," and S631, "Standard for Isolating Bushings for Steel Underground Tanks Protected with External Corrosion Protection Systems";
- Steel Tank Institute Standard F841, "Standard for Dual Wall Underground Steel Storage Tanks"; or
- NACE International Standard Practice SP 0285, "External Corrosion Control of Underground Storage Systems by Cathodic Protection," and Underwriters Laboratories Standard 58, "Standard for Steel Underground Tanks for Flammable and Combustible Liquids."

(3) The tank is constructed of steel and clad or jacketed with a noncorrodible material; or

NOTE: The following industry codes may be used to comply with subparagraph 135.3(1)*"a"*(3):

- Underwriters Laboratories Standard 1746, "Corrosion Protection Systems for Underground Storage Tanks";
- Steel Tank Institute ACT-100® Specification F894, "Specification for External Corrosion Protection of FRP Underground Storage Tanks";
- Steel Tank Institute ACT-100-U® Specification F961, "Specification for External Corrosion Protection of Composite Steel Underground Storage Tanks"; or
- Steel Tank Institute Specification F922, "Steel Tank Institute Specification for Permatank®."

(4) The tank is constructed of metal without additional corrosion protection measures provided that:

1. The tank is installed at a site that is determined by a corrosion expert not to be corrosive enough to cause it to have a release due to corrosion during its operating life; and

2. Owners and operators maintain records that demonstrate compliance with the requirements of paragraph 135.3(1)*"a"*(4)"1" for the remaining life of the tank; or

(5) The tank construction and corrosion protection are determined by the department to be designed to prevent the release or threatened release of any stored regulated substance in a manner that is no less protective of human health and the environment than subparagraphs 135.3(1)*"a"*(1) to (4).

b. Piping. The piping that routinely contains regulated substances and is in contact with the ground must be properly designed, constructed, and protected from corrosion in accordance with a code of

practice developed by a nationally recognized association or independent testing laboratory as specified in this rule. This includes piping for remote tank fill locations.

All piping must have secondary containment, installed according to manufacturer's specifications, and be compatible with the product stored and the environment to which it will be exposed. Piping must maintain its original specifications and structural integrity. Piping whose structural integrity has degraded must be replaced. All piping installations must meet National Fire Prevention Association Standard 30 and Standard 30A or the International Fire Code as adopted by the Iowa state fire marshal in 661—Chapter 221, "Flammable and Combustible Liquids."

(1) The piping is constructed of a noncorrodible material; or

NOTE: The following codes of practice may be used to comply with subparagraph 135.3(1)*"b"*(1):

- Underwriters Laboratories Standard 971, "Nonmetallic Underground Piping for Flammable Liquids"; or
- Underwriters Laboratories of Canada Standard S6660, "Standard for Nonmetallic Underground Piping for Flammable and Combustible Liquids."

(2) The piping is constructed of steel and cathodically protected in the following manner:

1. The piping is coated with a suitable dielectric material;
2. Field-installed cathodic protection systems are designed by a corrosion expert;
3. Impressed current systems are designed to allow determination of current operating status as required in paragraph 135.4(2)*"c"*; and
4. Cathodic protection systems are operated and maintained in accordance with subrule 135.4(2) or guidelines established by the department; or

NOTE: The following codes of practice may be used to comply with subparagraph 135.3(1)*"b"*(2):

- American Petroleum Institute Recommended Practice 1632, "Cathodic Protection of Underground Petroleum Storage Tanks and Piping Systems";
- Underwriters Laboratories Subject 971A, "Outline of Investigation for Metallic Underground Fuel Pipe";
- Steel Tank Institute Recommended Practice R892, "Recommended Practice for Corrosion Protection of Underground Piping Networks Associated with Liquid Storage and Dispensing Systems";
- NACE International Standard Practice SP 0169, "Control of External Corrosion on Underground or Submerged Metallic Piping Systems";
- NACE International Standard Practice SP 0285, "External Corrosion Control of Underground Storage Tank Systems by Cathodic Protection"; or
- National Fire Protection Association Standard 30, "Flammable or Combustible Liquids Code."

(3) The piping is constructed of metal without additional corrosion protection measures provided that:

1. The piping is installed at a site that is determined by a corrosion expert to not be corrosive enough to cause it to have a release due to corrosion during its operating life; and
2. Owners and operators maintain records that demonstrate compliance with the requirements of paragraph 135.3(1)*"b"*(3)"1" for the remaining life of the piping; or

(4) The piping construction and corrosion protection are determined by the department to be designed to prevent the release or threatened release of any stored regulated substance in a manner that is no less protective of human health and the environment than the requirements in subparagraphs 135.3(1)*"b"*(1) to (3).

c. Spill and overfill prevention equipment.

(1) Except as provided in subparagraph 135.3(1)*"b"*(2), to prevent spilling and overfilling associated with product transfer to the UST system, owners and operators must use the following spill and overfill prevention equipment:

1. Spill prevention equipment that will prevent release of product to the environment when the transfer hose is detached from the fill pipe (for example, a spill catchment basin); and
2. Overfill prevention equipment that will:

- Automatically shut off flow into the tank when the tank is no more than 95 percent full; or

- Alert the transfer operator when the tank is no more than 90 percent full by restricting the flow into the tank (not allowed for suction product delivery systems, for tanks with stage 1 vapor recovery or when product delivery is by pumping) or triggering a high-level alarm; or
- Restrict flow 30 minutes prior to overfilling, alert the transfer operator with a high-level alarm one minute before overfilling, or automatically shut off the flow into the tank so that none of the fittings located on top of the tank are exposed to product due to overfilling.

(2) Owners and operators are not required to use the spill and overfill prevention equipment specified in subparagraph 135.3(1)*"b"*(1) if:

1. Alternative equipment is used that is determined by the department to be no less protective of human health and the environment than the equipment specified in paragraph 135.3(1)*"b"*(1)"1" or "2"; or

2. The UST system is filled by transfers of no more than 25 gallons at one time.

(3) Flow restrictors used in vent lines may not be used to comply with paragraph 135.3(1)*"c"*(1)"2" when overfill prevention is installed or replaced.

(4) Spill and overfill prevention equipment must be periodically tested or inspected in accordance with subrule 135.4(12).

(5) Spill prevention equipment must be kept free of any liquid and debris. Any liquid or debris must be removed prior to product delivery.

d. Installation. The UST system must be properly installed in accordance with a code of practice developed by a nationally recognized association or independent testing laboratory and in accordance with the manufacturer's instructions. The UST system installation shall be conducted by an installer licensed by the department under 567—Chapter 134, Part C, and in accordance with 567—subrules 134.24(3) and 134.24(4).

NOTE: Tank and piping system installation practices and procedures described in the following codes may be used to comply with the requirements of paragraph 135.3(1)*"d"*:

- American Petroleum Institute Publication 1615, "Installation of Underground Petroleum Storage System";
- Petroleum Equipment Institute Publication RP100, "Recommended Practices for Installation of Underground Liquid Storage Systems"; or
- National Fire Protection Association Standard 30, "Flammable and Combustible Liquids Code," and 30A, "Code for Motor Fuel Dispensing Facilities and Repair Garages."

e. Certification of installation. All owners and operators must ensure that the following methods of certification, testing, and inspection are used to demonstrate compliance with paragraph 135.3(1)*"d"* by providing a certification of compliance on the UST registration form in accordance with subrule 135.3(3).

(1) The installer is licensed by the department as provided in 567—Chapter 134, Part C; and

(2) The installation has been inspected by a licensed installation inspector as required by 567—Chapter 134, Part C.

f. Dispenser systems. Each UST system must be equipped with under-dispenser containment (UDC) for any new or replaced dispenser system.

(1) A dispenser system is considered new when both the dispenser and the equipment needed to connect the dispenser to the underground storage tank system are installed at a location where there previously was no dispenser (new UST system or new dispenser location at an existing UST system). The equipment necessary to connect the dispenser to the underground storage tank system includes check valves, shear valves, unburied risers or flexible connectors, or other transitional components that are underneath the dispenser and connect the dispenser to the underground piping.

(2) UDC shall be installed whenever an existing dispenser system is removed and replaced with another dispenser and the equipment used to connect the dispenser to the underground storage tank system is replaced. This equipment includes flexible connectors or risers or other transitional components that are beneath the dispenser and connect the dispenser to the piping. UDC is not required when only the emergency shutoff or shear valves or check valves are replaced.

(3) UDC shall be installed beneath the dispenser whenever ten feet or more of piping is repaired or replaced within ten feet of a dispenser.

(4) UDC must be liquid-tight on its sides, bottom, and at any penetrations. UDC must allow for visual inspection and access to the components in the containment system or be periodically monitored for leaks from the dispenser system.

135.3(2) *Upgrading of existing UST systems.* Owners and operators must permanently close any UST system that does not meet the new UST system performance standards or has not been upgraded in accordance with paragraphs 135.3(2)*"b"* through *"d."* This subrule does not apply to previously deferred UST systems. Upgrading is no longer allowed for UST systems not upgraded by December 22, 1998.

a. Alternatives allowed. Not later than December 22, 1998, all existing UST systems had to comply with one of the following requirements:

(1) New UST system performance standards under 135.3(1);

(2) The upgrading requirements in paragraphs *"b"* through *"d"* below; or

(3) Closure requirements under rule 567—135.15(455B), including applicable requirements for corrective action under rules 567—135.7(455B) to 567—135.12(455B).

Replacement or upgrade of a tank system on a petroleum contaminated site classified as a high or low risk in accordance with rule 567—135.12(455B) shall be a double wall tank or a tank equipped with a secondary containment system with monitoring of the space between the primary and secondary containment structures in accordance with paragraph 135.5(4)*"g."*

b. Tank upgrading requirements. Steel tanks had to be upgraded to meet one of the following requirements in accordance with a code of practice developed by a nationally recognized association or independent testing laboratory:

(1) *Interior lining.* Tanks upgraded by internal lining must meet the following:

1. The lining was installed in accordance with the requirements of subrule 135.4(4), and

2. Within ten years after lining, and every five years thereafter, the lined tank is internally inspected and found to be structurally sound with the lining still performing in accordance with original design specifications.

3. If the internal lining is no longer performing in accordance with original design specifications and cannot be repaired in accordance with a code of practice developed by a nationally recognized association or independent testing laboratory, the lined tank must be permanently closed in accordance with rule 567—135.15(455B).

(2) *Cathodic protection.* Tanks upgraded by cathodic protection meet the requirements of paragraphs 135.3(1)*"a"*(2)"2," "3," and "4" and the integrity of the tank was ensured using one of the following methods:

1. The tank was internally inspected and assessed to ensure that the tank was structurally sound and free of corrosion holes prior to installing the cathodic protection system; or

2. The tank had been installed for less than ten years and is monitored monthly for releases in accordance with 135.5(4)*"d"* through *"i"*; or

3. The tank had been installed for less than ten years and was assessed for corrosion holes by conducting two tightness tests that meet the requirements of paragraph 135.5(4)*"c."* The first tightness test must have been conducted prior to installing the cathodic protection system. The second tightness test must have been conducted between three and six months following the first operation of the cathodic protection system; or

4. The tank was assessed for corrosion holes by a method that is determined by the department to prevent releases in a manner that is no less protective of human health and the environment than paragraphs 135.3(2)*"b"*(2)"1" to "3."

(3) *Internal lining combined with cathodic protection.* Tanks upgraded by both internal lining and cathodic protection must have met the following:

1. The lining was installed in accordance with the requirements of subrule 135.4(4); and

2. The cathodic protection system was installed within six months of lining installation and meets the requirements of paragraphs 135.3(1)*"a"*(2)"2," "3," and "4."

NOTE regarding paragraph 135.3(2)*"b"*: The following historical codes of practice were listed as options for complying with paragraph 135.3(2)*"b"*:

- American Petroleum Institute Publication 1631, "Recommended Practice for the Interior Lining of Existing Steel Underground Storage Tanks";
- National Leak Prevention Association Standard 631, "Spill Prevention, Minimum 10 Year Life Extension of Existing Steel Underground Tanks by Lining Without the Addition of Cathodic Protection";
- National Association of Corrosion Engineers Standard RP-02-85, "Control of External Corrosion on Metallic Buried, Partially Buried, or Submerged Liquid Storage Systems"; and
- American Petroleum Institute Publication 1632, "Cathodic Protection of Underground Petroleum Storage Tanks and Piping Systems."

NOTE regarding paragraph 135.3(2)*"b"*(1)"2": The following codes of practice may be used to comply with the periodic lining inspection requirement of this subrule:

- American Petroleum Institute Recommended Practice 1631, "Interior Lining and Periodic Inspection of Underground Storage Tanks";
- National Leak Prevention Association Standard 631, Chapter B, "Future Internal Inspection Requirements for Lined Tanks";
- Ken Wilcox Associates Recommended Practice, "Recommended Practice for Inspecting Buried Lined Steel Tanks Using a Video Camera"; or
- Underwriters Laboratories (UL) 1856 Underground Fuel Tank Internal Retrofit Systems.

c. *Piping upgrading requirements.* Metal piping that routinely contains regulated substances and is in contact with the ground must be cathodically protected in accordance with a code of practice developed by a nationally recognized association or independent testing laboratory and must meet the requirements of paragraphs 135.3(1)*"b"*(2)"2," "3," and "4."

NOTE: The codes of practice listed in the note following subparagraph 135.3(1)*"b"*(2) may be used to comply with this requirement.

d. *Spill and overfill prevention equipment.* To prevent spilling and overfilling associated with product transfer to the UST system, all existing UST systems must comply with UST system spill and overfill prevention equipment requirements specified in paragraph 135.3(1)*"c."*

135.3(3) *Registration and notification requirements.*

a. Except as provided in paragraph 135.3(3)*"b,"* the owner of an underground storage tank existing on or before July 1, 1985, shall complete and submit to the department a copy of the registration form provided by the department.

b. The owner of an underground storage tank system taken out of operation between January 1, 1974, and July 1, 1985, shall complete and submit to the department a copy of the registration form provided by the department unless the owner knows the tank has been removed from the ground. For purposes of this subrule, "owner" means the person who owned the tank immediately before the discontinuation of the tank's use.

c. An owner or operator who brings into use an underground storage tank system after July 1, 1985, shall complete and submit to the department a copy of the registration form provided by the department within 30 days of the final installation inspection required in 567—paragraph 134.27(2)*"c"* by a licensed installation inspector. The owner or operator shall not allow the deposit of any regulated substance into the tank without prior approval of the department or until the permanent registration tag and annual tank tag have been attached to the tank fill pipe and the tank system is covered by an approved financial responsibility mechanism in accordance with 567—Chapter 136.

d. All owners and operators of new UST systems must provide UST system details and a site diagram, and certify in the registration form compliance with the following requirements:

(1) Installation of tanks and piping under paragraph 135.3(1)*"e"*;
(2) Cathodic protection of steel tanks and piping under paragraphs 135.3(1)*"a"* and *"b"*;
(3) Financial responsibility under 567—Chapter 136;
(4) Release detection methods under subrules 135.5(2) and 135.5(3);
(5) Class A, B and C operator certification under subrule 135.4(6);
(6) NESHAP Stage 1 vapor recovery.

e. All owners and operators of new UST systems must ensure that the licensed installer certifies in the registration form that the methods used to install the tanks and piping comply with the requirements in paragraph 135.3(1)*"d."*

f. Exemption from reporting requirement. Paragraphs 135.3(1)*"a"* to *"c"* do not apply to an underground storage tank for which notice was given pursuant to Section 103, Subsection c, of the Comprehensive Environmental Response, Compensation and Liabilities Act of 1980. (42 U.S.C. Subsection 9603(c))

g. Reporting fee. The registration form submitted by the owner to the department under paragraphs 135.3(1)*"a"* to *"c"* shall be accompanied by a fee of $10 for each tank included in the form.

h. Notification requirement for installing a tank. A person installing an underground storage tank and the owner or operator of the underground storage tank must notify the department of their intent to install the tank 30 days prior to installation. Notification shall be on a form provided by the department.

i. Notification requirements for a person who acquires, sells, installs, modifies or repairs a UST system.

(1) A person, company or lending institution that assumes ownership or operation of a regulated underground storage tank must submit notification to the department on a form provided by the department within 30 days of acquisition and prior to tank operation. The owner must include copies of training certificates for the Class A and Class B operators (135.4(6)) and proof of financial responsibility required in 567—Chapter 136. The new owner is responsible for any current and back tank management fees that have not been previously paid.

(2) A person who sells, installs, modifies, or repairs a tank used or intended to be used in Iowa shall notify, in writing, the purchaser and the owner or operator of the tank of the obligations specified in paragraphs 135.3(3)*"c"* and *"j"* and the financial assurance requirements in 567—Chapter 136. The notification must include the prohibition on depositing a regulated substance into tanks which have not been registered and issued tags by the department, or tanks which do not have financial assurance as required in 567—Chapter 136. A standard notification form supplied by the department may be used to satisfy this requirement.

j. It is unlawful for a person to deposit or accept a regulated substance in an underground storage tank that has not been registered and issued permanent or annual tank management tags in accordance with rule 567—135.3(455B). It is unlawful for a person to deposit or accept a regulated substance into an underground storage tank if the person has received notice from the department that the underground storage tank is subject to a delivery prohibition or if there is a "red tag" attached to the UST fill pipe or fill pipe cap as provided in subrule 135.3(8).

(1) The department may provide written authorization to receive a regulated substance when there is a delay in receiving tank tags or at new tank installations to allow for testing the tank system.

(2) The department may provide known depositors of regulated substances lists of underground storage tank sites that have been issued tank tags, those that have not been issued tank tags, and those subject to a delivery prohibition pursuant to subrule 135.3(8). These lists do not remove the requirement for depositors to verify that current tank tags are affixed to the fill pipe prior to delivering product. Regulated substances cannot be delivered to underground storage tanks without current tank tags or those displaying a delivery prohibition "red tag" as provided in subrule 135.3(8).

(3) A person shall not accept or deposit a regulated substance in an underground storage tank after receiving written or oral notice from the department that the tank is not covered by an approved form of financial responsibility in accordance with 567—Chapter 136.

k. If an owner or operator fails to register an underground storage tank within 30 days after installation pursuant to paragraph 135.3(3)*"c,"* the owner or operator shall pay an additional $250 per tank late fee upon registration of the tank. The imposition of this fee does not preclude the department from assessing an additional administrative penalty in accordance with Iowa Code section 455B.476.

135.3(4) *Farm and residential tanks.*

a. The owner or operator of a farm or residential tank of 1100 gallons or less capacity used for storing motor fuel for noncommercial purposes is subject to the requirements of this subrule.

b. Farm and residential tanks, installed before July 1, 1987, are required to be registered with the department.

c. Farm and residential tanks installed on or after July 1, 1987, must be in compliance with all the underground storage tank regulations.

135.3(5) *Registration tags and annual management fee.*

a. Tanks of 1100 gallons or less capacity that have registered with the department will be issued a permanent registration tag.

b. The owner or operator of tanks over 1,100-gallon capacity must submit a tank management fee form and fee payment of $65 per tank by January 15 of each year.

(1) An additional $250 per tank late fee must be paid if the tank management fee is not paid by March 1.

(2) The owner or operator must submit written proof that the tanks are covered by an approved form of financial responsibility in accordance with 567—Chapter 136.

(3) Upon proper payment of the fee and acceptable proof of financial responsibility, and a determination there are no outstanding compliance violations, a one-year renewal tag will be issued for the period from April 1 to March 31.

(4) If there are outstanding compliance violations, the annual tank tags may be withheld until the violations are corrected.

(5) The department shall refund a tank management fee if the tank is permanently closed prior to April 1 for that year.

c. The owner or operator shall affix the tag to the fill pipe of the underground storage tank where it will be readily visible.

d. A person who conveys or deposits a regulated substance shall inspect the underground storage tank to determine the existence or absence of a permanent registration tag, a current annual renewal tag, or a delivery prohibition "red tag" as provided in subrule 135.3(8). If a current annual renewal tag, or a silver permanent tag for regulated tanks less than 1,100 gallons is not affixed to the fill pipe or fill pipe cap or if a delivery prohibition "red tag" is displayed, the person shall not deposit the substance in the tank.

e. The owner or operator must return the tank tags upon request of the department for failure to meet the requirements of rules 567—135.3(455B) to 567—135.5(455B) or the financial responsibility rules in 567—Chapter 136 after permanent tank closure or when tanks are temporarily closed for over 12 months, or when the tank system is suspected to be leaking and the responsible party fails to respond as required in subrule 135.8(1). The department will not return the tags until the tank system is in full compliance with the technical requirements of this chapter and financial responsibility requirements of 567—Chapter 136.

135.3(6) *Previously unregistered petroleum underground storage tanks.* A petroleum underground storage tank required to be registered under subrules 135.3(3) and 135.3(4), which has not been registered shall be registered under the following conditions:

a. The tank registration fee under paragraph 135.3(3)*"g"* shall accompany the registration.

b. The storage tank management fee and any late fees under subrule 135.3(5) and paragraph 135.3(3)*"k"* shall be paid for past years in which the tank should have been registered.

c. The department may waive the late fee(s).

135.3(7) *Exemption certificates from the environmental charge on petroleum diminution.* Rescinded IAB 5/19/21, effective 6/23/21.

135.3(8) *Delivery prohibition process.*

a. *Identifying sites subject to delivery response prohibition action.*

(1) Annual renewal tag and tank management fee process. Owners and operators shall certify to the following on a form prepared by the department when applying for annual tank tags pursuant to subrule 135.3(5):

1. Installation and performance of an approved UST and piping release detection method as provided in rule 567—135.5(455B), including an annual line tightness test and a line leak detector test if applicable.

2. Installation of an approved overfill and spill protection system as provided in paragraph 135.3(1)*"c."*

3. Installation of an approved corrosion protection system as provided in paragraphs 135.3(1)*"a"* and *"b."*

4. If the UST system has been out of operation for more than three months, that the UST system has been temporarily closed in accordance with rule 567—135.15(455B) and a certification of temporary closure has been submitted to the department.

5. If the UST system has been removed or filled in place within the last 12 months, the date of removal or filling in place and whether a closure report has been submitted as provided in rule 567—135.15(455B).

(2) Sites with provisional status. If the UST system has been classified as operating under provisional status as provided in paragraph 135.3(8)*"c,"* owners and operators when applying for annual tank tags pursuant to subrule 135.3(5) must certify on a form prepared by the department that the owners and operators are in compliance with an approved provisional status remedial plan as provided in paragraph 135.3(8)*"c."*

(3) Compliance inspections. The department may initiate a delivery prohibition response action based on: (1) a finding resulting from a third-party compliance inspection conducted pursuant to rule 567—135.20(455B); (2) a department investigation and inspection conducted pursuant to Iowa Code section 455B.475; or (3) review of a UST system check or other documentation submitted in response to a suspected release under rule 567—135.6(455B) or in response to a confirmed release under rule 567—135.7(455B).

b. Delivery prohibition eligibility criteria. A delivery prohibition response action may be initiated upon a finding that the UST system is out of compliance with department rules and meets the eligibility criteria as specified below. Reinstatement criteria define the standards and process for owners and operators to document that they have taken corrective action sufficient to authorize resumption of fuel to the USTs. Prior to initiation of the delivery prohibition, owners and operators are afforded a minimum level of procedural due process such as prior notice and the opportunity to present facts to dispute the finding. Where notice and the opportunity to take corrective action prior to initiation of a delivery prohibition response action are required, notice by the department or by a certified compliance inspector as provided in rule 567—135.20(455B) shall be sufficient.

If the department finds that any one of the following criteria has been satisfied, the department may initiate a delivery prohibition response action following the notice procedures outlined in paragraph *"e"* of this subrule. After initiation of the delivery prohibition response action, the department will offer the owner or operator an opportunity to establish reinstatement criteria by written documentation and, if requested, an in-person meeting.

(1) An approved release detection method for USTs or UST piping is not installed, such as automatic tank gauging, groundwater monitoring wells and line leak detectors, and there is no record that an approved method such as inventory control, statistical inventory reconciliation, or interstitial space monitoring has been employed during the previous three months. If the owner or operator claims to have documentation that an approved release detection method has been conducted, the owner or operator will be given two business days to produce the documentation.

REINSTATEMENT CRITERIA: The owner or operator must submit results of a passing UST system precision tightness test at the 0.1 gallon-per-hour leak rate in paragraphs 135.5(4)*"c"* and 135.5(5)*"b."* The owner or operator must also document installation and operation of an approved release detection system. This may include proof that a contract has been signed with a qualified statistical inventory reconciliation provider or that a qualified inventory control method has been implemented and training has been provided to onsite supervisory personnel.

(2) No documentation of a required annual line tightness test or line leak detector test has been provided, and the owner or operator has failed to conduct the required testing within 14 days of written notice by the department or a certified compliance inspector as provided in rule 567—135.20(455B).

REINSTATEMENT CRITERIA: The owner or operator must provide documentation of a passing line precision tightness test at the 0.1 gallon-per-hour leak rate in paragraph 135.5(5)*"b"* and a line leak detector test as provided in paragraph 135.5(5)*"a."*

(3) Overfill and spill protection is not installed.

REINSTATEMENT CRITERION: The owner or operator must provide documentation that overfill and spill protection equipment has been installed.

(4) A corrosion protection system is not installed or there is no record that an impressed current corrosion protection system has been in operation for the prior six months.

REINSTATEMENT CRITERIA: A manned entry tank integrity inspection must be completed prior to installation of a corrosion protection system, and the owner or operator must submit results of a passing UST system precision tightness test at the 0.1 gallon-per-hour leak rate in paragraphs 135.5(4)*"c"* and 135.5(5)*"b."* A corrosion protection analysis must be completed and approved by the department.

(5) The owner or operator has failed to provide proof of financial responsibility in accordance with 567—Chapter 136.

REINSTATEMENT CRITERION: The owner or operator must submit acceptable proof of financial responsibility in accordance with 567—Chapter 136.

(6) A qualified UST system release detection method is installed and is being used but the documentation or the absence of documentation is sufficient to question the reliability of the release detection over the past 12-month period. The owner or operator shall be notified of the deficiencies, shall be given at least two business days to produce documentation of compliance and, if necessary, shall be required to conduct a leak detection system analysis and a system tightness test within 14 days. If the owner or operator fails to produce documentation of compliance or to conduct the system analysis and the UST system precision tightness test at the 0.1 gallon-per-hour leak rate in paragraphs 135.5(4)*"c"* and 135.5(5)*"b,"* the department may initiate a delivery prohibition response action. Notice by the department or a compliance inspector as provided in rule 567—135.20(455B) shall be sufficient to initiate a delivery prohibition response action.

REINSTATEMENT CRITERIA: The owner or operator must submit documentation that the leak detection method analysis sufficiently documents compliance and explains the reasons for the accuracy and reliability concerns. If necessary, the owner or operator must submit passing results of a UST system precision tightness test at the 0.1 gallon-per-hour leak rate in paragraphs 135.5(4)*"c"* and 135.5(5)*"b."*

(7) The owner or operator has failed to document completion of a three-year corrosion protection test or to repair defective corrosion protection equipment within 30 days after notice of the violation by the department or a certified compliance inspector as provided in rule 567—135.20(455B).

REINSTATEMENT CRITERION: The owner or operator must submit documentation of a three-year corrosion protection test as provided in rule 567—135.3(455B).

(8) The owner or operator has failed to complete a compliance inspection required by rule 567—135.20(455B) within 60 days after written notice of the violation by the department.

REINSTATEMENT CRITERION: The owner or operator must submit a compliance inspection report as provided in rule 567—135.20(455B).

(9) The owner or operator has failed to take necessary abatement action in response to a confirmed release as provided in subrules 135.7(2) and 135.7(3).

REINSTATEMENT CRITERION: The owner or operator must document compliance with the abatement provisions in subrules 135.7(2) and 135.7(3).

(10) The owner or operator has failed to undertake and document release investigation and confirmation steps within seven days in response to a suspected release as provided in paragraph 135.6(3)*"a."*

REINSTATEMENT CRITERION: The owner or operator must document release confirmation and system check as provided in paragraph 135.6(3)*"a."*

(11) The owner or operator has failed to provide documentation of Class A or B operator training.

REINSTATEMENT CRITERION: The owner or operator must submit a copy of the certificates of training for Class A and B operators.

(12) The owner or operator has failed to install required secondary containment.

REINSTATEMENT CRITERION: The owner or operator must document secondary containment has been installed as provided in subrule 135.3(9).

(13) The owner or operator has failed to pay the annual tank management fee.

REINSTATEMENT CRITERION: The owner or operator must pay the current and any previous unpaid tank management fees in addition to any late fees as provided in paragraph 135.3(5)*"b."*

(14) When tanks are no longer in use or in temporary closure.

REINSTATEMENT CRITERION: The owner or operator must provide a completed Return to Service form along with required documents.

c. Provisional status. The department may classify a UST system as operating under a provisional status when the department documents a pattern of UST operation and maintenance violations under rules 567—135.3(455B) through 567—135.5(455B) and suspected release and confirmed release response actions under rules 567—135.6(455B) and 567—135.7(455B). The department shall provide the owner or operator with a notice specifying the basis for the proposed classification and a proposed remedial action plan. The objective of the remedial action plan is to provide the owner and operator an opportunity to undertake certain remedial actions sufficient to establish a reasonable likelihood that future regulatory compliance will be achieved.

The remedial action plan may include but is not limited to provisions for owner/operator training, development of a facility-specific compliance manual, more frequent third-party compliance inspections than otherwise required under rule 567—135.20(455B), monthly reporting, and retention of a third-party compliance manager/consultant. If the owner or operator and the department cannot reach agreement on a remedial action plan, the department may initiate enforcement action by issuance of an administrative order pursuant to 567—Chapter 10. This provision does not grant the owner or operator an entitlement to this procedure, and the department reserves all discretion to undertake an enforcement action and assess penalties as provided in Iowa Code sections 455B.476 and 455B.477.

d. Administrative orders. The department may impose a delivery prohibition as a remedy for violations of the operation and maintenance provisions in rules 567—135.3(455B) through 567—135.5(455B) and the suspected and confirmed release response actions in rules 567—135.6(455B) and 567—135.7(455B). This remedy may be in addition to the assessment of penalties as provided in Iowa Code section 455B.476 and other appropriate injunctive relief necessary to correct violations.

e. Due process prior to initiation of a delivery prohibition response action.

(1) Prior to imposing a delivery prohibition response action under paragraph 135.3(8)*"b"* above, the department will provide notice to the owner or operator or, if notice to the owner or operator cannot be confirmed, to a person in charge at the UST facility of the basis for the finding and the intent to initiate a delivery prohibition response action. Notice may be by verbal contact, by facsimile, or by regular or certified mail to the UST facility address or the owner's or operator's last-known address. The owner and operator will be given a minimum of one business day to provide documentation that the finding is inaccurate or that reinstatement criteria in subparagraphs 135.3(8)*"b"*(1) through (5) have been satisfied. Additional days and the opportunity for a telephone or in-person conference may be provided the owner and operator to contest the factual basis for a finding under subparagraphs 135.3(8)*"b"*(6) through (14). Additional procedural due process may be afforded the owner and operator on a case-by-case basis sufficient to satisfy Constitutional due process standards.

If insufficient information is submitted to change the finding, the department will notify the owner or operator and a person in charge at the UST facility of the final decision to impose the delivery prohibition response action.

(2) Provisional status. Upon a finding that an owner or operator under provisional status has failed to comply with the terms of a remedial action plan as provided above, the department may initiate a delivery prohibition response action by giving actual notice to the owner or operator of the basis for the finding of noncompliance and the department's intent to initiate a delivery prohibition response action. The delivery prohibition response action shall not be imposed without providing the owner or operator the opportunity for an evidentiary hearing consistent with the provisions for suspension and revocation of licenses under 567—Chapter 7.

f. *Delivery prohibition procedure.* Upon oral or written notice that the delivery prohibition response action has been imposed, the owner or operator and any person in charge of the UST facility shall be notified that they are not authorized to receive any further delivery of regulated substances until conditions for reinstatement of eligibility are satisfied. Owners and operators are required to provide the department with names and contact information for all persons who convey or deposit regulated substances to the USTs. The department will attempt to notify known persons who convey or deposit regulated substances to the USTs that they are not authorized to deliver to the USTs until further notice by the department as provided in paragraph 135.3(3)*"j"* and subrule 135.3(5).

The department shall visit the site and affix a "red tag" to the fill pipes or fill pipe caps of all affected USTs. It is unlawful for any person to deposit or accept a regulated substance into a UST that has a "red tag" affixed to the fill pipe or fill pipe cap. The department may allow the owner and operator to dispense and sell the remainder of existing fuel unless the department determines there is an immediate risk of a release or other risk to human health, safety or the environment. The department shall confirm in writing the basis for the delivery prohibition response action, contacts made prior to the action, and steps the owner or operator must take to reinstate fuel delivery.

135.3(9) *Secondary containment requirements for UST system installations.* All new and replacement underground storage tank systems and appurtenances used for the storage and dispensing of petroleum products shall have secondary containment in accordance with this subrule. The secondary containment provision includes the installation of containment sumps.

a. Tanks and piping installed or replaced after November 28, 2007, must have secondary containment that is designed, installed, and maintained according to the performance standards in subrule 135.3(1) and paragraph 135.5(3)*"b."*

(1) The secondary containment may be manufactured as an integral part of the primary containment or constructed as a separate containment system.

(2) At a minimum, the secondary containment must:

1. Contain regulated substances leaked from the UST system until detected and removed.

2. Prevent the release of regulated substances into the environment at any time during the operational life of the underground storage tank system.

3. Be checked for evidence of a release from the tank at least every 30 days as provided in paragraph 135.5(2)*"a."*

b. Testing and inspection. Containment sumps shall be liquid-tight and must be inspected and tested in accordance with the following:

(1) Inspections for secondary containment sumps (spill catchment basins, turbine sumps, transition or intermediate sumps, and under-dispenser containment).

1. Inspections for secondary containment sumps shall consist of visual inspection by an Iowa-licensed installer or Iowa-certified compliance inspector every two years.

2. Containment sumps must be intact (no cracks or perforations) and liquid-tight, including sides and bottom.

3. Containment sumps must be maintained and kept free of debris, liquid, and ice at all times.

4. Regulated substances leaked or spilled into any containment sumps shall be immediately removed.

(2) Secondary containment sumps used for interstitial monitoring of piping shall be tested upon installation and periodically in accordance with subrule 135.4(12).

[**ARC 5625C**, IAB 5/19/21, effective 6/23/21]

567—135.4(455B) General operating requirements.

135.4(1) *Spill and overfill control.*

a. Owners and operators must ensure that releases due to spilling or overfilling do not occur. The owner and operator must ensure that the volume available in the tank is greater than the volume of product to be transferred to the tank before the transfer is made and that the transfer operation is monitored constantly to prevent overfilling and spilling.

NOTE: The transfer procedures described in National Fire Protection Association Standard 385, "Standard for Tank Vehicles for Flammable and Combustible Liquids," or American Petroleum Institute Recommended Practice 1007, "Loading and Unloading of MC 306/DOT 406 Cargo Tank Motor Vehicles," may be used to comply with paragraph 135.4(1)*"a."* Further guidance on spill and overfill prevention appears in American Petroleum Institute, "Recommended Practice 1621 for Bulk Liquid Stock Control at Retail Outlets."

b. The owner and operator must report, investigate, and clean up any spills and overfills in accordance with 135.6(4).

135.4(2) *Operation and maintenance of corrosion protection.* All owners and operators of metal UST systems with corrosion protection must comply with the following requirements to ensure that releases due to corrosion are prevented until the UST system is permanently closed or undergoes a change in service in accordance with subrule 135.15(2):

a. All corrosion protection systems must be operated and maintained to continuously provide corrosion protection to the metal components of that portion of the tank and piping that routinely contain regulated substances and are in contact with the ground.

b. All UST systems equipped with cathodic protection systems must be inspected for proper operation by a qualified cathodic protection tester in accordance with the following requirements:

(1) *Frequency.* All cathodic protection systems must be tested within six months of installation and at least every three years thereafter or according to another reasonable time frame established by the department; and

(2) *Inspection criteria.* The criteria that are used to determine that cathodic protection is adequate as required by this subrule must be in accordance with a code of practice developed by a nationally recognized association.

NOTE: The following codes of practice may be used to comply with subparagraph 135.4(2)*"b"*(2).

- NACE International Test Method TM 0101, "Measurement Techniques Related to Criteria for Cathodic Protection of Underground Storage Tank Systems";
- NACE International Test Method TM0497, "Measurement Techniques Related to Criteria for Cathodic Protection on Underground or Submerged Metallic Piping Systems";
- Steel Tank Institute Recommended Practice R051, "Cathodic Protection Testing Procedures for STI-P3® USTs";
- NACE International Standard Practice SP 0285, "External Control of Underground Storage Tank Systems by Cathodic Protection"; or
- NACE International Standard Practice SP 0169, "Control of External Corrosion on Underground or Submerged Metallic Piping Systems."

c. UST systems with impressed current cathodic protection systems must also be inspected every 60 days to ensure the equipment is running properly.

d. For UST systems using cathodic protection, records of the operation of the cathodic protection must be maintained (in accordance with 135.4(5)) to demonstrate compliance with the performance standards in this subrule. These records must provide the following:

(1) The results of the last three inspections required in paragraph *"c"*; and

(2) The results of testing from the last two inspections required in paragraph *"b."*

e. When an impressed current cathodic protection system is failing cathodic protection for the time periods given below, owners and operators must take the following actions:

(1) For impressed current cathodic protection systems that have been inoperative for 0 to 90 days after failing a corrosion protection test or after discovering the system is not operating, all of the following must be completed:

1. Power must be restored to an inoperative corrosion protection system. A damaged or failed corrosion protection system must be repaired by a cathodic protection tester. A corrosion expert must approve any modifications to the system that are outside of the original design.
2. The corrosion protection system must be retested within six months of repair.
3. A copy of the test and any repairs must be kept as part of the cathodic protection records.
4. A copy of the new design standards must be kept as part of the cathodic protection records.

(2) For impressed current corrosion protection systems that have been inoperative for 90 to 365 days or repaired 90 to 365 days after failing a corrosion protection test, all of the following must be completed:

1. Notify the department.
2. Power must be restored to an inoperative corrosion protection system.
3. The corrosion protection system must be repaired, tested and returned to service under the supervision of a corrosion expert.
4. A precision tightness test must be conducted on the entire UST system.
5. The corrosion protection system must be retested within six months of the repair or power being restored.
6. A copy of the test and any repairs must be kept as part of the cathodic protection records.
7. A copy of the new design standards must be kept as part of the cathodic protection records.
8. If determined the tank is not suitable for corrosion protection, the tank must be permanently closed in accordance with subrule 135.15(2).

(3) If the impressed current corrosion protection system has been inoperative for more than 365 days or was not repaired for more than 365 days after failing a corrosion protection test, all of the following must be completed:

1. Notify the department.
2. Immediately empty and stop using the tank system.
3. An internal inspection of the steel tank must be conducted according to a national standard (e.g., API 1631). If the UST fails the internal inspection, the UST owner must permanently close the tank in accordance with subrule 135.15(2).
4. All metal piping and buried metal components (e.g., flex connectors, couplings) that routinely contain product must be inspected by a UST professional or cathodic protection tester. If the metallic components have no visible corrosion and have passed a line tightness test (unless the piping is exempt from leak detection, e.g., Safe or European Suction) then the cathodic protection system may be repaired or replaced under the supervision of a corrosion expert. Metallic components that show visible corrosion must be replaced.
5. A precision test must be conducted on the entire UST system following repair or replacement of the cathodic protection system.
6. The corrosion protection system must be retested within six months of repair.
7. A copy of the tests and any repairs must be kept as part of the cathodic protection records.
8. A copy of the new design standards must be kept as part of the cathodic protection records.

(4) If the impressed current cathodic protection system has been inoperable for more than 365 days and cannot or will not be brought back into immediate use, the tank system must be permanently closed in accordance with rule 567—135.15(2).

135.4(3) *Compatibility.* Owners and operators must use a UST system made of or lined with materials that are compatible with the substance stored in the UST system.

a. Owners and operators must notify the department at least 30 days prior to switching to a regulated substance containing greater than 10 percent ethanol, greater than 20 percent biodiesel, or any other regulated substance identified by the department.

b. Owners and operators must have a UST installer licensed under 567—Chapter 134, Part C, submit the department's checklist for equipment compatibility for the UST system to the department.

NOTE: Owners and operators storing alcohol blends may use the following codes to comply with the requirements of subrule 135.4(3): American Petroleum Institute Recommended Practice 1626, "Storing and Handling Ethanol and Gasoline-Ethanol Blends at Distribution Terminals and Service Stations Filling Stations."

135.4(4) *Repairs and replacement.* Owners and operators of UST systems must ensure that repairs will prevent releases due to structural failure or corrosion as long as the UST system is used to store regulated substances. The repairs must meet the following requirements:

a. Repairs to UST systems must be properly conducted in accordance with a code of practice developed by a nationally recognized association or an independent testing laboratory.

NOTE: The following codes and standards may be used to comply with paragraph 135.4(4)*"a"*:

- National Fire Protection Association Standard 30, "Flammable and Combustible Liquids Code";
- International Fire Code;
- American Petroleum Institute Recommended Practice 2200, "Repairing Crude Oil, Liquefied Petroleum Gas, and Product Pipelines";
- American Petroleum Institute Recommended Practice 1631, "Interior Lining and Periodic Inspection of Underground Storage Tanks";
- National Fire Protection Association Standard 326, "Standard for the Safeguarding of Tanks and Containers for Entry, Cleaning, or Repair";
- National Leak Prevention Association Standard 631, Chapter A, "Entry, Cleaning, Interior Inspection, Repair, and Lining of Underground Storage Tanks";
- Steel Tank Institute Recommended Practice R972, "Recommended Practice for the Addition of Supplemental Anodes to STI-P3® Tanks";
- NACE International Standard Practice SP 0285, "External Control of Underground Storage Tank Systems by Cathodic Protection"; or
- Fiberglass Tank and Pipe Institute Recommended Practice T-95-02, "Remanufacturing of Fiberglass Reinforced Plastic (FRP) Underground Storage Tanks."

b. Repairs to fiberglass-reinforced plastic tanks may be made by the manufacturer's authorized representatives or in accordance with a code of practice developed by a nationally recognized association or an independent testing laboratory.

c. Piping and fittings.

(1) Metal pipe sections and fittings that have released product as a result of corrosion or other damage must be replaced. Noncorrodible pipes and fittings may be repaired in accordance with the manufacturer's specifications.

(2) Any replacement of ten feet or more of piping shall have secondary containment.

(3) If 50 percent or more of any piping run is removed, the entire piping run must be removed and replaced with secondarily contained piping and interstitial monitoring.

(4) All piping replacements requiring secondary containment shall be constructed with transition or intermediate containment sumps.

d. Repairs to secondary containment areas of tanks and piping used for interstitial monitoring and to containment sumps used for interstitial monitoring of piping must have the secondary containment tested for tightness according to the manufacturer's instructions, a code of practice developed by a nationally recognized association or independent testing laboratory, or according to requirements established by the department within 30 days following the date of completion of the repair. All other repairs to tanks and piping must be tightness tested in accordance with paragraphs 135.5(4)*"c"* and 135.5(5)*"b"* within 30 days following the date of the completion of the repair except as provided in subparagraphs (1) to (3) below:

(1) The repaired tank is internally inspected in accordance with a code of practice developed by a nationally recognized association or an independent testing laboratory; or

(2) The repaired portion of the UST system is monitored monthly for releases in accordance with a method specified in paragraphs 135.5(4)*"d"* through *"i"*; or

(3) Another test method is used that is determined by the department to be no less protective of human health and the environment than those listed above.

NOTE regarding paragraph 135.4(4)*"d"*: The following codes of practice may be used to comply with paragraph 135.4(4)*"d"*:

- Steel Tank Institute Recommended Practice R012, "Recommended Practice for Interstitial Tightness Testing of Existing Underground Double Wall Steel Tanks"; or
- Fiberglass Tank and Pipe Institute Protocol, "Field Test Protocol for Testing the Annular Space of Installed Underground Fiberglass Double and Triple-Wall Tanks with Dry Annular Space."

- Petroleum Equipment Institute Publication RP1200, "Recommended Practices for the Testing and Verification of Spill, Overfill, Leak Detection and Secondary Containment Equipment at UST Facilities."

e. Within six months following the repair of any cathodically protected UST system, the cathodic protection system must be tested in accordance with paragraphs 135.4(2)*"b"* and *"c"* to ensure that it is operating properly.

f. Within 30 days following any repair to spill or overfill prevention equipment, the repaired spill or overfill prevention equipment must be tested or inspected, as appropriate, in accordance with subrule 135.4(1) to ensure it is operating properly.

g. Installation of any new or replacement turbine pumps involving the direct connection to the tank shall have secondary containment.

h. UST system owners and operators must maintain records of each repair until the UST system is permanently closed or undergoes a change-in-service pursuant to subrule 135.15(2).

i. Repairs or replacements to a UST system must be conducted by an Iowa-licensed UST professional whose license is issued for that specific work.

135.4(5) *Reporting and record keeping.* Owners and operators of UST systems must cooperate fully with inspections, monitoring and testing conducted by the department, as well as requests for document submission, testing, and monitoring by the owner or operator pursuant to Section 9005 of Subtitle I of the Solid Waste Disposal Act, as amended.

a. *Reporting.* Owners and operators must submit the following information to the department:

(1) Notification for all UST systems (135.3(3)), which includes certification of installation for new UST systems (135.3(1)*"e"*);

(2) Notification of equipment replacement or addition of new equipment;

(3) Reports of all releases including suspected releases (135.6(1)), spills and overfills (135.6(4)), and confirmed releases (135.7(2));

(4) Corrective actions planned or taken including initial abatement measures (135.7(3)), initial site characterization (567—135.9(455B)), free product removal (135.7(5)), investigation of soil and groundwater cleanup and corrective action plan (567—135.8(455B) to 567—135.12(455B));

(5) A notification before permanent closure or change-in-service (135.15(2));

(6) Notification of any change in ownership;

(7) Notification of any change in Class A or Class B operators;

(8) Notification of any loss of financial responsibility (i.e., insurance);

(9) Notification prior to UST systems switching to certain regulated substances.

b. *Record keeping.* Owners and operators must maintain the following information:

(1) A corrosion expert's analysis of site corrosion potential if corrosion protection equipment is not used (135.3(1)*"a"*(4); 135.3(1)*"b"*(3)).

(2) Documentation of operation of corrosion protection equipment (135.4(2));

(3) Documentation of UST system repairs (135.4(4)*"h"*);

(4) Documentation of compliance with release detection requirements (135.5(6));

(5) Results of the site investigation conducted at permanent closure (135.15(3));

(6) Cathodic protection system testing results (135.4(2));

(7) Class A, B and C operator training certificates (135.4(6));

(8) Secondary containment test results (135.3(9));

(9) Documentation of periodic walkthrough inspections (135.4(13));

(10) Documentation of compatibility for UST systems (135.4(3));

(11) Documentation of compliance for spill and overfill prevention equipment and containment sumps used for interstitial monitoring of piping (135.4(12)).

c. *Availability and maintenance of records.* Owners and operators must keep the records required either:

(1) At the UST site and immediately available for inspection by the department; or

(2) At a readily available alternative site and be provided for inspection to the department within two business days of department request.

NOTE: In the case of permanent closure records required under subrule 135.15(5), owners and operators are also provided with the additional alternative of mailing closure records to the department if they cannot be kept at the site or an alternative site as indicated above.

135.4(6) *Training required for UST operators.*

a. An owner or operator shall designate Class A, Class B, and Class C operators for each underground storage tank system or facility that has underground storage tanks regulated by the department, except for unstaffed facilities, which may designate only Class A and Class B operators.

b. A facility may not operate unless operators have been designated and trained as required in this rule, or unless otherwise agreed upon by the department based on a finding of good cause for failure to meet this requirement and a plan for designation and training at the earliest practicable date.

c. Trained operators must be readily available to respond to suspected or confirmed releases, equipment shut-offs or failures, and other unusual operating conditions.

d. A Class A or Class B operator should be immediately available for telephone consultation with the Class C operator when a facility is in operation. Class A or Class B operators should be able to be on site at the storage tank facility within four hours.

e. For staffed facilities, a Class C operator must be on site whenever the UST facility is in operation.

f. For unstaffed facilities, a Class B operator must be geographically located such that the person can be on site within two hours of being contacted by the public, the owner or operator of the facility, or the department. Emergency contact information and emergency procedures must be prominently displayed at the site. An unstaffed facility shall have an emergency shutoff device as provided in 135.5(1) and a sign posted in a conspicuous place that includes the name and telephone number of the facility owner, an emergency response telephone number to contact the Class B operator, and information on local emergency responders.

g. Designated operators must successfully complete required training under subrule 135.4(9).

h. A person may be designated for more than one class of operator.

i. When a facility is found to be out of compliance, the department may require that the designated UST system Class A, B, or C operator be retrained under a plan approved by the department. The retraining must occur within 30 days from departmental notice for Class A and Class B operators and within 15 days for Class C operators.

135.4(7) *UST operator responsibilities.*

a. *Class A operator.*

(1) Class A operators have the primary responsibility to operate, maintain, and have knowledge of the regulatory requirements for the underground storage tank system and facility. The Class A operator's responsibilities include managing resources and personnel to achieve and maintain compliance with regulatory requirements under this chapter in the following ways:

1. Class A operators assist the owner by ensuring that underground storage tank systems are properly installed and expeditiously repaired and inspected; financial responsibility is maintained; and records of system installation, modification, inspection and repair are retained and made available to the department and certified compliance inspectors. The Class A operator shall properly respond to and report emergencies caused by releases or spills from UST systems, ensure that the annual tank management fees are paid, and ensure that Class B and Class C operators are properly trained.

2. Class A operators shall be familiar with training requirements for each class of operator and may provide required training for Class C operators.

3. Class A operators shall provide site drawings that indicate equipment locations for Class B and Class C operators.

(2) Department-licensed installers, installation inspectors, and department-certified compliance inspectors may perform Class A operator duties when employed or contracted by the tank owner to perform these functions so long as they are properly trained and designated as Class A operators pursuant to subrules 135.4(9) through 135.4(11). Class A operators who are also certified compliance inspectors under 567—Chapter 134, Part B, may perform in-house facility inspections of the UST system, but shall not perform department-mandated compliance inspections pursuant to rule 567—135.20(455B).

Compliance inspections of a UST facility required by rule 567—135.20(455B) must be completed by a third-party compliance inspector certified under 567—Chapter 134, Part B.

(3) When there is a change in ownership or operator status, the new owner or operator is responsible for designating a Class A operator prior to bringing the UST system into operation. The Class A operator is responsible for ensuring that all necessary documentation for change of ownership is completed and submitted to the department and that all compliance requirements of this chapter are satisfied prior to bringing the UST system into operation. The compliance requirements may be provided to the owner or operator using the department's checklist.

If the UST system was temporarily closed, the designated Class A operator must ensure the department's checklist for returning a UST into service is followed, all compliance requirements of this chapter have been met, and the necessary documentation is submitted to the department.

(4) When there is a change in UST ownership, property ownership or operator status, the designated Class A operator for the current owner and operator is responsible for notifying the department when the change is final and, if possible, prior to the new owner or operator taking possession of the site.

b. Class B operator.

(1) A Class B operator is knowledgeable of the applicable underground storage tank regulatory requirements and standards and implements them in the field or at the tank facility. A Class B operator oversees and implements the day-to-day aspects of operation, maintenance, and record keeping for the underground storage tanks at facilities within four hours of travel time from the Class B operator's principal place of business. A Class B operator's responsibilities include, but are not limited to:

1. Performing mandated system tests at required intervals and making sure spill prevention, overfill control equipment, and corrosion protection equipment are properly functioning.

2. Assisting the owner by ensuring that release detection equipment is operational, release detection monitoring and tests are performed at the proper intervals, and release detection records are retained and made available to the department and compliance inspectors.

3. Making sure record-keeping and reporting requirements are met and that relevant equipment manufacturers' or third-party performance standards are available and followed.

4. Properly responding to, investigating, and reporting emergencies caused by releases or spills from USTs.

5. Performing UST release detection in accordance with rule 567—135.5(455B).

6. Monitoring the status of UST release detection.

7. Meeting spill prevention, overfill prevention, and corrosion protection requirements.

8. Reporting suspected and confirmed releases and taking release prevention and response actions according to the requirements of rule 567—135.6(455B).

9. Training and documenting Class C operators to make sure at least one Class C operator is on site during operating hours. Class B operators shall be familiar with Class C operator responsibilities and may provide training for Class C operators.

(2) Department-licensed installers, installation inspectors, and department-certified compliance inspectors may perform Class B operator duties when employed or contracted by the tank owner to perform these functions so long as they are properly trained and designated as Class B operators under subrules 135.4(9) through 135.4(11). Class B operators who are also certified compliance inspectors under 567—Chapter 134, Part B, may perform in-house facility inspections of the UST system, but cannot perform department-mandated compliance inspections pursuant to rule 567—135.20(455B). Compliance inspections of a UST facility pursuant to rule 567—135.20(455B) must be completed by a third-party compliance inspector certified under 567—Chapter 134, Part B.

(3) The owner or operator of a site undergoing a change in ownership shall designate a Class B operator prior to bringing the UST system into operation. The Class B operator must conduct an inspection using the department's inspection checklist and submit the completed checklist along with the change of ownership form prior to operation. If a UST system was temporarily closed, the Class B operator shall ensure that the department's checklist for returning a UST to service is followed and that the necessary documentation is submitted to the department prior to operation of the UST system.

c. Class C operator. A Class C operator is an on-site employee who typically controls or monitors the dispensing or sale of regulated substances and is the first to respond to events indicating emergency conditions. A Class C operator must be present at the facility at all times during normal operating hours. A Class C operator monitors product transfer operations to ensure that spills and overfills do not occur. The Class C operator must know how to properly respond to spills, overfills and alarms when they do occur. In the event of a spill, overfill or alarm, a Class C operator shall notify the Class A and Class B operators, as well as the department and appropriate local emergency authorities as required by rule.

(1) Written basic operating instructions, emergency contact names and telephone numbers, and basic procedures specific to the facility shall be provided to all Class C operators and readily available on site.

(2) There may be more than one Class C operator at a storage tank facility, but not all employees of a facility need be Class C operators.

135.4(8) *UST operator training course requirements.* Individuals must attend a department-approved training course covering material designated for each operator class. Individuals must attend every session of the training, take the examination, and attend examination review.

a. Class A operators. To be certified as a Class A operator, the applicant must successfully complete a department-approved training course that covers underground storage tank system requirements as outlined in 567—Chapters 134 to 136. The course must also provide a general overview of the department's UST program, purpose, groundwater protection goals, public safety and administrative requirements. The training must include, but is not limited to, the following:

(1) Components and materials of underground storage tank systems.

(2) A general discussion of the content of PEI/RP900-08, Recommended Practices for the Inspection and Maintenance of UST Systems, and PEI/RP500, Recommended Practices for Inspection and Maintenance of Motor Fuel Dispensing Equipment.

(3) Spill and overfill prevention, to include the American Petroleum Institute (API) Publication RP1621, "Recommended Practice for Bulk Liquid Stock Control at Retail Outlets," and National Fire Protection Association Standard 30, "Flammable and Combustible Liquids Code."

(4) Ensuring product delivery to the correct tank by using color-symbol codes in the API Standard RP1637, "Using the API Color-Symbol System to Mark Equipment and Vehicles for Product Identification at Service Stations and Distribution Terminals."

(5) Proper fuel ordering and delivery, including procedures in API RP1007, "Loading and Unloading of MC/DOT 406 Cargo Tank Motor Vehicles."

(6) Release detection methods and related reporting requirements.

(7) Corrosion protection and inspection requirements, including the requirement to have a department-licensed cathodic protection tester.

(8) Discussion of the benefits of monthly or frequent inspections and content and use of inspection checklists. Training materials for operators shall include the department's "Iowa UST Operator Inspection Checklist" or a checklist template similar to the department's document.

(9) Requirement and content of third-party compliance inspections.

(10) How to properly respond to an emergency, including hazardous conditions.

(11) Product and equipment compatibility, including the department's ethanol compatibility guidance and certification.

(12) Financial responsibility, including detailed explanation of liability, notice and claim procedures, and the six-month window to check for and report a release prior to insurance termination to maintain coverage for corrective action.

(13) Notification of installation and storage tank registration requirements.

(14) Requirement to use department-licensed companies and individuals for UST installation, testing, lining, and removal.

(15) Temporary and permanent closure procedures and requirements.

(16) NESHAP vapor recovery requirements.

(17) Conditions under which the department may stop fuel delivery and take enforcement action.

(18) Ensuring that annual tank management fees are paid.

(19) Ensuring that suspected and confirmed releases are investigated and reported according to subrule 135.6(1).

b. Class B operators. To be certified as a Class B operator, the individual must successfully complete a department-approved training course that provides in-depth understanding of UST system regulations applicable to this class. Training must also provide a general overview of the department's UST program, purpose, groundwater protection goals, public safety and administrative requirements. Training shall cover the operation and maintenance requirements set forth in this chapter, including, but not limited to, the following:

(1) A general discussion of the content of PEI/RP900-08, Recommended Practices for the Inspection and Maintenance of UST Systems, and PEI/RP500, Recommended Practices for Inspection and Maintenance of Motor Fuel Dispensing Equipment.

(2) Components and materials of underground storage tank systems.

(3) Spill and overfill prevention.

(4) Ensuring product delivery to the correct tank by using color-symbol codes in the API Standard RP1637.

(5) Proper fuel ordering and delivery, including procedures from API RP1007.

(6) Methods of release detection and related reporting requirements.

(7) Corrosion protection and related testing.

(8) Requirements of 30-day and annual walkthrough inspections. Training materials for operators shall include the department's "Iowa UST Operator Inspection Checklist" or a checklist template similar to the department's document.

(9) Requirement and content of third-party compliance inspections.

(10) Emergency response, reporting and investigating releases.

(11) Product and equipment compatibility, including the department's ethanol compatibility guidance and certification.

(12) Financial responsibility, including detailed explanation of liability, notice and claim procedures, and the six-month window to check for and report a release prior to insurance termination to maintain coverage for corrective action.

(13) Notification of installation and storage tank registration requirements.

(14) Requirement to use department-licensed companies and individuals for UST installation, testing, lining, and removal.

(15) Reporting and record-keeping requirements.

(16) Overview of Class C operator training requirements.

(17) NESHAP vapor recovery requirements.

(18) Conditions under which the department may stop fuel delivery and take enforcement action.

(19) Requirements for facilities that operate unstaffed at any time.

c. Class C operators. To be certified as a Class C operator, an individual must complete a department-approved training course. A Class A or Class B operator who has completed a department-approved training course may provide the Class C training. Class C operator training must include at a minimum:

(1) A general overview of the department's UST program and purpose;

(2) Groundwater protection goals;

(3) Public safety;

(4) UST system overview;

(5) Administrative requirements; and

(6) Action to be taken in response to an emergency condition due to a spill or release from a UST system.

Training must include written procedures for the Class C operator, including notification instructions necessary in the event of emergency conditions. The written instructions and procedures must be readily available on site. A Class A or Class B operator may provide additional on-site Class C training specific to the operator's UST system.

135.4(9) *Examination and review requirement.* Class A and Class B operators must complete the department-approved training course and take an examination to verify their understanding and knowledge. The examination may include both written and practical (hands-on) testing activities. The trainer must follow up the examination with a review of missed test questions with the class or individual to ensure understanding of problem areas. Upon successful completion of the training course, the applicant will receive a certificate verifying the applicant's status as a Class A, Class B, or Class C operator.

a. *Reciprocity.* The department may waive the training course for operators upon a showing of successful completion of a training course and examination approved by another state or regulatory agency that the department determines are substantially equivalent to the UST requirements contained in this chapter.

b. *Transferability to another UST site.* Class A and Class B operators may transfer to other UST facilities in Iowa provided the operator is properly designated by the facility owner as a Class A or Class B operator according to 567—subrule 135.4(11). Class A and Class B operators transferring from other states shall seek prior approval of training qualifications, unless the department has preapproved the out-of-state program as substantially equivalent to the requirements of this chapter.

135.4(10) *Timing of UST operator training.*

a. An owner shall ensure that Class A, Class B, and Class C operators are trained by approved training providers before an operator assumes duties of that class of operator.

b. When a Class A or Class B operator is replaced, a new operator must be trained prior to assuming duties for that class of operator. A copy of the certificate of training must be submitted to the department within 30 days of assuming duties.

c. Class C operators must be trained before assuming the duties of a Class C operator. Written basic operating instructions, emergency contact names and telephone numbers, and basic procedures specific to the facility shall be provided to all Class C operators and readily available on site. A Class C operator may be briefed on these procedures concurrent with annual safety training required under Occupational Safety and Health Administration regulations, 29 CFR, Part 1910.

135.4(11) *Documentation of operator training.*

a. The owner of an underground storage tank facility shall maintain a list of designated operators. The list shall be made available to the department in accordance with subrule 135.4(5). The list shall represent the current Class A, Class B and Class C operators for the UST facility and must include:

(1) The name of each operator and the operator's class(es); contact information for Class A and Class B operators; the date each operator successfully completed initial training and refresher training, if any; the name of the company providing the training; and the name of the trainer.

(2) For all classes of operators, the site(s) for which an operator is responsible if more than one site.

b. A copy of the certificates of training for Class A and Class B operators shall be on file and readily available for inspection in accordance with subrule 135.4(5). Records verifying completion of training or retraining of Class A, Class B, and Class C operators must identify name of trainee, date trained, operator training class completed, and list the name of the trainer or examiner and the training company name, address, and telephone number. Owners and operators must maintain these records for as long as Class A, Class B, and Class C operators are designated.

c. A copy of the certificates of training for Class B and Class C operators shall be available at each facility for which the operator is responsible.

d. Class A and Class B operator contact information, including names and telephone numbers and any emergency information, shall be conspicuously posted at unstaffed facilities near the dispensers and the station building.

135.4(12) *Periodic testing of spill prevention equipment and containment sumps used for interstitial monitoring of piping and periodic inspection of overfill prevention equipment.*

a. Owners and operators of UST systems with spill and overfill prevention equipment and containment sumps used for interstitial monitoring of piping must meet these requirements to ensure the equipment is operating properly and will prevent releases to the environment:

(1) Spill prevention equipment (such as a catchment basin, spill bucket, or other spill containment device) and containment sumps used for interstitial monitoring of piping must prevent releases to the environment by meeting one of the following:

1. The equipment is double walled and the integrity of both walls is periodically monitored at a frequency of not less than the frequency of the walkthrough inspections described in subrule 135.4(13). If owners and operators discontinue periodic monitoring of this equipment, they must begin meeting paragraph 135.4(12)*"a"*(1)"2" and conduct a test within 30 days of discontinuing periodic monitoring of this equipment; or

2. The spill prevention equipment and containment sumps used for interstitial monitoring of piping are tested at least once every three years to ensure the equipment is liquid tight by using vacuum, pressure, or liquid testing in accordance with one of the following criteria:

- Requirements developed by the manufacturer (Note: Owners and operators may use this option only if the manufacturer has developed requirements); or
- A code of practice developed by a nationally recognized association or independent testing laboratory; or
- Requirements determined by the department to be no less protective of human health and the environment than the requirements listed in this subrule.

(2) Overfill prevention equipment must be inspected at least once every three years. At a minimum, the inspection must ensure that overfill prevention equipment is set to activate at the correct level specified in paragraph 135.3(1)*"c"* and will activate when regulated substance reaches that level. Inspections must be conducted in accordance with one of the following criteria:

1. Requirements developed by the manufacturer (Note: Owners and operators may use this option only if the manufacturer has developed requirements); or

2. A code of practice developed by a nationally recognized association or independent testing laboratory; or

3. Requirements determined by the department to be no less protective of human health and the environment than the requirements listed in this subrule.

b. Owners and operators must begin meeting these requirements as follows:

(1) For UST systems in use on or before June 23, 2021, the initial spill prevention equipment test and overfill prevention equipment inspection must be conducted not later than October 13, 2021.

(2) For UST systems brought into use after June 23, 2021, these requirements apply at installation.

c. Owners and operators must maintain records as follows for spill prevention equipment and overfill prevention equipment:

(1) All records of testing or inspection must be maintained for three years; and

(2) For spill prevention equipment and containment sumps used for interstitial monitoring of piping not tested every three years, documentation showing that the prevention equipment is double-walled and the integrity of both walls is periodically monitored must be maintained for as long as the equipment is periodically monitored.

NOTE: The following code of practice may be used to comply with this section: Petroleum Equipment Institute Publication RP1200, "Recommended Practices for the Testing and Verification of Spill, Overfill, Leak Detection and Secondary Containment Equipment at UST Facilities."

135.4(13) *Periodic operation and maintenance walkthrough inspections.* Conduct inspections to properly operate and maintain UST systems.

a. Conduct a walkthrough inspection every 30 days that, at a minimum, checks the following equipment as specified below (Exception: spill prevention equipment at UST systems receiving deliveries at intervals greater than every 30 days may be checked prior to each delivery):

(1) Spill prevention equipment: visually check for damage; remove liquid or debris; check for and remove obstructions in the fill pipe; check the fill cap to make sure it attaches securely on the fill pipe and gasket is in good condition; and, for double-walled spill prevention equipment with interstitial monitoring, check for a leak in the interstitial area, and

(2) Release detection equipment: check to make sure the release detection equipment is operating with no alarms or other unusual operating conditions present, and ensure records of release detection testing are reviewed and current.

b. Conduct a walkthrough inspection annually, at a minimum, checking the following equipment as specified below:

(1) Containment sumps: visually check for damage, leaks to the containment area, or releases to the environment; remove liquid (in contained sumps) or debris; and, for double-walled sumps with interstitial monitoring, check for a leak in the interstitial area, and

(2) Handheld release detection equipment: check devices such as tank gauge sticks or groundwater bailers for operability and serviceability;

c. Conduct operation and maintenance walkthrough inspections according to a standard code of practice developed by a nationally recognized association or independent testing laboratory that checks equipment comparable to paragraphs 135.4(13)*"a"* and *"b"*; or

NOTE regarding paragraph 135.4(13)*"c"*: the following code of practice may be used to comply with paragraph 135.4(13)*"c"*: Petroleum Equipment Institute Recommended Practice RP 900, "Recommended Practices for the Inspection and Maintenance of UST Systems."

d. Conduct operation and maintenance walkthrough inspections developed by the department that checks equipment comparable to paragraphs 135.4(13)*"a"* and *"b."*

e. Owners and operators must maintain records (in accordance with subrule 135.4(5)) of operation and maintenance walkthrough inspections for 12 consecutive months. Records must include a list of each area checked, whether each area checked was acceptable or needed action taken, a description of actions taken to correct an issue, and delivery records if spill prevention equipment is checked less frequently than every 30 days due to infrequent deliveries.

[**ARC 8124B**, IAB 9/9/09, effective 10/14/09; **ARC 5625C**, IAB 5/19/21, effective 6/23/21]

567—135.5(455B) Release detection.

135.5(1) *General requirements for all UST systems.*

a. Owners and operators of UST systems must provide a method, or combination of methods, of release detection that:

(1) Can detect a release from any portion of the tank and the connected underground piping that routinely contains product;

(2) Is installed and calibrated in accordance with the manufacturer's instructions, including routine maintenance and service checks for operability or running condition; and

(3) Beginning October 13, 2021, is operated and maintained, and electronic and mechanical components are tested for proper operation, in accordance with one of the following:

1. Manufacturer's instructions;

2. A code of practice developed by a nationally recognized association or independent testing laboratory; or

3. Requirements determined by the department to be no less protective of human health and the environment than the two options listed above.

(4) A test of the proper operation must be performed at least annually and, at a minimum, as applicable to the facility, cover the following components and criteria:

1. Automatic tank gauge and other controllers: test alarm; verify system configuration; test battery backup;

2. Probes and sensors: inspect for residual buildup; ensure floats move freely; ensure shaft is not damaged; ensure cables are free of kinks and breaks; test alarm operability or running condition and communication with controller;

3. Automatic line leak detector: test operation to meet criteria in paragraph 135.5(5)*"a"* by simulating a leak;

4. Vacuum pumps and pressure gauges: ensure proper communication with sensors and controller; and

5. Handheld electronic sampling equipment associated with groundwater and vapor monitoring: ensure proper operation.

NOTE regarding subparagraphs 135.5(1)*"a"*(3) and (4): The following code of practice may be used to comply with subparagraphs 135.5(1)*"a"*(3) and (4): Petroleum Equipment Institute Publication RP1200, "Recommended Practices for the Testing and Verification of Spill, Overfill, Leak Detection and Secondary Containment Equipment at UST Facilities."

(5) Meets the performance requirements in subrule 135.5(4) or 135.5(5), with any performance claims and their manner of determination described in writing by the equipment manufacturer or installer. In addition, methods conducted in accordance with paragraphs 135.5(4)*"b," "c,"* and *"d"* and paragraphs 135.5(5)*"a"* and *"b"* must be capable of detecting the leak rate or quantity specified for that method with a probability of detection of 0.95 and a probability of false alarm of 0.05.

b. When a release detection method operated in accordance with the performance standards in subrule 135.5(4) or 135.5(5) indicates a release may have occurred, owners and operators must notify the department in accordance with rule 567—135.6(455B).

c. When an owner and operator continually show the inability to conduct leak detection with the method being used, the department may require the owner and operator to find an alternative leak detection method. If the owner and operator cannot demonstrate compliance with leak detection, delivery prohibition in accordance with subrule 135.3(8) may be enforced.

d. Any UST system that cannot apply a method of release detection that complies with the requirements of this rule must complete the closure procedures in rule 567—135.15(455B). For previously deferred UST systems described in rules 567—135.1(455B) and 567—135.21(455B), this requirement applies after the effective dates described in subrule 135.1(3) and paragraph 135.21(1)*"a."*

e. Any UST facility that uses pressurized piping and dispenses product in the absence of a Class A, B, or C operator shall comply with the following requirements:

(1) Employ automatic line leak detectors that do one or more of the following:

1. Shut down the submersible pump when a leak is detected.
2. Restrict the flow of product when a leak is detected.
3. Trigger an audible or visual alarm when a leak is detected.

(2) At facilities implementing 135.5(1)*"e"*(1)"2" or "3," the facility's operator shall be notified or shall conduct a visit through one of the following methods:

1. Notification of the Class B operator by immediate electronic communication.
2. Signage directing the customer to contact the Class B operator or a designated contact person. The sign must be immediately visible to the customer and state that slow flow or an audible or visual alarm is an indication of a possible release. The sign must provide a 24-hour telephone number of the Class B operator or designee and direct the customer to stop dispensing product.
3. Daily visit to the site by a Class A, B, or C operator or designee. Visits shall include observation of every automatic line leak detector for shutdown, alarm, or restricted flow conditions. Methods of observing for restricted flow conditions may include dispensing product into a proper container or personal vehicle, observing a customer dispense product into a vehicle, or another method approved by the department. Owners and operators shall maintain an onsite log of site visits to demonstrate compliance with this provision. The log shall include the name of the observer and method used to observe the status of the automatic line leak detectors.

(3) All UST facilities subject to 135.5(1)*"e"* must comply with its provisions by July 1, 2014.

135.5(2) *Requirements for petroleum UST systems.* Owners and operators of petroleum UST systems must provide release detection for tanks and piping as follows:

a. Tanks. Tanks must be monitored at least every 30 days for releases using one of the methods listed in paragraphs 135.5(4)*"d"* to *"i"* except that:

(1) Tanks installed after November 28, 2007, must use interstitial monitoring of the secondary containment as the primary leak detection method in accordance with paragraph 135.5(4)*"g."*

(2) Tanks installed on or before November 28, 2007, with capacity of 550 gallons or less and tanks with a capacity of 551 to 1,000 gallons that meet the tank diameter criteria in paragraph 135.5(4)*"b"* may use manual tank gauging (conducted in accordance with paragraph 135.5(4)*"b"*).

b. *Piping.* Underground piping that routinely contains regulated substances must be monitored for releases in a manner that meets one of the following requirements:

(1) *Pressurized piping.* Underground piping that conveys regulated substances under pressure must:

1. Be equipped with an automatic line leak detector conducted in accordance with paragraph 135.5(5)*"a"*; and

2. Have an annual line tightness test conducted in accordance with paragraph 135.5(5)*"b"* or have monthly monitoring conducted in accordance with paragraph 135.5(5)*"c."* Piping installed after November 28, 2007, must use interstitial monitoring of the piping secondary containment in accordance with paragraph 135.5(5)*"d."*

(2) *Suction piping.* Underground piping that conveys regulated substances under suction must either have a line tightness test conducted at least every three years and in accordance with paragraph 135.5(5)*"b,"* or use a monthly monitoring method conducted in accordance with paragraph 135.5(5)*"c."* Remote fill is considered suction piping. No release detection is required for suction piping that is designed and constructed to meet the following standards:

1. The below-grade piping operates at less than atmospheric pressure;

2. The below-grade piping is sloped so that the contents of the pipe will drain back into the storage tank if the suction is released;

3. Only one check valve is included in each suction line;

4. The check valve is located directly below and as close as practical to the suction pump; and

5. A method is provided that allows compliance with "2" through "4" to be readily determined.

(3) Piping installed or replaced must meet one of the following:

1. Pressurized piping must be monitored for releases at least every 30 days in accordance with paragraph 135.5(5)*"d"* and be equipped with an automatic line leak detector.

2. Suction piping must be monitored for releases at least every 30 days. No release detection is required for suction piping that meets paragraphs 135.5*"b"*(2)"1" through 135.5*"b"*(2)"5."

135.5(3) *Requirements for hazardous substance UST systems.* Owners and operators of hazardous substance UST systems must have containment that meets the following requirements and monitor these systems pursuant to paragraph 135.5(4)*"g"* at least every 30 days:

a. Secondary containment systems must be designed, constructed and installed to:

(1) Contain regulated substances leaked from the primary containment until they are detected and removed;

(2) Prevent the release of regulated substances to the environment at any time during the operational life of the UST system; and

(3) Be checked for evidence of a release at least every 30 days.

b. Double-walled tanks must be designed, constructed, and installed to:

(1) Contain a leak from any portion of the inner tank within the outer wall; and

(2) Detect the failure of the inner wall.

c. External liners (including vaults) must be designed, constructed, and installed to:

(1) Contain 100 percent of the capacity of the largest tank within its boundary;

(2) Prevent the interference of precipitation or groundwater intrusion with the ability to contain or detect a release of regulated substances; and

(3) Surround the tank completely (i.e., it is capable of preventing lateral as well as vertical migration of regulated substances).

d. Underground piping must be equipped with secondary containment that satisfies the requirements of this subrule (e.g., trench liners, jacketing of double-walled pipe). In addition, underground piping that conveys regulated substances under pressure must be equipped with an automatic line leak detector in accordance with paragraph 135.5(5)*"a"*;

e. For hazardous substance UST systems installed on or before November 28, 2007, other methods of release detection may be used if owners and operators:

(1) Demonstrate to the department that an alternate method can detect a release of the stored substance as effectively as any of the methods allowed in paragraphs 135.5(4)*"b"* to *"i"* can detect a release;

(2) Provide information to the department on effective corrective action technologies, health risks, and chemical and physical properties of the stored substance, and the characteristics of the UST site; and

(3) Obtain approval from the department to use the alternate release detection method before the installation and operation of the new UST system.

135.5(4) *Methods of release detection for tanks.* Each method of release detection for tanks used to meet the requirements of 135.5(2) must be conducted in accordance with the following:

a. Inventory control. Product inventory control (or another test of equivalent performance) must be conducted monthly to detect a release of at least 1.0 percent of flow-through plus 130 gallons on a monthly basis in the following manner:

(1) Inventory volume measurements for regulated substance inputs, withdrawals, and the amount still remaining in the tank are recorded each operating day;

(2) The equipment used is capable of measuring the level of product over the full range of the tank's height to the nearest 1/8 of an inch;

(3) The regulated substance inputs are reconciled with delivery receipts by measurement of the tank inventory volume before and after delivery;

(4) Deliveries are made through a drop tube that extends to within 1 foot of the tank bottom;

(5) Product dispensing is metered and recorded within the local standards for meter calibration or an accuracy of 6 cubic inches for every 5 gallons of product withdrawn; and

(6) The measurement of any water level in the bottom of the tank is made to the nearest 1/8 of an inch at least once a month.

NOTE: Practices described in the American Petroleum Institute Recommended Practice 1621, "Recommended Practice for Bulk Liquid Stock Control at Retail Outlets," may be used, where applicable, as guidance in meeting the requirements of subparagraphs 135.5(4)*"a"*(1) to 135.5(4)*"a"*(6).

b. Manual tank gauging. Manual tank gauging must meet the following requirements:

(1) Tank liquid level measurements are taken at the beginning and end of the test period during which no liquid is added to or removed from the tank;

(2) Level measurements are based on an average of two consecutive stick readings at both the beginning and ending of the period;

(3) The equipment is capable of measuring the level of product over the full range of the tank's height to the nearest 1/8 of an inch;

(4) A release is suspected and subject to the requirements of rule 567—135.6(455B) if the variation between the beginning and ending measurements exceeds the weekly or monthly standards in the following table. Immediately contact the department if these standards are exceeded.

Nominal Tank Capacity	Minimum Duration of Test	Weekly Standard (one test)	Monthly Standard (four-test average)
550 gallons or less	36 hours	10 gallons	5 gallons
551-1,000 gallons (when tank diameter is 64 inches)	44 hours	9 gallons	4 gallons
551-1,000 gallons (when tank diameter is 48 inches)	58 hours	12 gallons	6 gallons
551-1,000 gallons (also requires annual tank tightness testing)	36 hours	13 gallons	7 gallons
1,001-2,000 gallons (also requires annual tank tightness test)	36 hours	26 gallons	13 gallons

(5) Only those tanks of 550 gallons or less nominal capacity or tanks of 551 to 1,000 gallons nominal capacity with diameters of 64 inches or 48 inches may use this as the sole method of release detection. Other tanks of 551 to 2,000 gallons may use this method in place of inventory control in

paragraph 135.5(4)*"a."* Tanks of greater than 2,000 gallons nominal capacity may not use this method to meet the requirements of this rule.

c. Tank tightness testing. Tank tightness testing (or another test of equivalent performance) must be capable of detecting a 0.1 gallon-per-hour leak rate from any portion of the tank that routinely contains product while accounting for the effects of thermal expansion or contraction of the product, vapor pockets, tank deformation, evaporation or condensation, and the location of the water table.

The tank tightness test procedure must be certified by a third party and meet US EPA testing procedures. The testing procedures are found in *Standard Test Procedures for Evaluating Leak Detection Methods*: *Volumetric Tank Tightness Testing Methods* (EPA /530/UST-90/004) March 1990 or as revised by EPA or *Non-Volumetric Tank Tightness Testing Methods* (EPA /530/UST-90/005) March 1990 or as revised by EPA.

d. Automatic tank gauging. Equipment for automatic tank gauging that tests for the loss of product and conducts inventory control must meet the following requirements:

(1) The automatic product level monitor test can detect a 0.2 gallon-per-hour leak rate from any portion of the tank that routinely contains product;

(2) The automatic tank gauging equipment must meet the inventory control (or other test of equivalent performance) requirements of paragraph 135.5(4)*"a"*;

(3) The leak test must be performed according to manufacturer specifications;

(4) The automatic tank gauging equipment must be certified by a third party and meet US EPA testing procedures in *Standard Test Procedures for Evaluating Leak Detection Methods: Automatic Tank Gauging Systems* (ATGS) (EPA /530/UST-90/006) March 1990 or as revised by US EPA; and

(5) The test must be performed with the system operating in one of the following modes:

1. In-tank static testing conducted at least once every 30 days; or

2. Continuous in-tank leak detection operating on an uninterrupted basis or operating within a process that allows the system to gather incremental measurements to determine the leak status of the tank at least once every 30 days.

e. Vapor monitoring. Testing or monitoring for vapors within the soil gas of the excavation zone must meet the following requirements:

(1) The materials used as backfill are sufficiently porous (e.g., gravel, sand, crushed rock) to readily allow diffusion of vapors from releases into the excavation area;

(2) The stored regulated substance, or a tracer compound placed in the tank system, is sufficiently volatile (e.g., gasoline) to result in a vapor level that is detectable by the monitoring devices located in the excavation zone in the event of a release from the tank;

(3) The measurement of vapors by the monitoring device is not rendered inoperative by the groundwater, rainfall, or soil moisture or other known interferences so that a release could go undetected for more than 30 days;

(4) The level of background contamination in the excavation zone will not interfere with the method used to detect releases from the tank;

(5) The vapor monitors are designed and operated to detect any significant increase in concentration above background of the regulated substance stored in the tank system, a component or components of that substance, or a tracer compound placed in the tank system;

(6) In the UST excavation zone, the site is assessed to ensure compliance with the requirements in subparagraphs 135.5(4)*"e"*(1) through (4) and to establish the number and positioning of monitoring wells that will detect releases within the excavation zone from any portion of the tank that routinely contains product;

(7) Monitoring wells are clearly marked and secured to avoid unauthorized access and tampering; and

(8) The vapor product detector must be certified by a third party and meet US EPA testing procedures in *Standard Test Procedures for Evaluating Leak Detection Methods: Vapor-Phase Out-of-Tank Product Detectors* (EPA/530/UST-90/008) March 1990 or as revised by US EPA.

f. Groundwater monitoring. Testing or monitoring for liquids on the groundwater must meet the following requirements:

(1) The regulated substance stored is immiscible in water and has a specific gravity of less than 1;

(2) Groundwater is never more than 20 feet from the ground surface and the hydraulic conductivity of the soil(s) between the UST system and the monitoring wells or devices is not less than 0.01 cm/sec (e.g., the soil should consist of gravels, coarse to medium sands, coarse silts or other permeable materials);

(3) The slotted portion of the monitoring well casing must be designed to prevent migration of natural soils or filter pack into the well and to allow entry of regulated substance on the water table into the well under both high and low groundwater conditions;

(4) Monitoring wells shall be sealed from the ground surface to the top of the filter pack;

(5) Monitoring wells or devices intercept the excavation zone or are as close to it as is technically feasible;

(6) The continuous monitoring devices or manual methods used can detect the presence of at least 1/8 of an inch of free product on top of the groundwater in the monitoring wells;

(7) Within and immediately below the UST system excavation zone, the site is assessed to ensure compliance with the requirements in subparagraphs 135.5(4)*"f"*(1) through (5) and to establish the number and positioning of monitoring wells or devices that will detect releases from any portion of the tank that routinely contains product; and

(8) Monitoring wells are clearly marked and secured to avoid unauthorized access and tampering.

g. Interstitial monitoring. Interstitial monitoring between the UST system and a secondary barrier immediately around or beneath it may be used, but only if the system is designed, constructed and installed to detect a leak from any portion of the tank that routinely contains product and also meets one of the following requirements:

(1) For secondary containment systems, the sampling or testing method must be able to detect a leak through the inner wall in any portion of the tank that routinely contains product:

1. Continuously, by means of an automatic leak sensing device that signals to the operator the presence of any regulated substance in the interstitial space; or

2. Monthly, by means of a procedure capable of detecting the presence of any regulated substance in the interstitial space.

3. The interstitial space shall be maintained and kept free of liquid, debris or anything that could interfere with leak detection capabilities.

(2) For UST systems with a secondary barrier within the excavation zone, the sampling or testing method used can detect a leak between the UST system and the secondary barrier:

1. The secondary barrier around or beneath the UST system consists of artificially constructed material that is sufficiently thick and impermeable (at least 10^{-6} cm/sec for the regulated substance stored) to direct a leak to the monitoring point and permit its detection;

2. The barrier is compatible with the regulated substance stored so that a leak from the UST system will not cause a deterioration of the barrier allowing a release to pass through undetected;

3. For cathodically protected tanks, the secondary barrier must be installed so that it does not interfere with the proper operation of the cathodic protection system;

4. The groundwater, soil moisture, or rainfall will not render the testing or sampling method used inoperative so that a release could go undetected for more than 30 days;

5. The site is assessed to ensure that the secondary barrier is always above the groundwater and not in a 25-year flood plain, unless the barrier and monitoring designs are for use under such conditions; and

6. Monitoring wells are clearly marked and secured to avoid unauthorized access and tampering.

(3) For tanks with an internally fitted liner, an automated device can detect a leak between the inner wall of the tank and the liner, and the liner is compatible with the substance stored.

h. Statistical inventory reconciliation. Release detection methods based on the application of statistical principles to inventory data that test for the loss of product must meet the following requirements:

(1) Use a leak threshold that does not exceed one-half the minimum detectible leak rate;

(2) The statistical test must be able to detect at least a 0.2 gallon per hour leak rate from any portion of the tank that routinely contains product; and

(3) The report by the SIR company must be a quantitative result with a calculated leak rate and include the leak threshold (leak rate at which a leak is declared), the calculated leak rate (leak rate calculated from the inventory records) and minimum detectable leak rate (minimum leak rate that can be determined from the inventory records).

1. A "pass" means that the calculated leak rate for the data set is less than the leak threshold and the minimum detectable leak rate is less than or equal to the certified performance standard;

2. A "fail" means the calculated leak rate for the data set is equal to or greater than the leak threshold;

3. An "inconclusive" means the minimum detectable leak rate exceeds the certified performance standard and the calculated leak rate is less than the leak threshold. If for any other reason the test result is not a "pass" or "fail," the result is "inconclusive";

(4) Owners and operators must notify the department in accordance with rule 567—135.6(455B) when a monthly SIR report of "fail" occurs or two consecutive inconclusive results occur.

(5) Owners and operators must assure the SIR analytical results are complete and available to the department upon request.

(6) The statistical inventory reconciliation method must be certified by a third party and meet US EPA testing procedures in *Standard Test Procedures for Evaluating Release Detection Methods: Statistical Inventory Reconciliation* (EPA 510-B-19-004) May 2019 or as revised by EPA.

i. Other methods. Any other type of release detection method, or combination of methods, can be used if:

(1) It can detect a 0.2 gallon-per-hour leak rate or a release of 150 gallons within a month with a probability of detection of 0.95 and a probability of false alarm of 0.05; or

(2) The department may approve another method if the owner and operator can demonstrate that the method can detect a release as effectively as any of the methods allowed in paragraphs *"c"* to *"h."* In comparing methods, the department shall consider the size of release that the method can detect and the frequency and reliability with which it can be detected. If the method is approved, the owner and operator must comply with any conditions imposed by the department on its use to ensure the protection of human health and the environment.

135.5(5) *Methods of release detection for piping.* Each method of release detection for piping used to meet the requirements of 135.5(2) must be conducted in accordance with the following:

a. Automatic line leak detectors. Methods which alert the operator to the presence of a leak in pressurized piping by restricting or shutting off the flow of regulated substances through piping or triggering an audible or visual alarm may be used only if they detect leaks of 3 gallons per hour at 10 pounds per square inch line pressure within one hour. An annual test of the operation of the leak detector must be conducted in accordance with paragraph 135.5(1)*"a."*

b. Line tightness testing. A periodic test of piping may be conducted only if it can detect a 0.1 gallon-per-hour leak rate at one and one-half times the operating pressure. The line leak detection method must be certified by a third party and meet US EPA testing procedures in *Standard Test Procedures for Evaluating Release Detection Methods: Pipeline Release Detection* (EPA 510-B-19-005) May 2019 or as revised by EPA.

c. Applicable tank methods. Except as described in paragraph 135.5(2)*"a,"* any of the methods in paragraphs 135.5(4)*"e"* through *"i"* may be used if they are designed to detect a release from any portion of the underground piping that routinely contains regulated substances.

d. Interstitial monitoring of secondary containment. Interstitial monitoring may be used for any piping with secondary containment designed for and capable of interstitial monitoring.

(1) Leak detection shall be conducted:

1. Continuously, by means of an automatic leak sensing device that signals to the operator the presence of any regulated substance in the interstitial space or containment sump; or

2. Monthly, by means of a procedure capable of detecting the presence of any regulated substance in the interstitial space or containment sump, such as visual inspection.

(2) The interstitial space or sump shall be maintained and kept free of water, debris or anything that could interfere with leak detection capabilities.

(3) At least every two years, any sump shall be visually inspected for integrity of sides and floor and tightness of piping penetration seals. Any automatic sensing device shall be tested for proper function.

135.5(6) *Release detection record keeping.* All UST system owners and operators must maintain records in accordance with 135.4(5) demonstrating compliance with all applicable requirements of this rule. These records must include the following:

a. All written performance claims pertaining to any release detection system used, and the manner in which these claims have been justified or tested by the equipment manufacturer or installer, must be maintained for five years, or for another reasonable period of time determined by the department, from the date of installation. Records of site assessments required for vapor monitoring under subparagraph 135.5(4)*"e"*(6) and groundwater monitoring under subparagraph 135.5(4)*"f"*(7) must be maintained for as long as the methods are used. Records of site assessments must be signed by a professional engineer or professional geologist, or equivalent licensed professional with experience in environmental engineering, hydrogeology, or other relevant technical discipline acceptable to the department;

b. The results of any sampling, testing, or monitoring must be maintained for at least one year, or for another reasonable period of time determined by the department, except as follows:

(1) The results of tank tightness testing conducted in accordance with paragraph 135.5(4)*"c"* must be retained until the next test is conducted; and

(2) The results of annual operation tests conducted in accordance with subparagraphs 135.5(1)*"a"*(3) and (4), must be maintained for three years. At a minimum, the results must list each component tested, indicate whether each component tested meets criteria in subparagraphs 135.5(1)*"a"*(3) and (4), or needs to have action taken, and describe any action taken to correct an issue; and

(3) The results of tank tightness testing, line tightness testing, and vapor monitoring using a tracer compound placed in the tank system conducted in accordance with paragraph 135.21(2)*"f"* must be retained until the next test is conducted; and

c. Written documentation of all calibration, maintenance, and repair of release detection equipment permanently located on-site must be maintained for at least one year after the servicing work is completed, or for another reasonable time period determined by the department. Any schedules of required calibration and maintenance provided by the release detection equipment manufacturer must be retained for five years from the date of installation.

[**ARC 8469B**, IAB 1/13/10, effective 2/17/10 (See Delay note at end of chapter); **ARC 0559C**, IAB 1/9/13, effective 12/19/12; **ARC 1100C**, IAB 10/16/13, effective 11/20/13; **ARC 5625C**, IAB 5/19/21, effective 6/23/21]

567—135.6(455B) Release reporting, investigation, and confirmation.

135.6(1) *Reporting of suspected releases.* Owners and operators of UST systems must report to the department within 24 hours, or within 6 hours in accordance with 567—Chapter 131 if a hazardous condition exists as defined in 567—131.1(455B), or another reasonable time period specified by the department, and follow the procedures in 135.8(1) for any of the following conditions:

a. The discovery by owners and operators or others of released regulated substances at the UST site or in the surrounding area (such as the presence of free product or vapors in soils, basements, sewer and utility lines, and nearby surface water);

b. Unusual operating conditions observed by owners and operators (such as the erratic behavior of product dispensing equipment, the sudden loss of product from the UST system, an unexplained presence of water in the tank, or liquid in the interstitial space of secondarily contained systems), unless:

(1) The system equipment or component is found not to be releasing regulated substances to the environment;

(2) Any defective system equipment or component is immediately repaired or replaced; and

(3) For secondarily contained systems, except as provided for in paragraph 135.5(4)*"g"*(2)"4," any liquid in the interstitial space not used as part of the interstitial monitoring method (for example, brine filled) is immediately removed.

c. Monitoring results, including investigation of an alarm, from a release detection method required under subrules 135.5(2) and 135.5(3) that indicate a release may have occurred unless:

(1) The monitoring device is found to be defective, and is immediately repaired, recalibrated or replaced, and additional monitoring does not confirm the initial result; or

(2) The leak is contained in the secondary containment and:

1. Except as provided for in paragraph 135.5(4)*"g"*(2)"4," any liquid in the interstitial space not used as part of the interstitial monitoring method (for example, brine filled) is immediately removed; and

2. Any defective system equipment or component is immediately repaired or replaced;

(3) In the case of inventory control, a second month of data does not confirm the initial result or the investigation determines no release has occurred; or

(4) The alarm was investigated and determined to be a non-release event (for example, from a power surge or caused by filling the tank during release detection testing).

135.6(2) *Investigation due to off-site impacts.* When required by the department, owners and operators of UST systems must follow the procedures in 135.6(3) to determine if the UST system is the source of off-site impacts. These impacts include the discovery of regulated substances (such as the presence of free product or vapors in soils, basements, sewer and utility lines, and nearby surface and drinking waters) that has been observed by the department or brought to its attention by another party.

135.6(3) *Release investigation and confirmation steps.* Owners and operators must immediately investigate and confirm all suspected releases of regulated substances requiring reporting under 135.6(1) within seven days, or another reasonable time period specified by the department, using either the following steps or another procedure approved by the department:

a. System test. Owners and operators must conduct tests (according to the requirements for tightness testing in paragraphs 135.5(4)*"c"* and 135.5(5)*"b"*) or, as appropriate, secondary containment testing described in paragraph 135.4(4).

(1) The test must determine whether:

1. A leak exists in that portion of the tank that routinely contains product, or the attached delivery piping; or

2. A breach of either wall of the secondary containment has occurred.

(2) If the system test confirms a leak into the interstice or a release, owners and operators must repair, replace, upgrade, or close the UST system. In addition, owners and operators must begin corrective action in accordance with rule 567—135.9(455B) if the test results for the system, tank, or delivery piping indicate a release exists.

(3) Further investigation is not required if the test results for the system, tank, and delivery piping do not indicate a release exists and if environmental contamination is not the basis for suspecting a release.

(4) Owners and operators must conduct a site check as described in paragraph 135.6(3)*"b"* if the test results for the system, tank, and delivery piping do not indicate a release exists but environmental contamination is the basis for suspecting a release.

b. Site check. A certified groundwater professional must conduct a site check in accordance with the tank closure in place procedures as provided in 135.15(3) or they may conduct a Tier 1 assessment in accordance with subrule 135.9(3). Under either procedure, the certified groundwater professional must follow the policies and procedures applicable to sites where bedrock is encountered before groundwater as provided in 135.8(5) to avoid creating a preferential pathway for soil or groundwater contamination to reach a bedrock aquifer. The certified groundwater professional must measure for the presence of a release where contamination is most likely to be present at the UST site. In selecting sample types, sample locations, and measurement methods, the certified groundwater professional must consider the nature of the stored substance, the type of initial alarm or cause for suspicion, the type of backfill, the depth of groundwater, and other factors appropriate for identifying the presence and source of the release.

(1) If the test results of the site check indicate action levels in 567—135.14(455B) have been exceeded, owners and operators must begin corrective action in accordance with rules 567—135.7(455B) to 567—135.12(455B).

(2) If the test results for the excavation zone or the UST site do not indicate a release has occurred, further investigation is not required.

135.6(4) *Reporting and cleanup of spills and overfills.*

a. *Reportable releases.* Owners and operators of UST systems must contain and immediately clean up a spill, overfill or any aboveground release, and report to the department within 24 hours, or within 6 hours in accordance with 567—Chapter 131 if a hazardous condition exists as defined in rule 567—131.1(455B) and begin corrective action in accordance with rules 567—135.7(455B) to 567—135.12(455B) in the following cases:

(1) Spill, overfill or any aboveground release of petroleum that results in a release to the environment that exceeds 25 gallons, causes a sheen on nearby surface water, impacts adjacent property, or contaminates groundwater; and

(2) Spill, overfill or any aboveground release of a hazardous substance that results in a release to the environment that equals or exceeds its reportable quantity under CERCLA (40 CFR 302).

b. *Nonreportable releases.* Owners and operators of UST systems must contain and immediately clean up a spill, overfill or any aboveground release of petroleum that is less than 25 gallons and a spill, overfill or any aboveground release of a hazardous substance that is less than the reportable quantity. If cleanup cannot be accomplished within 24 hours, owners and operators must immediately notify the department.

NOTE: Any spill or overfill that results in a hazardous condition as defined in rule 567—131.1(455B) must be reported within 6 hours. This includes the transporter of the product. A release of a hazardous substance equal to or in excess of its reportable quantity must also be reported immediately (rather than within 24 hours) to the National Response Center under Sections 102 and 103 of the Comprehensive Environmental Response, Compensation, and Liability Act of 1980 and to appropriate state and local authorities under Title III of the Superfund Amendments and Reauthorization Act of 1986.

[**ARC 5625C**, IAB 5/19/21, effective 6/23/21]

567—135.7(455B) Release response and corrective action for UST systems containing petroleum or hazardous substances.

135.7(1) *General.* Owners and operators of petroleum or hazardous substance UST systems must, in response to a confirmed release from the UST system, comply with the requirements of this rule except for USTs excluded under 135.1(3)*"b"* and UST systems subject to RCRA Subtitle C corrective action requirements under Section 3004(u) of the Resource Conservation and Recovery Act, as amended.

135.7(2) *Initial response.* Upon confirmation of a release in accordance with 135.6(3) or after a release from the UST system is identified in any other manner, owners and operators must perform the following initial response actions within 24 hours of a release or within another reasonable period of time specified by the department:

a. Report the release to the department (e.g., by telephone or electronic mail);

b. Take immediate action to prevent any further release of the regulated substance into the environment; and

c. Identify and mitigate fire, explosion, and vapor hazards.

135.7(3) *Initial abatement measures.*

a. Unless directed to do otherwise by the department, owners and operators must perform the following abatement measures:

(1) Remove as much of the regulated substance from the UST system as is necessary to prevent further release to the environment;

(2) Visually inspect any aboveground releases or exposed below-ground releases and prevent further migration of the released substance into surrounding soils and groundwater;

(3) Continue to monitor and mitigate any additional fire and safety hazards posed by vapors or free product that have migrated from the UST excavation zone and entered into subsurface structures (such as sewers or basements);

(4) Remedy hazards posed by contaminated soils that are excavated or exposed as a result of release confirmation, site investigation, abatement, or corrective action activities. If these remedies

include treatment or disposal of soils, the owner and operator must comply with applicable state and local requirements;

(5) Rescinded IAB 7/17/96, effective 8/15/96.

(6) Investigate to determine the possible presence of free product, and begin free product removal as soon as practicable and in accordance with 135.7(5).

b. Within 20 days after release confirmation, or within another reasonable period of time determined by the department, owners and operators must submit a report to the department summarizing the initial abatement steps taken under paragraph *"a"* and any resulting information or data.

135.7(4) *Initial site characterization.* Rescinded IAB 7/17/96, effective 8/15/96.

135.7(5) *Free product assessment and removal.* The free product assessment and removal requirements in this chapter are primarily concerned with a regulated substance that is present as a light nonaqueous phase liquid (LNAPL) in a monitoring well, boring, excavation, or other location at a thickness of more than 0.01 ft. At sites where investigations under subparagraph 135.7(3)*"a"*(6) indicate 0.01 ft. or more of free product, owners and operators must immediately initiate a free product recovery assessment and submit a report in accordance with paragraph 135.7(5)*"d"* and initiate interim free product removal while continuing, as necessary, any actions initiated under subrules 135.7(2) and 135.7(3), or preparing for actions required under rules 567—135.8(455B) to 567—135.12(455B). Owners and operators must immediately begin interim free product removal by bailing or by installation and maintenance of passive skimming equipment until an alternative removal method is required by or approved by the department. A certified groundwater professional must initially determine the frequency of bailing and proper installation and maintenance of the skimming equipment based on a determination of the recharge rate of the free product. The department may approve implementation of this interim removal process by persons not certified as groundwater professionals. For approval a certified groundwater professional must submit (1) sufficient documentation establishing that the bailing or skimming system has been adequately designed and tested, and (2) a written plan for regular maintenance, reporting and supervision by a certified groundwater professional. Interim free product recovery reports must be submitted to the department on a monthly basis and on forms provided by the department. In meeting the requirements of this subrule, owners and operators must:

a. Conduct free product removal at a frequency determined by the recharge rate of the product and in a manner that minimizes the spread of contamination into previously uncontaminated zones by using recovery and disposal techniques appropriate to the hydrogeologic conditions at the site, and that properly treats, discharges or disposes of recovery by-products in compliance with applicable local, state and federal regulations. Unless approved by the department, free product assessment and recovery activities must be conducted by a certified groundwater professional. Owners and operators must report the results of free product removal activities on forms designated by the department;

b. Use abatement of free product migration as a minimum objective for the design of the free product removal system. Free product recovery systems must be designed to remove free product to the maximum extent practicable;

c. Handle any flammable products in a safe and competent manner to prevent fires or explosions; and

d. Free product recovery assessment and report. Unless directed to do otherwise by the department, prepare and submit to the department, within 45 days after confirming a release, a free product recovery assessment report and a proposal for subsequent free product removal activities. The free product recovery assessment report and removal proposal must contain at least the following information:

(1) The name of the person(s) responsible for implementing the free product removal measures;

(2) The estimated quantity, type and thickness of free product observed or measured in monitoring wells, boreholes, and excavations, the recharge rate in all affected monitoring wells and a detailed description of the procedures used to determine the recharge rate;

(3) A detailed justification for the free product removal technology proposed for the site. Base the justification narrative on professional judgment considering the characteristics of the free product

plume (i.e., estimated volume, type of product, thickness, extent), an assessment of cost effectiveness based on recovery costs compared to alternative methods, site hydrology and geology, when the release event occurred, testing conducted to verify design assumptions and the potential for petroleum vapors or explosive conditions to occur in enclosed spaces. Proposals for removal systems other than hand bailing or passive skimming systems must be completed and submitted on a format consistent with the department's corrective action design report.

(4) A schematic and narrative description of the free product recovery system used;

(5) Whether any discharge will take place on site or off site during the recovery operation and where this discharge will be located;

(6) A schematic and narrative description of the treatment system, and the effluent quality expected from any discharge;

(7) The steps that have been or are being taken to obtain necessary permits for any discharge;

(8) The disposition of the recovered free product;

(9) Free product plume definition and map. The extent of free product must be assessed. If monitoring wells are used to define the free product plume, the number and location of wells and separation distance between the wells used to define the plume must be based on the receptors present and the site hydrology and geology. A minimum of five monitoring wells are required to construct the plume map. The boundary of the plume may be determined by half the distance between wells with free product and wells with no free product. If the groundwater professional can adequately define the plume using other technology as approved by the department, fewer than five wells may be used to define the boundary of the plume;

(10) The estimated volume of free product present, how the volume was calculated, recoverable volume and estimated recovery time; and

(11) Identification of all water lines, regardless of construction material, within the area of free product. A water line shall be considered within the area of free product if it is located within the boundary of the free product plume as defined by wells unless it can be demonstrated that no LNAPL exists within 10 feet (horizontally or vertically) of the water line and the LNAPL is not migrating nor is likely to migrate. Water lines within the area of free product must be relocated unless there is no other option and the department has approved an alternate plan of construction. See paragraph 135.12(3)*"c."*

e. The department will review the free product assessment report; and, if approved, the owner or operator must implement the installation of the approved recovery system within 60 days or other time period approved by the department.

f. Termination of free product recovery activities. Owners and operators may propose to the department to terminate free product recovery activities when significant amounts of hydrocarbons are not being recovered. The department will consider proposals to terminate free product recovery when the amount of product collected from a monitoring well is equal to or less than 0.1 gallon each month for a year unless another plan is approved by the department. When free product activities have been terminated, owners and operators must inspect the monitoring wells monthly for at least a year unless another schedule is approved by the department. The department must be notified and may require that free product recovery activities be reinitiated if during the monthly well inspections it is determined the product thickness in a monitoring well exceeds 0.02 ft. The monthly well inspection records must be kept available for review by the department.

g. Unless directed to do otherwise by the department, prepare and submit to the department within 180 days after confirming a release, a Tier 2 site cleanup report.

[**ARC 5625C**, IAB 5/19/21, effective 6/23/21]

567—135.8(455B) Risk-based corrective action.

135.8(1) *General.* The objective of risk-based corrective action is to effectively evaluate the risks posed by contamination to human health, safety and the environment using a progressively more site-specific, three-tiered approach to site assessment and data analysis. Based on the tiered assessment, a corrective action response is determined sufficient to remove or minimize risks to acceptable levels. Corrective action response includes a broad range of options including reduction of contaminant

concentrations through active or passive methods, monitoring of contamination, use of technological controls or institutional controls.

a. Tier 1. The purpose of a Tier 1 assessment is to identify whether a site poses an unreasonable risk to public health and safety or the environment based on limited site data. The objective is to determine maximum concentrations of chemicals of concern at the source of a release(s) in soil and groundwater. The Tier 1 assessment assumes worst-case scenarios in which actual or potential receptors could be exposed to these chemicals at maximum concentrations through certain soil and groundwater pathways. The point of exposure is assumed to be the source showing maximum concentrations. Risk-based screening levels (Tier 1 levels) contained in the Tier 1 Look-Up Table have been derived from models which use conservative assumptions to predict exposure to actual and potential receptors. (These models and default assumptions are contained in Appendix A.) If Tier 1 levels are not exceeded for a pathway, that pathway may not require further assessment. If the maximum concentrations exceed a Tier 1 level, the options are to conduct a more extensive Tier 2 assessment, apply an institutional control, or in limited circumstances excavate contaminated soil to below Tier 1 levels. If all pathways clear the Tier 1 levels, it is possible for the site to obtain a no action required classification.

b. Tier 2. The purpose of a Tier 2 assessment is to use site-specific data to assess the risk from chemicals of concern to existing receptors and potential receptors using fate and transport models in accordance with 567—135.10(455B). See 135.10(2)*"a."*

c. Tier 3. Where site conditions may not be adequately addressed by Tier 2 procedures, a Tier 3 assessment may provide more accurate risk assessment. The purpose of Tier 3 is to identify reasonable exposure levels of chemicals of concern and to assess the risk of exposure to existing and potential receptors based on additional site assessment information, probabilistic evaluations, or sophisticated chemical fate and transport models in accordance with 567—135.11(455B).

d. Notification. Whenever the department requires a tiered site assessment and a public water supply well is within 2,500 feet of a leaking underground storage tank site, the department will notify the public water supply operator.

e. Pathway reevaluation. Prior to issuance of a no further action certificate in accordance with 135.12(10) and Iowa Code section 455B.474(1)*"h"*(3), if it is determined that the conditions for an individual pathway that has been classified as "no action required" no longer exist, or the site presents an unreasonable risk to a public water supply well and the model used to obtain the pathway clearance underpredicts the actual contaminant plume, the individual pathway shall be further assessed consistent with the risk-based corrective action provisions in rules 567—135.8(455B) through 567—135.12(455B).

135.8(2) *Certified groundwater professional.* All assessment, corrective action, data analysis and report development required under rules 567—135.6(455B) to 567—135.12(455B) must be conducted by or under the supervision of a certified groundwater professional in accordance with these rules and department guidance as specified.

135.8(3) *Chemicals of concern.* Soil and groundwater samples from releases of petroleum regulated substances must always be analyzed for the presence of benzene, ethylbenzene, toluene, and xylenes. In addition, if the release is suspected to include any petroleum regulated substance other than gasoline or gasoline blends, or if the source of the release is unknown, the samples must be tested for the presence of Total Extractable Hydrocarbons (TEH). Appendices A and B and department Tier 2 guidance define a method for converting TEH values to a default concentration for naphthalene, benzo(a)pyrene, benz(a)anthracene and chrysene and conversion back to a representative TEH value. These default values must be used in order to apply Tier 2 modeling to these constituents in the absence of accurate laboratory analysis.

135.8(4) *Boring depth for sampling.* When drilling for the placement of groundwater monitoring wells, if groundwater is encountered, drilling must continue to the maximum of 10 feet below the first encountered groundwater or to the bottom of soil contamination as estimated by field screening. If groundwater is not encountered, drilling must continue to the deeper of 10 feet below the soil contamination as estimated by field screening or 75 feet from the ground surface.

135.8(5) *Bedrock aquifer assessment.* Prior to conducting any groundwater drilling, a groundwater professional must determine if there is a potential to encounter bedrock before groundwater. These

potential areas include (1) areas where karst features or outcrops exist in the vicinity and (2) areas with bedrock less than 50 feet from the surface as illustrated in Tier 1 and Tier 2 guidance. The purpose of this determination is to prevent drilling through contaminated subsurface areas thereby creating a preferential pathway to a bedrock aquifer. If the first encountered groundwater is above bedrock but near the bedrock surface or fluctuates above and below bedrock, the groundwater professional should evaluate the subsurface geology and aquifer characteristics to determine the potential for creating a preferential pathway. If it is determined that the aquifer acts like a nongranular aquifer as provided in 135.10(3)*"a"* or bedrock is encountered before groundwater, the groundwater professional must conduct a Tier 2 assessment for all pathways under 567—135.10(455B), including the specified bedrock procedures under 135.10(3).

If the first encountered groundwater is above bedrock with sufficient separation and aquifer characteristics to establish that it acts as a granular aquifer, site assessment may proceed under the site check procedure in 567—135.6(455B), the Tier 1 procedure in 567—135.9(455B) or the Tier 2 procedure in 567—135.10(455B) as would be customary regardless of the bedrock designation. However, even under this condition, drilling through bedrock should be avoided in contaminated areas.
[**ARC 7621B**, IAB 3/11/09, effective 4/15/09; **ARC 5625C**, IAB 5/19/21, effective 6/23/21]

567—135.9(455B) Tier 1 site assessment policy and procedure.

135.9(1) *General.* The main objective of a Tier 1 site assessment is to reasonably determine the highest concentrations of chemicals of concern which would be associated with any suspected or confirmed release and an accurate identification of applicable receptors. The potential source of a release, nature of the substance released, site stratigraphy, depth to groundwater, and other appropriate factors must be considered when selecting the sample types, sample locations, and measurements methods. The placement and depth of borings and the construction of monitoring wells must be sufficient to determine the sources of all releases, the vertical extent of contamination, an accurate description of site stratigraphy, and a reliable determination of groundwater flow direction.

a. *Pathway assessment.* The pathways to be evaluated at Tier 1 are the groundwater ingestion pathway, soil leaching to groundwater pathway, groundwater vapor to enclosed space pathway, soil vapor to enclosed space pathway, soil to water line pathway, groundwater to water line pathway and the surface water pathway. Assessment requires a determination of whether a pathway is complete, an evaluation of actual and potential receptors, and a determination of whether conditions are satisfied for obtaining no further action clearance for individual pathways or for obtaining a complete site classification of "no action required." A pathway is considered complete if a chemical of concern has a route which could be followed to reach an actual or potential receptor.

b. *Pathway clearance.* If contaminant concentrations for an individual pathway do not exceed the applicable Tier 1 levels or if a pathway is incomplete, no further action is required to evaluate the pathway unless otherwise specified in these rules. If the contaminant concentrations for a pathway exceed the applicable Tier 1 level(s) in the "Iowa Tier 1 Look-up Table," the response is to conduct further assessment under Tier 2 or Tier 3 unless an effective institutional control is approved. In limited circumstances excavation of contaminated soils may be used as an option to obtain pathway clearance. If further site assessment indicates site data exceeds an applicable Tier 1 level(s) for a previously cleared pathway or the conditions justifying a determination of pathway incompleteness change, that pathway must be reevaluated as part of a Tier 2 or Tier 3 assessment.

c. *Chemical group clearance.* If concentrations for all chemicals of concern within a designated group of chemicals are below the Tier 1 levels, no further action is required as to the group of chemicals unless otherwise specified in these rules. Group one consists of benzene, ethylbenzene, toluene, and xylenes (BTEX). Group two consists of naphthalene, benzo(a)pyrene, benz(a)anthracene and chrysene; TEH default values are incorporated into the Iowa Tier 1 Look-Up Table and Appendix A for group two chemicals.

d. *Site classification.* A site can be classified as no action required only after all pathways have met the conditions for pathway clearance as provided in this rule.

e. Groundwater sampling procedure. Groundwater sampling and field screening must be conducted in accordance with department Tier 1 guidance. A minimum of three properly constructed groundwater monitoring wells must be installed, subject to the limitations on maximum drilling depths, for the purpose of identifying maximum concentrations of groundwater contamination, suspected sources of releases, and groundwater flow direction.

(1) Field screening must be used to locate suspected releases and to determine locations with the greatest concentrations of contamination. Field screening is required as per department guidance at each former and current tank basin, each former and current pump island, along the piping, and at any other areas of actual or suspected releases. In placing monitoring wells, the following must be considered: field screening data, available current and historical information regarding the releases, tank and piping layout, site conditions, and drilling data available from sites in the vicinity. At least one well must be placed at each suspected source of release which shall include at a minimum: the pump island with the greatest field screening level, each current and former underground storage tank basin, and if field screening shows greater levels than at the pump islands or tank basins, at other suspected sources of releases. As a general rule, wells should be installed outside of the tank basin through native soils but as close to the tank basin as feasible. A well must be installed in a presumed downgradient direction and within 30 feet of the sample with the greatest field screening level. Three of the wells must be placed in a triangular arrangement to determine groundwater flow direction.

(2) Where the circumstances which prompt a Tier 1 assessment identify a discrete source and cause of a release, and the groundwater professional is able to rule out other suspected sources or contributing sources such as pump islands, piping runs and tank basins, the application of field screening and groundwater well placement may be limited to the known source.

f. Soil sampling procedure. The objective of soil sampling is to identify the maximum concentrations of soil contamination in the vadose and saturated zones and to identify sources of releases. The same principles stated above apply to soil sampling. Soil samples must be taken from borings with the greatest field screening levels even if the boring will not be converted to a monitoring well. At a minimum, soil and groundwater samples must be collected for analysis from all borings which are converted to monitoring wells.

Iowa Tier 1 Look-Up Table

Media	Exposure Pathway	Receptor	Group 1				Group 2: TEH	
			Benzene	Toluene	Ethylbenzene	Xylenes	Diesel*	Waste Oil
Groundwater (µg/L)	Groundwater Ingestion	Actual	5	1,000	700	10,000	1,200	400
		Potential	290	7,300	3,700	73,000	75,000	40,000
	Groundwater Vapor to Enclosed Space	All	1,540	20,190	46,000	NA	2,200,000	NA
	Groundwater to Water Line	PVC or Gasketed Mains	7,500	6,250	40,000	48,000	75,000	40,000
		PVC or Gasketed Service Lines	3,750	3,120	20,000	24,000	75,000	40,000
		PE/PB/AC Mains or Service Lines	200	3,120	3,400	19,000	75,000	40,000
	Surface Water	All	290	1,000	3,700	73,000	75,000	40,000
Soil (mg/kg)	Soil Leaching to Groundwater	All	0.54	42	15	NA	3,800	NA
	Soil Vapor to Enclosed Space	All	1.16	48	79	NA	47,500	NA
	Soil to Water Line	All	2.0	3.2	45	52	10,500	NA

NA: Not applicable. There are no limits for the chemical for the pathway, because for groundwater pathways the concentration for the designated risk would be greater than the solubility of the pure chemical in water, and for soil pathways the concentration for the designated risk would be greater than the soil concentration if pure chemical were present in the soil.

TEH: Total Extractable Hydrocarbons. The TEH value is based on risks from naphthalene, benzo(a)pyrene, benz(a)anthracene, and chrysene. Refer to Appendix B for further details.

Diesel*: Standards in the Diesel column apply to all low volatile petroleum hydrocarbons except waste oil.

135.9(2) *Conditions requiring Tier 1 site assessment.* Unless owners and operators choose to conduct a Tier 2 assessment, the presence of bedrock requires a Tier 2 assessment as provided in 135.8(5), or these rules otherwise require preparation of a Tier 2 site assessment, a Tier 1 site assessment must be completed in response to release confirmation as provided in rule 567—135.6(455B), or tank closure investigation under 567—135.15(455B), or other reliable laboratory analysis which confirms the presence of contamination above the action levels in 567—135.14(455B).

135.9(3) *Tier 1 assessment report.* Unless directed to do otherwise by the department or the owners or operators choose to prepare a Tier 2 site cleanup report, owners and operators must assemble information about the site and the nature of the release in accordance with the department Tier 1 guidance, including information gained while confirming the release under 567—135.6(455B), tank closure under 567—135.15(455B) or completing the initial abatement measures in 135.7(1) and 135.7(2). This information must include, but is not necessarily limited to, the following:

a. Data on the nature and estimated quantity of release.

b. Results of any release investigation and confirmation actions required by subrule 135.6(3).

c. Results of the free product investigations required under 135.7(3)*"a"*(6), to be used by owners and operators to determine whether free product must be recovered under 135.7(5).

d. Chronology of property ownership and underground storage tank ownership, identification of the person(s) having control of, or having responsibility for the daily operation of the underground storage tanks and the operational history of the underground storage tank system. The operational history shall include, but is not limited to, a description of or suspected known subsurface or aboveground releases, past remediation or other corrective action, type of petroleum product stored, recent tank and

piping tightness test results, any underground storage tank system repairs, upgrades or replacements and the underground storage tank and piping leak detection method being utilized. The operational history shall confirm that current release detection methods and record keeping comply with the requirements of 567—135.5(455B), that all release detection records have been reviewed and report any evidence that a release detection standard has been exceeded as provided in 135.5(4) and 135.5(5).

e. Appropriate diagrams of the site and the underground storage tank system and surrounding land use, identifying site boundaries and existing structures and uses such as residential properties, schools, hospitals, child care facilities and a general description of relevant land use restrictions and known future land use.

f. Current proof of financial responsibility as required by 567—136.19(455B) and 567—136.20(455B) and the status of coverage for corrective action under any applicable financial assurance mechanism or other financial assistance program.

g. A receptor survey including but not limited to the following: existing buildings, enclosed spaces (basements, crawl spaces, utility vaults, etc.), conduits (gravity drain lines, sanitary and storm sewer mains and service lines), water lines and other utilities within 500 feet of the source. For conduits and enclosed spaces, there must be a description of construction material, conduit backfill material, slope of conduit and trenches (include flow direction of sewers), burial depth of utilities or subsurface enclosed spaces, and the relationship to groundwater elevations.

h. An explosive vapor survey of enclosed spaces where there may be the potential for buildup of explosive vapors. The groundwater professional must provide a specific justification for not conducting an explosive vapor survey.

i. A survey of all surface water bodies within 200 feet of the source.

j. A survey of all active, abandoned and plugged groundwater wells within 1,000 feet of the source with a description of construction and present or future use.

k. Accurate and legible site maps showing the location of all groundwater monitoring wells, soil borings, field screening locations and screening values, and monitoring well and soil boring construction logs.

l. A tabulation of all laboratory analytical results for chemicals of concern and copies of the laboratory analytical reports.

m. Results of hydraulic conductivity testing and description of the procedures utilized.

n. A Tier 1 site assessment in accordance with the department's Tier 1 guidance. The Tier 1 report shall be submitted on forms and in a format prescribed by this guidance.

135.9(4) *Groundwater ingestion pathway assessment.* The groundwater ingestion pathway addresses the potential for human ingestion of petroleum-regulated substances from existing groundwater wells or potential drinking water wells.

a. *Pathway completeness.* This pathway is considered complete if: (1) there is a drinking or non-drinking water well within 1,000 feet of the source(s) exhibiting the maximum concentrations of the chemicals of concern; or (2) the first encountered groundwater is a protected groundwater source.

b. *Receptor evaluation.* A drinking or non-drinking water well within 1,000 feet of the source(s) is an actual receptor. The Tier 1 levels for actual receptors apply to drinking water wells and the Tier 1 levels for potential receptors apply to non-drinking water wells. Potential receptor points of exposure exist if the first encountered groundwater is a protected groundwater source but no actual receptors presently exist within 1,000 feet of the source.

c. *Pathway clearance.* If the pathway is incomplete, no further action is required for this pathway. If the Tier 1 level for actual or potential receptors is not exceeded, no further action is required for this pathway. Groundwater wells that are actual or potential receptors may be plugged in accordance with 567—Chapter 39 and 567—Chapter 49 and may result in no further action clearance if the groundwater is not a protected groundwater source and the pathway is thereby incomplete.

d. *Corrective action response.* If maximum concentrations exceed the applicable Tier 1 levels for either actual or potential receptors, a Tier 2 assessment must be conducted unless effective institutional controls are implemented as provided below. Technological controls are not acceptable at Tier 1 for

this pathway. Abandonment and plugging of drinking and non-drinking water wells in accordance with 567—Chapters 39 and 49 is an acceptable corrective action response.

e. Use of institutional controls. To apply an effective institutional control, if drinking or non-drinking water wells are present within 1,000 feet of the source, and the applicable Tier 1 level is exceeded, the well(s) for which there is an exceedence must be properly plugged. If the groundwater is a protected groundwater source and the maximum concentrations do not exceed the Tier 1 level for potential receptors but do exceed the Tier 1 level for actual receptors, the owner or operator must provide notification of site conditions on a department form to the department water supply section, or if a county has delegated authority, then the designated county authority responsible for issuing private water supply construction permits or regulating non-public water well construction as provided in 567—Chapters 38 and 49.

If the groundwater is a protected source and the maximum concentrations exceed the Tier 1 level for potential receptors, the owner or operator must (1) implement an institutional control prohibiting the use of the groundwater for installation of drinking and non-drinking water wells within 1,000 feet of the source; and (2) provide notification as provided above. If an effective institutional control is not feasible, a Tier 2 assessment must be performed for this pathway in accordance with rule 567—135.10(455B).

f. Receptor evaluation for public water supply wells. Rescinded IAB 3/11/09, effective 4/15/09.

135.9(5) *Soil leaching to groundwater pathway assessment.* This pathway addresses the potential for soil contamination to leach to groundwater creating a risk of human exposure through the groundwater ingestion pathway.

a. Pathway completeness. If the groundwater ingestion pathway is complete, the soil leaching to groundwater pathway is considered complete.

b. Receptor evaluation. There is a single receptor type for this pathway and one applicable Tier 1 level.

c. Pathway clearance. If the pathway is incomplete or the pathway is complete and the maximum concentrations of chemicals of concern do not exceed the Tier 1 levels, no further action is required for assessment of this pathway.

d. Corrective action response. If the Tier 1 levels are exceeded for this pathway, a Tier 2 assessment must be conducted or alternatively, institutional controls or soil excavation may be undertaken in accordance with 135.9(7)*"h."*

e. Use of institutional controls. Institutional controls must satisfy the conditions applicable to the groundwater ingestion pathway as provided in 135.9(4)*"e."*

135.9(6) *Groundwater vapor to enclosed space pathway assessment.* This pathway addresses the potential for vapors from contaminated groundwater to migrate to enclosed spaces where humans could inhale chemicals of concern at unacceptable levels. This pathway assessment assumes the health-based Tier 1 levels will adequately protect against any associated short- and long-term explosive risks.

a. Pathway completeness. This pathway is always considered complete for purposes of Tier 1 and must be evaluated.

b. Explosive vapor survey. An explosive vapor survey must be conducted in accordance with procedures outlined in the department Tier 1 guidance. If potentially explosive levels are detected, the groundwater professional must notify the owner or operator with instructions to report the condition in accordance with 567—Chapter 131. The owner or operator must begin immediate response and abatement procedures in accordance with 567—135.7(455B) and 567—Chapter 133.

c. Receptor evaluation. For purposes of Tier 1, there is one receptor type for this pathway and the Tier 1 level applies regardless of the existence of actual or potential receptors.

d. Pathway clearance. No further action is required for this pathway, if the maximum groundwater concentrations do not exceed the Tier 1 levels for this pathway.

e. Corrective action response. If the maximum concentrations exceed the Tier 1 levels for this pathway, a Tier 2 assessment of this pathway must be conducted unless institutional controls are implemented. Technological controls are not acceptable at Tier 1 for this pathway.

f. Use of institutional controls. An institutional control must be effective to prohibit the placement of enclosed space receptors within 500 feet of the source.

135.9(7) *Soil vapor to enclosed space pathway assessment.* This pathway addresses the potential for vapors from contaminated soils to migrate to enclosed spaces where humans could inhale chemicals of concern at unacceptable levels. This pathway assessment assumes health-based screening levels at Tier 1 will adequately protect against short- and long-term explosive risks.

a. Pathway completeness. This pathway is always considered complete for purposes of Tier 1 and must be evaluated.

b. Explosive vapor survey. An explosive vapor survey must be conducted in accordance with procedures outlined in the department Tier 1 guidance. If potentially explosive levels are detected, the groundwater professional must notify the owner or operator with instructions to report the condition in accordance with 567—Chapter 131. The owner or operator must begin immediate response and abatement procedures in accordance with 567—135.7(455B) and 567—Chapter 133.

c. Receptor evaluation. For purposes of Tier 1, there is one receptor type for this pathway, and the Tier 1 level applies regardless of existing or potential receptors.

d. Pathway clearance. No further action is required for this pathway, if the maximum soil concentrations do not exceed the Tier 1 levels for this pathway. If the Tier 1 levels are exceeded, soil gas measurements may be taken in accordance with the Tier 2 guidance at the area(s) of maximum concentration. Subject to confirmation sampling, if the soil gas measurements do not exceed the target levels in 135.10(7)*"f,"* no further action is required for this pathway. If the Tier 1 level is not exceeded but the soil gas measurement exceeds the target level, further action is required for the pathway.

e. Soil gas samples. To establish that the soil gas measurement is representative of the highest expected levels, a groundwater professional must obtain two soil gas samples taken at least two weeks apart. One of the samples should be collected beneath the frost line depth during a seasonal period of lowest groundwater elevation.

f. Corrective action response. If the maximum concentrations exceed the Tier 1 levels and the soil gas measurements exceed target levels for this pathway, or if no soil gas measurement was taken, a Tier 2 assessment of this pathway must be conducted unless institutional controls are implemented or soil excavation is conducted as provided below. Technological controls are not acceptable at Tier 1 for this pathway.

g. Use of institutional controls. An institutional control must be effective to eliminate the placement of enclosed space receptors within 500 feet of the source.

h. Soil excavation. Excavation of contaminated soils for the purpose of removing soils contaminated above the Tier 1 levels is permissible as an alternative to conducting a Tier 2 assessment. Adequate field screening methods must be used to identify maximum concentrations during excavation. At a minimum, one soil sample must be taken for field screening every 100 square feet of the base and each sidewall. Soil samples must be taken for laboratory analysis at least every 400 square feet of the base and each sidewall of the excavated area to confirm that remaining concentrations are below Tier 1 levels. If the base or a sidewall of the excavation is less than 400 square feet, a minimum of one sample must be analyzed for each sidewall and the base.

135.9(8) *Groundwater to water line pathway assessment.* This pathway addresses the potential for creating a drinking water ingestion risk due to contact with water lines and causing infusion to the drinking water.

a. Pathway completeness and receptor evaluation.

(1) Actual receptors. This pathway is considered complete for an actual receptor if there is an existing water line within 200 feet of the source and the first encountered groundwater is less than 20 feet below ground surface.

(2) Potential receptors. This pathway is considered complete for a potential receptor if the first encountered groundwater is less than 20 feet below ground surface.

b. Pathway clearance. If the pathway is not complete, no further action is required for this pathway. If the pathway is complete and the maximum concentrations of all chemicals of concern do not exceed the Tier 1 levels for this pathway, no further action is required for this pathway.

c. *Utility company notification.* The utility company which supplies water service to the area must be notified of all actual and potential water line impacts as soon as knowledge of a potential risk is determined.

d. *Corrective action response.*

(1) For actual receptors, if the Tier 1 levels are exceeded for this pathway, all water lines within 200 feet must be replaced with water line materials and gasket materials of appropriate construction in accordance with current department standards set forth in 567—Chapter 43 and with no less than nitrile or FKM gaskets or as otherwise approved by the department, or the water lines must be relocated beyond the 200-foot distance from the source. A Tier 2 assessment must be conducted for this pathway if lines are not replaced or relocated.

(2) For potential receptors, upon utility company notification, no further action will be required for this pathway.

135.9(9) *Soil to water line pathway assessment.* This pathway addresses the potential for creating a drinking water ingestion risk due to contact with water lines and infusion into the drinking water.

a. *Pathway completeness and receptor evaluation.*

(1) Actual receptors. This pathway is considered complete for an actual receptor if a water line exists within 200 feet of the source.

(2) Potential receptors. This pathway is always considered complete for potential receptors.

b. *Pathway clearance.* If the pathway is not complete for actual receptors, no further action is required for this pathway. If the pathway is complete for actual receptors and the maximum concentrations of all chemicals of concern do not exceed Tier 1 levels for this pathway, no further action is required. For potential receptors, upon utility company notification, no further action will be required for this pathway for potential receptors.

c. *Utility company notification.* The utility company which supplies water service to the area must be notified of all actual and potential water line impacts as soon as knowledge of a potential risk is determined.

d. *Corrective action response.* For actual receptors, if the Tier 1 levels are exceeded for this pathway, all water lines within 200 feet must be replaced with water line materials and gasket materials of appropriate construction in accordance with current department standards set forth in 567—Chapter 43 and with no less than nitrile or FKM gaskets or as otherwise approved by the department, or the water lines must be relocated beyond the 200-foot distance from the source. Excavation of soils to below Tier 1 levels may be undertaken in accordance with 135.9(7)*"h."* If none of these options is implemented, a Tier 2 assessment must be conducted for this pathway.

135.9(10) *Surface water pathway assessment.* This pathway addresses the potential for contaminated groundwater to impact surface water bodies creating risks to human health and aquatic life.

a. *Pathway completeness.* This pathway is considered complete if a surface water body is present within 200 feet of the source. For purposes of Tier 1, surface water bodies include both general use segments and designated use segments as provided in 567—subrule 61.3(1).

b. *Receptor evaluation.* The Tier 1 levels for this pathway only apply to designated use segments of surface water bodies as provided in 567—subrules 61.3(1) and 61.3(5). The point of compliance is the source with the highest concentrations of chemicals of concern. General use segments of surface water bodies as provided in 567—paragraph 61.3(1)*"a"* are only subject to the visual inspection criteria.

c. *Visual inspection requirements.* A visual inspection of all surface water bodies within 200 feet of the source must be conducted to determine if there is evidence of a sheen on the water or there is evidence of petroleum residue along the bank. If a sheen or residue is evident or has been reported to be present, the groundwater professional must make a sufficient investigation to reasonably determine its source. If in the opinion of the groundwater professional, the sheen is not associated with the underground storage tank site, the professional must report and reasonably justify this opinion. If in the opinion of the groundwater professional the sheen is not a petroleum-regulated substance, a sample must be laboratory tested in accordance with 567—135.16(455B) to confirm it is not a petroleum-regulated substance.

d. *Pathway clearance.* If the pathway is not complete or it is complete and the maximum concentrations of all chemicals of concern at the point of compliance do not exceed the Tier 1 levels and there is no petroleum sheen or residue attributable to the site, no further action is required for assessment of this pathway.

e. *Corrective action response.* If a Tier 1 level is exceeded for any chemical of concern for a designated use segment within 200 feet of the source, or the groundwater professional determines the presence of a petroleum-regulated substance sheen or residue, a Tier 2 assessment of this pathway must be conducted.

135.9(11) *Tier 1 submission and review procedures.*

a. Within 90 calendar days of release confirmation or another reasonable period of time determined by the department, owners and operators must submit to the department a Tier 1 report in a format prescribed by the department and in accordance with these rules and the department Tier 1 guidance.

b. If the owner or operator elects to prepare a Tier 2 site cleanup report instead of a Tier 1 assessment, the department must be notified in writing prior to the expiration of the Tier 1 submission deadline. The Tier 2 site cleanup report must be submitted to the department in accordance with rule 567—135.10(455B) within 180 calendar days of release confirmation or another reasonable period of time determined by the department.

c. Tier 1 report completeness and accuracy. A Tier 1 report is considered to be complete if it contains all the information and data required by this rule and the department Tier 1 guidance. The report is accurate if the information and data is reasonably reliable based first on application of the standards in these rules and department guidance and second, generally accepted industry standards.

d. The certified groundwater professional shall include the following certification with the Tier 1 site assessment report:

I, _____, Groundwater Professional Certification No. _____, am familiar with all applicable requirements of Iowa Code section 455B.474 and all rules and procedures adopted thereunder including, but not limited to, 567—Chapter 135 and the Department of Natural Resources Tier 1 guidance. Based on my knowledge of those documents and information I have prepared and reviewed regarding this site, UST Registration No. _____, LUST No._____ I certify that this document is complete and accurate as provided in 567 IAC 135.9(11)*"c"* and meets the applicable requirements of the Tier 1 site assessment.

Signature:

Date:

e. Upon receipt of the groundwater professional's certified Tier 1 report, the groundwater professional's proposed site classification for the site shall be determinative unless, within 90 days of receipt, the department identifies material information in the report that is inaccurate or incomplete. Material information may be data found to be inaccurate or incomplete or a report that lacks information which, if correct and complete, would result in a different site classification than proposed by the certified groundwater professional. If the department determines that the site cleanup report is inaccurate or incomplete, the department shall notify the groundwater professional of the inaccurate or incomplete information within 90 days of receipt of the report and shall work with the groundwater professional and the party responsible for cleanup to obtain correct information or additional information necessary to appropriately classify the site. If the groundwater professional recommends proceeding to Tier 2, or a Tier 2 site cleanup report is required pursuant to 135.7(5)*"g,"* 135.8(5), or 567—135.9(455B), the groundwater professional's site classification and pathway classification recommendations shall not be considered determinative until the Tier 2 report is submitted for review as provided in 135.10(11).

f. If a "no action required" site classification is proposed, the department shall review the report in accordance with 135.12(6) and the review standards in paragraph 135.9(11)*"e."*

135.9(12) *Tier 1 site classification and corrective action response.*

a. No action required site classification. At Tier 1, a site is only eligible for a "no action required" classification. To be classified as no action required, each pathway must meet the requirements for pathway clearance as specified in this rule. If the department determines a no action required site classification is appropriate, a no further action certificate will be issued as provided in 135.12(10).

b. Where an individual pathway or a chemical group meets the requirements for clearance but the site is not entitled to a no action required classification, only those pathways and chemical groups which do not meet the no further action requirements must be evaluated as part of a Tier 2 assessment as provided in rule 567—135.10(455B).

c. Compliance monitoring and confirmation sampling. Compliance monitoring is not an acceptable corrective action at Tier 1. Except for soil gas sampling under 135.9(7), confirmation sampling to verify a sample does not exceed a Tier 1 level is not required. However, the department retains the authority to require confirmation sampling from existing groundwater monitoring wells if a no action required classification is being proposed at Tier 1 and the department has a reasonable basis to question the representative validity of the samples based on, for example, the seasonal bias of the sampling, evidence of multiple sources of releases, marginal groundwater monitoring well locations and analytical variability.

d. *Expedited corrective action.* Expedited corrective action is permissible in accordance with 135.12(11).

[**ARC 7621B**, IAB 3/11/09, effective 4/15/09; **ARC 9011B**, IAB 8/25/10, effective 9/29/10; **ARC 9331B**, IAB 1/12/11, effective 2/16/11; **ARC 5625C**, IAB 5/19/21, effective 6/23/21]

567—135.10(455B) Tier 2 site assessment policy and procedure.

135.10(1) *General conditions.* A Tier 2 site assessment must be conducted and a site cleanup report submitted for all sites which have not obtained a no action required site classification and for all pathways and chemicals of concern groups that have not obtained no further action clearance as provided in 567—135.9(455B). If in the course of conducting a Tier 2 assessment, data indicates the conditions for pathway clearance under Tier 1 no longer exist, the pathway shall be further assessed under this rule. The Tier 2 assessment and report must be completed whenever free product is discovered as provided in 567—135.7(455B). If the owner or operator elects to complete the Tier 2 site assessment without doing a Tier 1 assessment, all the Tier 1 requirements as provided in 567—135.9(455B) must be met in addition to requirements under this rule.

a. *Guidance.* The Tier 2 site assessment shall be conducted in accordance with the department's "Tier 2 Site Assessment Guidance" and these rules. The site cleanup report shall be submitted on forms and in a format prescribed by this guidance. The Tier 2 data analysis shall be performed by using computer software or online application developed by the department.

b. *Classification.* At Tier 2, individual pathways may be classified as high risk or low risk or no action required and separate classification criteria may apply to actual and potential receptors for any pathway. A single pathway may have multiple classifications based on actual or potential receptor evaluations. A pathway must meet both the criteria for actual and potential receptors for the pathway to obtain a classification of no action required. Sites may have multiple pathway classifications. For a site to obtain a no action required classification, all pathways must meet the individual pathway criteria for no action required classification.

c. *Public right-of-way.* As a general rule, public right-of-way will not be considered an area of potential receptor exposure except for potential sanitary sewer evaluation under the soil and groundwater vapor pathways, subrules 135.10(6) and 135.10(7).

135.10(2) *General Tier 2 assessment procedures.*

a. *Objectives.* The objective of a Tier 2 assessment is to collect site-specific data and with the use of Tier 2 modeling determine what actual or potential receptors could be impacted by chemicals of concern and what concentrations at the source are predicted to achieve protection of these receptors. Both Tier 1 and Tier 2 are based on achieving similar levels of protection of human health, safety and the environment.

b. *Groundwater modeling.* Tier 2 uses fate and transport models to predict the maximum distance groundwater contamination is expected to move and the distribution of concentrations of chemicals of concern within this area. The model is used for two basic purposes. One, it is used to predict at what levels of concentration contamination would be expected to impact actual and potential receptors. Two, it is used to determine a concentration at the source which if achieved, and after dispersion and degradation,

would protect actual and potential receptors at the point of exposure. In predicting the transport of contaminants, the models assume the contaminant plume is at "steady state" such that concentrations throughout the plume have reached a maximum level and are steady or decreasing. The Tier 2 models are only designed to predict transport in a direct line between the source and downgradient to a receptor. In order to more reasonably define a modeled plume in all directions, paragraph *"i"* defines a method of decreasing modeled concentrations as a percentage of their distance in degrees from the downgradient direction.

c. Soil vapor models. The soil vapor models are vertical transport models and do not use modeling to predict soil contaminant transport horizontally to receptors.

d. Soil leaching to groundwater modeling. The soil leaching to groundwater model is a model that predicts the maximum concentrations of chemicals of concern that would be expected in groundwater due to vertical leaching from the area of maximum soil concentrations and then incorporates the groundwater transport models to predict contaminant transport through groundwater pathways.

e. Modeling default parameters. The Tier 2 model formulas and applicable parameters are designated in Appendix B and must be followed unless otherwise specified in these rules. Unless otherwise specified, target levels at a point of exposure may be the Tier 1 level(s) or may be determined using site-specific parameters. The target level at a point of exposure is calculated using the Tier 1 formulas in Appendix A and either site-specific measurements or the default values for those parameters identified as "optional" and "site-specific" in Appendix B.

f. Source width. The source width and source length are variables used in modeling and must be determined by the following criteria and as specified in the department's Tier 2 guidance. The following are not to be used as criteria for defining the extent of the contaminant plumes.

(1) Source width (equals S_w in models) for groundwater transport modeling. The sum of group one chemical (benzene, toluene, ethylbenzene, xylenes or "BTEX") concentrations for each groundwater sample is determined and the location of the sample with the maximum total BTEX is identified. Linear interpolation is used to estimate the area where groundwater concentrations would be expected to exceed 50 percent of the maximum BTEX value, and this area is considered for the source width measurement. The same procedure is used to determine source width for group two chemicals, using TEH in groundwater. The width of the groundwater contamination perpendicular to estimated groundwater flow direction (S_w) is determined, and the larger of either group one or group two chemicals is used in the groundwater transport model.

(2) Source width (S_w) and source length (equals W in models) for soil leaching to groundwater transport modeling. Both the source width perpendicular to the estimated groundwater flow direction (S_w) and the source length parallel to the estimated groundwater flow direction (W) are used in the soil leaching to groundwater model. The sum of BTEX concentrations for each soil sample is determined and the location of the sample with the maximum total BTEX is identified. Concentrations from both the vadose zone and the saturated zone must be considered when determining the maximum. Linear interpolation is used to estimate the area where soil concentrations would be expected to exceed 50 percent of the maximum BTEX value, and this area is considered for the source width and source length measurements. The same procedure is used to determine source width for group 2 chemicals, using TEH in soil. Source width and source length measurements for BTEX in groundwater are also taken following the same linear interpolation criteria in *"f"*(1) above. The source width value used in the model is the greatest of either the soil source width measurements or the groundwater source width measurement. The source length value used in the model is the greatest of either of the soil source length measurements or the groundwater length measurement.

g. Modeled simulation line. The simulation line represents the predicted maximum extent of groundwater contamination and distribution of contaminant concentrations between the source(s) and actual or potential receptor locations. The model calculates the simulation line using maximum concentrations at the source(s) and predicting the amount of dispersion and degradation. Modeled data in the simulation line are compared with actual contaminant concentrations to verify the predictive validity of the model and to make risk classification decisions.

h. Modeled site-specific target level (SSTL) line. The modeled SSTL line represents acceptable levels of contaminant concentrations at points between and including the source(s) and an applicable point(s) of exposure or other point(s) of compliance (ex. a potential receptor point of exposure). The SSTL line is calculated by assuming an applicable target level concentration at the point(s) of exposure or point(s) of compliance and modeling back to the source to determine the maximum concentrations at the source (SSTL) that must be achieved to meet the target level at the point of exposure or compliance. Comparison of contaminant concentrations from actual samples to this SSTL line is used to determine a risk classification and determine appropriate corrective action response.

i. Crossgradient and upgradient modeling. In determining the SSTL line and the simulation line in directions other than downgradient, the modeled contaminant concentrations are applied to reduced distances, as specified in the "Tier 2 Guidance." The modeled results are applied to 100 percent of the distance within an angle of 30 degrees on either side of the range of downgradient directions, as specified in Tier 2 guidance. The modeled results are applied to 20 percent of the distance in the upgradient direction and directly proportional distances between these two outer limits. If the groundwater gradient is less than 0.005 or the groundwater contaminant plume shows no definitive direction or shows directional reversals, the modeled concentrations are applied to 100 percent of the distance in all directions from the source. As the downgradient velocity increases, the upgradient modeled distance is reduced to less than 20 percent of the downgradient modeled distance.

j. Plume definition. The purpose of plume definition at Tier 2 is to obtain sufficient data to determine the impact on actual and potential receptors, to determine and confirm the highest levels of contamination, to verify the validity of the models, and to determine groundwater flow direction. The number and location of borings and monitoring wells and the specificity of plume definition will depend on the pathway or pathways being assessed and the actual or potential receptors of concern. Unless otherwise specified, groundwater and soil contamination shall be defined to Tier 1 levels for the applicable pathways. Linear interpolation between two known concentrations must be used to delineate plume extent. Samples with no concentrations detected shall be considered one-half the detection limit for interpolation purposes.

k. Pathway completeness. Unless a pathway has obtained clearance under Tier 1, each pathway must be evaluated at Tier 2. Pathways are generally considered complete (unless otherwise specified) and receptors affected if actual receptors or potential receptor points of exposure exist within the modeled contaminant plume using the modeled simulation line calculated to the applicable target level at a point of exposure. If the actual contaminant plume exceeds the modeled plume, the pathway is complete and must be evaluated if actual or potential points of exposure exist within a distance extending 10 percent beyond the edge of the defined plume.

l. Points of exposure and compliance. For actual receptors, the point(s) of exposure is the receptor. For potential receptors, the potential receptor point(s) of exposure is determined by using actual plume definition or the modeled simulation line to determine all points which exceed the target level(s) for potential receptors. The potential receptor point(s) of exposure is the location(s) closest to the source where a receptor could reasonably exist and which is not subject to an institutional control; for example, the source is the potential receptor point of exposure if not subject to an institutional control or an adjoining property boundary line if that property is not subject to an institutional control. At Tier 2, the point(s) of exposure or potential receptor point(s) of exposure is a point of compliance unless otherwise specified. Other points of compliance are specified by rules and will generally include all points along the SSTL line for purposes of pathway and site classification and corrective action response.

135.10(3) *Bedrock assessment.*

a. General. As provided in 135.8(5), if bedrock is encountered before groundwater, special assessment procedures under this subrule apply. The Tier 2 assessment procedures apply to the extent they are not inconsistent with this subrule. The objectives of these special procedures are to avoid creating a preferential pathway for contamination through a confining layer to a bedrock aquifer; to avoid creating a preferential pathway to a fractured system, and to determine whether groundwater transport modeling can be used and, if not, what alternative procedures are required. The owner or operator may choose to conduct a Tier 3 assessment under 567—135.11(455B) as an alternative to

proceeding under this subrule. For sites where bedrock is encountered before groundwater, there are three general categories of site conditions which determine the assessment procedures that apply:

(1) Nongranular bedrock. Nongranular bedrock is bedrock which is determined to not act as a granular aquifer as provided in subparagraph (2). Nongranular bedrock generally has some type of fractured system where groundwater transport modeling cannot be applied and which makes it difficult to define the extent of contamination.

(2) Granular bedrock. Granular bedrock is bedrock which is determined to act as a granular aquifer and for which monitoring wells do not exist at the source. For purposes of this rule, a granular aquifer is one that shows no extraordinary variations or inconsistencies in groundwater elevations across the site, groundwater flow, hydraulic conductivities, or total dissolved solid concentrations among monitoring wells. Although the extent of contamination can be defined in granular bedrock, groundwater transport modeling cannot be used because monitoring wells shall not be installed at the source if soil contamination is present. If soil contamination above a Tier 1 level is not identified or an overexcavation of contaminated soil has successfully removed all soil contamination greater than a Tier 1 level, then monitoring wells can be installed in the source area and the site can be evaluated as exempt granular bedrock.

(3) Exempt granular bedrock. Exempt granular bedrock is bedrock which is determined to act as a granular aquifer as provided in subparagraph (2) and for which monitoring wells exist at the source as of August 15, 1996. Sites in exempt granular bedrock shall be evaluated using regular Tier 1 and Tier 2 procedures in this rule.

NOTE: Nongranular bedrock is subject to special bedrock assessment procedures even if groundwater monitoring wells exist at the source, because the flow is not predictable by the Tier 2 model.

b. Exempt soil pathways. The soil vapor to enclosed space pathway and the soil to water lines pathway shall be assessed under the regular Tier 2 procedures in subrules 135.10(7) and 135.10(9) respectively. In all cases, the assessment must comply with the policy of avoiding a preferential pathway to groundwater consistent with subrule 135.8(5) and this subrule.

c. Soil and groundwater assessment. The vertical and horizontal extent of soil contamination shall first be defined to Tier 1 levels for the soil leaching to groundwater pathway without drilling into bedrock. A minimum of three groundwater monitoring wells shall be located and installed between 50 to 100 feet beyond the soil contamination Tier 1 levels to avoid creating a preferential pathway. Analytical data as normally required by these rules and guidance must be obtained.

d. Soil contamination remediation. For all sites where soil contamination exceeds the soil leaching to groundwater Tier 1 levels, soil excavation or other active soil remediation technology must be conducted in accordance with department guidance to reduce concentrations to below this Tier 1 level. Soil remediation monitoring must be conducted in accordance with 567—135.12(455B).

e. Groundwater plume definition. If it is determined the groundwater acts in a manner consistent with a granular aquifer as provided in subparagraph *"a"*(2) and guidance but does not meet the criteria for exemption under subparagraph *"a"*(3), the plume must be defined. The policy of avoiding the creation of a preferential pathway to the bedrock aquifer in accordance with 135.8(5) must be followed.

f. Soil leaching to groundwater ingestion pathway. Under this subrule, the soil leaching to groundwater pathway only need be evaluated in combination with the groundwater ingestion pathway. Because of the policies requiring soil remediation to the soil leaching to groundwater Tier 1 levels under paragraphs *"d"* and *"k,"* the soil leaching pathway target levels applicable to other groundwater transport pathways and other soil pathways would not be exceeded. If a soil leaching to groundwater Tier 1 level is exceeded, the pathway is high risk.

g. Special procedures for the groundwater ingestion pathway.

(1) A protected groundwater source is assumed without measurements of hydraulic conductivity for all sites designated as granular or nongranular bedrock.

(2) Groundwater well receptor evaluation for granular and nongranular bedrock designations. All drinking and non-drinking water wells within 1,000 feet of the source must be identified and tested for chemicals of concern. All public water supply systems within one mile of the source must be identified

and raw water tested for chemicals of concern. All area within 1,000 feet of the source is considered a potential receptor point of exposure.

(3) Target levels. The following target levels apply regardless of granular aquifer designation. If drinking water wells are within 1,000 feet of the source, the applicable target level is the groundwater ingestion pathway Tier 1 level for actual receptors. If non-drinking water wells are within 1,000 feet of the source, the applicable target level is the groundwater ingestion pathway Tier 1 level for potential receptors. For potential wells, the applicable target level is the groundwater ingestion pathway Tier 1 level for potential receptors.

(4) Sentry well. If the Tier 1 level for actual receptors is exceeded at sites designated as granular bedrock and the receptor has not yet been impacted, a monitoring well shall be placed between the source and an actual receptor, outside the defined plume and approximately 200 feet from the actual receptor. For alternative well placement, the certified groundwater professional must provide justification and obtain department approval. This monitoring well is to be used for monitoring potential groundwater contamination of the receptor.

(5) High risk classification. A site where bedrock is encountered before groundwater shall be classified high risk for this pathway if any of the following conditions exist regardless of granular aquifer determination: The target level at any actual receptor is exceeded; drinking water well receptors are present within 1,000 feet and groundwater concentrations in any monitoring well exceed the groundwater ingestion Tier 1 level for actual receptors; non-drinking water wells are within 1,000 feet and groundwater concentrations in any monitoring well exceed the groundwater ingestion pathway Tier 1 level for potential receptors; or for sites designated nongranular bedrock, if groundwater concentrations for chemicals of concern from any public water system well within one mile of the source exceed 40 percent of the Tier 1 level for actual receptors, and groundwater concentrations in any monitoring well exceed the groundwater ingestion Tier 1 level for actual receptors. Corrective action shall be undertaken as provided in paragraph *"k."*

(6) Low risk classification. Sites without an actual receptor within 1,000 feet shall be classified as low risk for this pathway if no high risk conditions exist, and the Tier 1 level for potential receptors is exceeded. The site is subject to monitoring as provided in paragraph *"l."* If an actual receptor exists within 1,000 feet, a site designated as granular or nongranular bedrock shall be classified low risk for this pathway when soil contamination has been removed or remediated to below the soil leaching to groundwater Tier 1 levels, and all groundwater monitoring wells are non-detect or below the applicable target level for actual and potential receptors. A site may be reclassified to no action required for this pathway after all monitoring wells meet the exit monitoring criteria as specified in paragraph *"l."* (NOTE: Exit monitoring is required because groundwater monitoring wells are not located at the source or if they are, the data is highly unreliable given the nature of bedrock.) If actual receptors do not exist or have been properly plugged and concentrations exceed the Tier 1 level for potential receptors, institutional controls and notification to permitting authorities may be employed in accordance with 135.10(4)*"i."* The institutional control must prohibit use of groundwater for 1,000 feet.

h. Special procedures for the groundwater vapor to enclosed space pathway.

(1) Soil gas plume. Soil gas measurements must be taken regardless of granular aquifer determination and in accordance with Tier 2 guidance to determine a soil gas plume. Soil gas where practical should be measured at the soil-bedrock interface. At a minimum, soil gas must be measured at the suspected area of maximum contamination and near the three monitoring wells with the highest concentrations that exceed the Tier 1 level for the groundwater to enclosed space pathway. Where the plume has been defined, soil gas measurements should be taken near wells exceeding the Tier 1 level. Other soil gas measurements must be taken as needed to define the extent of contamination where soil gas measurements exceed the soil gas vapor target levels.

(2) The soil gas target levels are those defined in 135.10(7)*"f."*

(3) High risk classification. A site designated as granular or nongranular bedrock shall be classified high risk for this pathway if an actual confined space receptor exists within 50 feet of the soil gas plume based on the soil gas target level as defined in 135.10(6).

(4) Low risk classification. A site designated as granular or nongranular bedrock shall be classified as low risk for this pathway if the soil gas exceeds the vapor target level at any point and no actual confined space receptors exist within 50 feet of the soil gas contaminant plume.

i. Special procedure for the groundwater to water line pathway.

(1) Target level. The applicable target level is the Tier 1 level for the specific type of water line.

(2) High risk classification. A site designated as granular or nongranular bedrock shall be classified high risk for this pathway if the highest groundwater elevation is within three feet of the bottom of a water line as provided in subparagraph 135.10(8)*"a"*(1), risk classification cannot be determined as provided in rule 567—135.12(455B) due to limitations on placement of monitoring wells, and water lines exist within 200 feet of a monitoring well which exceeds the Tier 1 level.

j. Special procedures for the surface water pathway. Any surface water body within 200 feet of the source must be evaluated under the following for sites designated as granular or nongranular bedrock. The provisions of 135.10(10) apply to the extent they are not inconsistent with the following, including the visual inspection requirements.

(1) Point of compliance. The monitoring well closest to the surface water body must be used as the point of compliance to evaluate impacts to designated use segments as described in subrule 135.10(10) and for general use segments that fail the visual inspection criteria of paragraph 135.10(10)*"b."* If the surface water criteria are exceeded for a designated use segment, an allowable discharge concentration must be calculated and met at the point of compliance. For general use segments failing the visual inspection criteria, the acutely toxic target level must be met at the point of compliance.

(2) High risk classification. A site designated as granular or nongranular bedrock shall be classified high risk for this pathway if the surface water body is within 200 feet of the source, risk classification cannot be determined as per 567—135.12(455B) due to limitations on placement of monitoring wells, and the monitoring well closest to the designated use segment exceeds the allowable discharge concentration. A general use segment failing the visual inspection criteria is high risk if, after the sheen is removed, the monitoring well closest to the general use segment exceeds the acutely toxic target level.

(3) Low risk classification. If the allowable discharge concentration is not exceeded at the point of compliance, the site shall be classified as low risk for this pathway and subject to monitoring under paragraph *"l."* The monitoring well closest to the receptor shall serve as the sentry well for monitoring purposes.

k. High risk corrective action response. Owners and operators have the option to conduct a Tier 3 assessment in accordance with 567—135.11(455B).

(1) Groundwater ingestion pathway. For high risk sites, where soil exceeds the soil leaching to groundwater Tier 1 level for actual receptors, soil excavation or other active remediation of soils must be conducted in accordance with department guidance to reduce soil concentrations to below the soil leaching Tier 1 level. Corrective action other than monitoring of groundwater is required at sites designated as nongranular bedrock if the actual receptor has been or is likely to be impacted. Corrective action other than monitoring of groundwater is required at sites designated as granular bedrock if the actual receptor has been impacted or the sentry well required by subparagraph 135.10(3)*"g"*(4) has been impacted above Tier 1 levels. Acceptable corrective action for impacted or vulnerable groundwater wells may include active remediation, technological controls, institutional controls, well plugging, relocation, and well reinstallation with construction measures sufficient to prevent contaminant infiltration to the well and to prevent formation of a preferential pathway.

(2) Groundwater ingestion pathway high risk monitoring. For high risk sites designated as nongranular or granular bedrock, if the soil concentrations do not exceed the soil leaching to groundwater Tier 1 levels or have been reduced to this level by corrective action, and corrective action of groundwater is not required as in subparagraph 135.10(3)*"k"*(1), these sites shall be subject to groundwater monitoring as provided in paragraph 135.10(3)*"l."* Corrective action other than monitoring of groundwater is required at sites designated as granular bedrock if groundwater concentrations exceed the applicable target level less than 200 feet from an actual receptor. Reevaluation of the potential for

impact to actual receptors is required at sites designated as nongranular bedrock if concentrations from monitoring wells increase more than 20 percent of the previous samples.

(3) For water line pathways. For high risk sites, active remediation must be conducted to reduce concentrations below the applicable target levels, or water lines and gaskets must be replaced or relocated, including the use of institutional and technological controls. If lines are polybutylene, polyethylene, or asbestos-cement, the lines must be removed or relocated. All water lines that are replaced must be replaced with water line materials and gasket materials of appropriate construction in accordance with current department standards set forth in 567—Chapter 43 and with no less than nitrile or FKM gaskets or as otherwise approved by the department.

(4) Other pathways. For high risk sites other than groundwater ingestion and water lines, active remediation must be conducted to reduce concentrations below the applicable target levels including the use of institutional and technological controls.

l. *Monitoring.* For high and low risk sites, annual monitoring at a minimum is required as specified below, and potential receptor status for low risk sites must be confirmed. Annual monitoring may be used to meet the exit requirements for no action required classification in accordance with paragraph *"m."*

(1) Groundwater in nongranular bedrock designations. All groundwater monitoring wells must be monitored at least annually.

(2) Groundwater in granular bedrock designations. The following monitoring wells must be monitored at least annually: a well with detected levels of contamination closest to the leading edge of the groundwater plume between the source and the receptor, and a sentry well with concentrations below the applicable target level consistent with subparagraph *"g"*(4) and paragraph *"j."*

(3) Soil gas. For sites where the soil gas target level is exceeded, annual monitoring of soil gas is required at the suspected area of maximum contamination and between the soil gas plume and any actual receptors within 100 feet of the soil gas plume.

m. *No action required classification.* A site may be given a no action required classification after conducting a Tier 2 assessment as provided in this subrule if maximum soil concentrations do not exceed the Tier 1 levels for the soil leaching pathway, and if groundwater exit monitoring criteria and soil gas confirmation sampling are met as specified below.

(1) Groundwater in nongranular bedrock designations. Exit monitoring requires that samples from all groundwater monitoring wells must not exceed the applicable target levels for annual sampling for three consecutive years. If soil contamination above a Tier 1 level is not identified or if an overexcavation has successfully removed all soil contamination greater than a Tier 1 level and monitoring wells are installed in the source area, exit monitoring criteria are met when two consecutive samples collected at least six months apart from all monitoring wells show concentrations less than the lowest target level.

(2) Groundwater in granular bedrock designations. Exit monitoring must be met in two ways: A monitoring well between the source and the receptor must not exceed applicable target levels for three sampling events, and samples must be separated by at least six months; and the three most recent consecutive groundwater samples from a monitoring well between the source and the receptor with detected levels of contamination must show a steady or declining trend and meet the following criteria: The first of the three samples must be greater than detection limits, concentrations cannot increase more than 20 percent from the first of the three samples to the third sample; concentrations cannot increase more than 20 percent from the previous sample; and samples must be collected at least six months apart.

(3) Soil gas. Confirmation sampling for soil gas must be conducted as specified in 135.12(6)*"c."*

n. After receiving a no action required classification, all monitoring wells must be properly plugged in accordance with 567—Chapters 39 and 49.

135.10(4) *Groundwater ingestion pathway assessment.*

a. *Pathway completeness.* Unless cleared at Tier 1, this pathway is complete and must be evaluated under any of the following conditions: (1) the first encountered groundwater is a protected groundwater source; or (2) there is a drinking water well or a non-drinking water well within the modeled groundwater plume or the actual plume as provided in 135.10(2)*"j"* and 135.10(2)*"k."*

b. Receptor evaluation. All drinking and non-drinking water wells located within 100 feet of the largest actual plume (defined to the appropriate target level for the receptor type) must be tested, at a minimum, for chemicals of concern as part of the receptor evaluation. Actual plumes refer to groundwater plumes for all chemicals of concern. Untreated or raw water must be collected for analysis unless it is determined to be infeasible or impracticable.

All existing drinking water wells and non-drinking water wells within the modeled plume or the actual plume as provided in paragraph *"a"* must be evaluated as actual receptors. Potential receptors only exist if the groundwater is a protected groundwater source. Potential receptor points of exposure are those points within the modeled plume or actual plume that exceed the potential point of exposure target level. The point(s) of compliance for actual receptor(s) is the receptor. The point(s) of compliance for potential receptor(s) is the potential receptor point of exposure as provided in 135.10(2)*"j"* and 135.10(2)*"k."*

c. Target levels. For drinking water wells, the target level at the point(s) of exposure is the Tier 1 level for actual receptors. For non-drinking water wells, the target level at the point(s) of exposure is the Tier 1levels for potential receptors. For potential receptors, the target level at the potential receptor point(s) of exposure is the Tier 1 level for potential receptors.

d. The soil leaching to groundwater pathway must be evaluated in accordance with 135.9(5) if this pathway is complete.

e. Modeling. At Tier 2, the groundwater well located within the modeled plume is assumed to be drawing from the contaminated aquifer, and the groundwater transport model is designed to predict horizontal movement to the well. If the groundwater professional determines that assessment of the vertical movement of contamination is advisable to determine the potential or actual impact to the well source, a Tier 3 assessment of this vertical pathway may be conducted. The groundwater professional shall submit a work plan to the department specifying the assessment methods and objectives for approval in accordance with 567—135.11(455B). Factors which should be addressed include, but are not limited to, well depth and construction, radius of influence, hydrogeologic separation of aquifer, preferential pathways, and differing water quality characteristics.

f. Public water supply well assessment. Rescinded IAB 3/11/09, effective 4/15/09.

g. Plume definition. The groundwater plume shall be defined to the applicable Tier 1 level for actual receptors except, where there are no actual receptors and the groundwater is a protected groundwater source, the plume shall be defined to the Tier 1 level for potential receptors.

h. Pathway classification. This pathway shall be classified as high risk, low risk or no action required in accordance with 567—135.12(455B).

i. Corrective action response. Corrective action must be conducted in accordance with 567—135.12(455B). Abandonment and plugging of wells in accordance with 567—Chapters 39 and 49 is an acceptable corrective action response.

j. Use of institutional controls. Institutional controls may be used to obtain no action required pathway classification. If the pathway is complete and the concentrations exceed the applicable Tier 1 level(s) for actual receptors, the drinking or non-drinking water well must be properly plugged in accordance with 567—Chapters 39 and 49 and the institutional control must prohibit the use of a protected groundwater source (if one exists) within the actual or modeled plume as provided in paragraphs 135.10(2)*"j"* and 135.10(2)*"k."* If the Tier 1 level is exceeded for potential receptors, the institutional control must prohibit the use of a protected groundwater source within the actual or modeled plume, whichever is greater. If concentrations exceed the Tier 1 level for drinking water wells and the groundwater is a protected groundwater source, the owner or operator must provide notification of the site conditions on a department form to the department water supply section, or if a county has delegated authority, then the designated county authority responsible for issuing private water supply construction permits or regulating non-public water well construction as provided in 567—Chapters 38 and 49.

k. Notification of well owners. Upon receipt of a Tier 2 site cleanup report and as soon as practicable, the department shall notify the owner of any public water supply well identified within

the Tier 2 site cleanup report that a leaking underground storage tank site is within 2,500 feet and an assessment has been performed.

135.10(5) *Soil leaching to groundwater pathway assessment.*

a. General. The soil leaching to groundwater pathway is evaluated using a one-dimensional model which predicts vertical movement of contamination through soil to groundwater and transported by the groundwater to a receptor. The model is used to predict the maximum concentrations of chemicals of concern that would be present in groundwater beneath a source which is representative of residual soil contamination and maximum soil concentrations. The predicted groundwater concentrations then must be used as a groundwater source concentration to evaluate its impact on other groundwater transport pathways, including the groundwater ingestion pathway, the groundwater vapor pathway, the groundwater water line pathway and the surface water pathway.

b. Pathway completeness. This pathway is complete whenever a groundwater transport pathway is complete as provided in this rule.

c. Plume definition. The soil plume shall be defined to the Tier 1 levels for the soil leaching to groundwater pathway.

d. Receptor evaluation. Receptors for this pathway are the same as the receptors for each complete groundwater transport pathway.

e. Modeling and target levels. The soil and groundwater parameters shall be measured as provided in 135.10(2).

The soil leaching to groundwater model shall be used to calculate the predicted groundwater source concentration. Each applicable groundwater transport pathway model shall then be used in accordance with the rules for that pathway to predict potential impact to actual receptors, the location of potential receptor points of exposure and the site-specific target level (SSTL) in groundwater at the source. This SSTL then is used to calculate a SSTL for soil at the source. If the soil concentrations exceed the SSTL for soil, corrective action response shall be evaluated.

f. Corrective action response. If the maximum soil concentration at the source exceeds the SSTL for soil for actual or potential receptors, corrective action must be taken in accordance with 567—135.12(455B).

135.10(6) *Groundwater vapor to enclosed space pathway assessment.*

a. Pathway completeness. Unless cleared at Tier 1, this pathway is always considered complete for purposes of Tier 2.

b. Explosive vapor survey. If an explosive vapor survey has not been conducted as part of a Tier 1 assessment, an explosive vapor survey of enclosed spaces must be conducted during the Tier 2 assessment in accordance with 135.9(6)*"b"* and procedures outlined in the department's Tier 1 guidance.

c. Confined space receptor evaluation. Actual and potential receptors are evaluated at Tier 2 for this pathway.

(1) Actual receptors. An existing confined space within the modeled groundwater plume or the actual groundwater plume as provided in 135.10(2)*"j"* and 135.10(2)*"k"* is an actual receptor. For the purpose of Tier 2, a confined space is a basement in a building occupied by humans. Buildings constructed with a concrete slab on grade or buildings constructed without a concrete slab, but with a crawl space are not considered confined spaces. Sanitary sewers are considered confined space receptors and preferential pathways if an occupied building exists within 200 feet of where the sewer line crosses over or through actual or modeled groundwater contamination which exceeds the target levels calculated for sewers. The sanitary sewer includes its utility envelope. The point of exposure is the receptor and points of compliance include the locations where target level measurements may be taken as provided in paragraphs *"f"* and *"g."*

(2) Potential receptors. Potential receptors are confined spaces that do not presently exist but could exist in the future. Areas within the actual groundwater plume perimeter or modeled groundwater plume perimeter are considered potential receptor points of exposure. Potential receptors are evaluated and target levels established based on the current zoning as provided in paragraph *"f."* The potential receptor point of exposure is a point of compliance.

d. Owners and operators may be required to address vapor inhalation hazards in occupied spaces other than confined spaces as defined in these rules when evidence arises which would give the department a reasonable basis to believe vapor hazards are present or may occur.

e. Plume definition.

(1) The soil plume must be defined in accordance with 135.10(2)*"f"* for the purposes of estimating source width and source length used in soil leaching to groundwater and groundwater transport models.

(2) The groundwater plume must be defined to the target levels derived from site-specific data as provided in paragraph *"f."*

f. Target levels. Target levels can be based on groundwater concentrations, soil gas measurements, and indoor vapor measurements as provided below.

(1) For actual receptors and potential receptors, groundwater modeling as provided in 135.10(2) is used to calculate the groundwater concentration target level at the point of exposure. Default residential exposure factors, default residential building parameters, and a target risk of 10^{-4} are used to determine target levels for actual receptors and potential receptor points of exposure in residential areas and areas with no zoning. Default nonresidential exposure factors, default nonresidential building parameters, and a target risk of 10^{-4} are used to determine target levels for actual receptors and potential receptor points of exposure in nonresidential areas. Default values are provided in Appendices A and B.

(2) For actual receptors, the indoor vapor target levels are designated in 135.10(7)*"f."* For actual and potential receptors, the soil gas target levels are designated in 135.10(7)*"f."*

(3) Sanitary sewers are treated as human health receptors, and groundwater concentration target levels at the point of exposure are based on the application of a target risk of 2×10^{-4} for carcinogens and a hazard quotient of 2 for noncarcinogens.

g. Pathway evaluation and classification. Upon completion of evaluation of analytical results of appropriate samples and modeled data, the pathway must be classified high risk, low risk or no further action as provided in rule 567—135.12(455B).

(1) Actual receptors. If it can be demonstrated that the groundwater plume has reached steady state concentrations under a confined space, indoor vapor measurements at the point(s) of exposure and soil gas measurements at an alternative point(s) of compliance may be used for the pathway evaluation. When assessing sanitary sewers for pathway clearance, soil gas measurements may be evaluated against the soil gas target levels; however, indoor vapor cannot be used as criteria for pathway clearance. Soil gas measurements shall be taken and analyzed in accordance with 135.16(5) and the department's Tier 2 guidance, and at locations in the plume where measured groundwater concentrations exceed the levels which are projected by modeling to exist beneath the actual receptor. If measured groundwater concentrations beneath the actual receptor exceed the levels projected from modeling, then the soil gas measurements may be taken either adjacent to the actual receptor in areas expected to exhibit the greatest soil gas measurements or at an alternative point of compliance between the source and receptor where the actual groundwater concentrations exceed the groundwater concentrations which exist beneath the confined space. If the soil gas measurements and confirmation samples taken in accordance with 135.12(6)*"c"* do not exceed the soil gas target levels, the pathway as to actual receptors shall be classified no action required. If the soil gas target levels are exceeded, either the pathway shall be classified high risk, or indoor vapor measurements may be taken in accordance with the department's Tier 2 guidance. If indoor vapor measurements and confirmation samples do not exceed the indoor vapor target levels, the pathway as to actual confined space receptors shall be classified no action required. If the Tier 1 indoor vapor target levels are exceeded, the pathway shall be classified high risk.

(2) Potential receptors. If the potential receptor groundwater concentration target level(s) is exceeded at any potential receptor point of exposure based on actual data or modeling, the pathway shall be classified low risk. However, if soil gas measurements taken at the potential receptor point(s) of exposure and alternate point(s) of compliance and confirmation samples do not exceed the target levels in 135.10(7)*"f,"* the pathway, as to potential receptors, shall be classified no action required. If the target level(s) for potential sanitary sewer receptors is exceeded, the pathway shall be classified as low risk. Where the area of potential receptor exposure includes public right-of-way, the pathway may be classified as no action required if the owner or operator provides sufficient documentation

to establish that there are no foreseeable plans for construction of sanitary sewers through the area of potential receptor exposure. The municipal authority must acknowledge consent to the no action required classification whenever target levels are exceeded. If the municipal authority reports that it has confirmed plans for construction of sanitary sewers through the area of potential receptor exposure, the pathway shall be reevaluated as an actual receptor.

h. Corrective action response. Unless the pathway is classified as no action required, corrective action for this pathway must be conducted as provided in 567—135.12(455B). Actual receptors are subject to corrective actions which: (1) reduce groundwater concentrations beneath the enclosed space to below the target level; (2) reduce the measured soil gas levels to below the soil gas target levels; (3) reduce the indoor vapor concentrations to below the indoor vapor target level; or (4) reduce the vapor level to below 10 percent of the lower explosive limit (LEL), if applicable. Potential receptors are subject to the monitoring requirements in 135.12(5). Soil vapor monitoring may be conducted in lieu of groundwater monitoring for this pathway. Institutional or technological controls as provided in 567—135.12(455B) may be used.

i. Municipal authority notification for potential sewer receptors. The municipal authority responsible for sewer construction must be notified of the environmental conditions whenever target level(s) is exceeded for potential sanitary sewers. The notification must show the area where groundwater concentrations and soil gas samples exceed target levels. The owner or operator must acknowledge what plans, if any, exist for construction of sanitary sewers through the area of potential receptor exposure.

135.10(7) *Soil vapor to enclosed space pathway assessment.*

a. Pathway completeness. Unless cleared at Tier 1, this pathway is always considered complete for purposes of Tier 2.

b. Explosive vapor survey. If an explosive vapor survey has not been conducted as part of a Tier 1 assessment, an explosive vapor survey of enclosed spaces must be conducted during the Tier 2 assessment in accordance with 135.9(6)*"b"* and procedures outlined in the department's Tier 1 guidance.

c. Confined space receptor evaluation. Actual and potential receptors are evaluated at Tier 2 for this pathway.

(1) Actual receptors. An existing confined space within 50 feet of the edge of the plume is an actual receptor. For the purpose of Tier 2, a confined space is a basement in a building occupied by humans. Buildings constructed with a concrete slab on grade or buildings constructed without a concrete slab, but with a crawl space are not considered receptors. Sanitary sewers are considered confined space receptors and preferential pathways if an occupied building exists within 200 feet of where the sewer line crosses over or through soil contamination which exceeds the target levels calculated for sewers. The sanitary sewer includes its utility envelope. The point of exposure is the receptor and points of compliance include the locations where target level measurements may be taken as provided in paragraphs *"f"* and *"g."*

(2) Potential receptors. Potential receptors are confined spaces that do not presently exist but could exist in the future. Areas where soil concentrations are greater than the Tier 1 level applicable to residential areas or alternative target levels for nonresidential areas as specified in paragraph *"f"* are considered potential receptor points of exposure. Potential receptors are evaluated and target levels established based on the current zoning. An area with no zoning is considered residential. The potential receptor point of exposure is a point of compliance.

d. Owners and operators may be required to address vapor inhalation hazards in occupied spaces other than confined spaces as defined in these rules when evidence arises which would give the department a reasonable basis to believe vapor hazards are present or may occur.

e. Plume definition. The soil plume must be defined to the Tier 1 level for this pathway unless vapor measurements taken at the area(s) with the maximum levels of soil contamination do not exceed the soil gas target level in 135.10(7)*"f."* If soil gas measurements taken from the area(s) of maximum soil concentration do not exceed target levels, confirmation sampling must be conducted in accordance with 135.12(6)*"c"* prior to proposing a no action pathway classification.

f. Target levels. Target levels can be based on soil concentrations, soil gas measurements, and indoor vapor measurements as provided below:

(1) For actual receptors, the soil concentration target level is the Tier 1 level. For potential receptors, the soil concentration target level for residential areas and areas with no zoning is the Tier 1 level. For areas zoned nonresidential, the target level is calculated using the default nonresidential exposure factors and building parameters from Appendix A and a target risk of 10^{-4} .

(2) The following indoor vapor target levels apply to actual receptors other than sanitary sewers and the soil gas target levels apply to all actual and potential receptors. These levels were derived from the ASTM indoor air inhalation and the soil vapor to enclosed space models designated in Appendix A.

	Indoor Vapor ($\mu g/m^3_{air}$)	**Soil Gas ($\mu g/m^3$)**
Benzene	39.2	600,000
Toluene	555	9,250,000

(3) Sanitary sewers are treated as human health receptors, and soil concentration target levels at the point of exposure are based on application of a target risk of 2 x 10^{-4} for carcinogens and hazard quotient of 2 for noncarcinogens.

g. Pathway evaluation and classification.

(1) Actual receptors. Confined space receptors may be evaluated using soil gas measurements and indoor vapor measurements. When assessing sanitary sewers for pathway clearance, soil gas measurements may be evaluated against the soil gas target levels, however, indoor vapor cannot be used as criteria for pathway clearance. Soil gas measurements shall be taken adjacent to the actual receptor or at an alternative point of compliance between the source and receptor such as the property boundary, and in accordance with 135.16(5) and the department's Tier 2 guidance. If the soil gas measurements and confirmation samples taken in accordance with 135.12(6)*"c"* do not exceed the soil gas target levels, the pathway as to actual receptors shall be classified no action required. If the soil gas target levels are exceeded, either the pathway shall be classified high risk, or indoor vapor measurements may be taken in accordance with the department's Tier 2 guidance. If indoor vapor measurements and confirmation samples do not exceed the indoor vapor target levels, the pathway as to actual receptors shall be classified no action required. If the indoor vapor target levels are exceeded, the pathway shall be classified high risk.

(2) Potential receptors. If the potential receptor target level(s) based on soil concentrations is exceeded at any potential receptor point of exposure, the pathway shall be classified low risk. However, if soil gas measurements taken at the potential receptor point(s) of exposure and alternate point(s) of compliance and confirmation samples do not exceed the target levels in paragraph *"f,"* the pathway shall be classified no action required as to potential receptors. If the target level(s) for potential sanitary sewer receptors is exceeded, the pathway shall be classified as low risk. Where the area of potential receptor exposure includes public right-of-way, the pathway may be classified as no action required if the owner or operator provides sufficient documentation to establish that there are no foreseeable plans for construction of sanitary sewers through the area of potential receptor exposure. The municipal authority must acknowledge consent to the no action required classification whenever target levels are exceeded. If the municipal authority reports that it has confirmed plans for construction of sanitary sewers through the area of potential receptor exposure, the pathway shall be reevaluated as an actual receptor.

h. Corrective action response. Unless the pathway is classified as no action required, corrective action for this pathway must be conducted as provided in 567—135.12(455B) and in accordance with department Tier 2 guidance. Actual receptors are subject to corrective actions which: (1) reduce the indoor vapor concentrations to below the target level; (2) reduce measured soil gas levels to below the soil gas target levels; and (3) if applicable, reduce the vapor level to below 10 percent of the lower explosive limit (LEL). Potential receptors are subject to monitoring requirements as provided in 135.12(5). Soil vapor monitoring may be conducted in lieu of soil monitoring for this pathway. Institutional or technological controls as provided in 567—135.12(455B) may be used.

i. Municipal authority notification for potential sewer receptors. The municipal authority responsible for sewer construction must be notified of the environmental conditions whenever target level(s) is exceeded for potential sanitary sewers. The notification must show the area where soil concentrations and soil gas samples exceed target levels. The owner or operator must acknowledge what plans, if any, exist for construction of sanitary sewers through the area of potential receptor exposure.

135.10(8) *Groundwater to water line pathway assessment.*

a. Pathway completeness and receptor evaluation.

(1) Actual receptors include all water lines where the highest groundwater elevation is higher than three feet below the bottom of the water line at the measured or predicted points of exposure. The highest groundwater elevation is the estimated average of the highest measured groundwater elevations for each year. All water lines must be evaluated for this pathway regardless of distance from the source and regardless of the Tier 1 evaluation, if the lines are in areas with actual data above the applicable Tier 1 level and modeled data above the SSTL line. If actual data exceeds modeled data, then all water lines are considered actual receptors if they are within a distance extending 10 percent beyond the edge of the contaminant plume defined by the actual data.

(2) Potential receptors include all areas where the first encountered groundwater is less than 20 feet deep and where actual data or modeled data are above Tier 1 levels.

(3) The point(s) of exposure is the water line, and the points of compliance are monitoring wells between the source and the water line which would be effective in monitoring whether the line has been or may be impacted by chemicals of concern.

b. Plume definition. If this pathway is complete for an actual receptor, the groundwater plume must be defined to the Tier 1 levels, with an emphasis between the source and any actual water lines. The water inside the water lines shall be analyzed for all chemicals of concern.

c. Target levels. Groundwater modeling as provided in 135.10(2) must be used to calculate the projected concentrations of chemicals of concern and site-specific target levels. The soil leaching to groundwater pathway must be evaluated to ensure contaminated soil will not cause future groundwater concentrations to exceed site-specific target levels. The target level at the point(s) of exposure is the Tier 1 level.

d. Pathway evaluation and classification. Upon completion of evaluation of analytical results of appropriate samples and modeled data, the pathway must be classified high risk, low risk or no further action as provided in rule 567—135.12(455B). The water quality inside the water lines is not a criterion for clearance of this pathway.

e. Utility company notification. The utility company which supplies water service to the area must be notified of all actual and potential water line impacts as soon as knowledge of a potential risk is determined. If the extent of contamination has been defined, this information must be included in utility company notification, and any previous notification made at Tier 1 must be amended to include this information.

f. Corrective action response.

(1) For actual receptors, unless the pathway is classified as no further action, corrective action for this pathway must be conducted as provided in 567—135.12(455B). If the concentrations of chemicals of concern in a water line exceed the Tier 1 levels for actual receptors for the groundwater ingestion pathway, immediate corrective action must be conducted to eliminate exposure to the water, including but not limited to replacement of the line with an approved material.

(2) For potential receptors, upon utility company notification, no further action will be required for this pathway for potential receptors.

135.10(9) *Soil to water line pathway assessment.*

a. Pathway completeness and receptor evaluation.

(1) Actual receptors include all water lines within ten feet of the soil plume defined to the Tier 1 level. All water lines must be evaluated for this pathway regardless of distance from the source if the lines are in areas where Tier 1 levels are exceeded.

(2) Potential receptors include all areas where Tier 1 levels are exceeded.

b. Plume definition. The extent of soil contamination must be defined to Tier 1 levels for the chemicals of concern.

c. Target level. The point(s) of exposure includes all areas within ten feet of the water line. The target level at the point(s) of exposure is the Tier 1 level.

d. Pathway classification. Upon completion of evaluation of analytical results of appropriate samples, the pathway must be classified high risk, low risk or no further action as provided in rule 567—135.12(455B). Measurements of water quality inside the water lines may be required, but are not allowed as criteria to clear this pathway.

e. Utility company notification. The utility company which supplies water service to the area must be notified of all actual and potential water line impacts as soon as knowledge of the potential risk is determined. If the extent of contamination has been defined, this information must be included in utility company notification, and any previous notification made at Tier 1 must be amended to include this information.

f. Corrective action response.

(1) For actual receptors, unless the pathway is classified as no further action, corrective action for this pathway must be conducted as provided in 567—135.12(455B).

(2) For potential receptors, upon utility company notification, no further action will be required for this pathway for potential receptors.

135.10(10) *Surface water pathway assessment.*

a. Pathway completeness. Unless maximum concentrations are less than the applicable Tier 1 levels, this pathway is complete and must be evaluated under any of the following conditions: (1) there is a designated use surface water within the modeled groundwater plume or the actual plume as provided in 135.10(2)*"f"* and 135.10(2)*"g"*; or (2) any surface water body which failed the Tier 1 visual inspection as provided in 135.9(10).

b. Visual inspection. A visual inspection must be conducted according to 135.9(10)*"c."* If a sheen or residue from a petroleum-regulated substance is present, soil and groundwater sampling must be conducted to identify the source of the release and to define the extent of the contaminant plume to the levels acutely toxic to aquatic life as provided in 567—subrule 61.3(2).

c. Receptor evaluation.

(1) Surface water criteria apply only to designated use segments of surface water bodies as provided in 567—subrules 61.3(1) and 61.3(5). If the surface water body is a designated use segment and if maximum groundwater concentrations exceed applicable surface water criteria, the extent of contamination must be defined as provided in paragraph *"d."* The point of compliance for measuring chemicals of concern at the point of exposure is the groundwater adjacent to the surface water body because surface water must be protected for low flow conditions. In-stream measurements of concentrations are not allowed as a basis for no further action.

(2) If the visual inspection indicates the presence of a petroleum sheen in a general use segment within 200 feet of the source, as defined in 567—paragraph 61.3(1)*"a,"* the segment must be evaluated as an actual receptor. The point of compliance for measuring chemicals of concern at the point of exposure is the groundwater adjacent to the general use segment.

d. Plume definition. The groundwater plume must be defined to the surface water criteria levels for designated use segment receptors and to the acutely toxic levels for general use segment receptors, with an emphasis between the source and the surface water body.

e. Target levels. Determining target levels for this pathway involves a two-step process.

(1) Groundwater modeling as provided in subrule 135.10(2) must be used to calculate the projected concentrations of chemicals of concern at the point of compliance. If the modeled concentrations or field data at the point of compliance exceed surface water criteria for designated use segments, an allowable discharge concentration must be calculated. If the projected concentrations and actual concentrations at the point of compliance do not exceed surface water criteria, no further action is required to assess this pathway.

(2) The department water quality section will calculate the allowable discharge concentration using information provided by the certified groundwater professional on a department form. Required

information includes, at a minimum, the site location and a discharge flow rate calculated according to the department's Tier 2 guidance. The allowable discharge concentration is the target level which must be met adjacent to the surface water body which is the point of compliance.

(3) The target level at the point of exposure/compliance for general use segments subject to evaluation is the acutely toxic levels established by the department under 567—Chapter 61 and 567—subrule 62.8(2). If the modeled concentrations of contaminant concentrations at the point of exposure/compliance exceed the acutely toxic levels, modeling must be used to determine site classifications and corrective action in accordance with rule 567—135.12(455B).

f. *Pathway evaluation and classification.* Upon completion of evaluation of analytical results of appropriate samples and modeled data, the pathway must be classified high risk, low risk or no further action as provided in rule 567—135.12(455B).

(1) For general use segments, as defined in 567—subrule 61.3(1), if the groundwater professional determines there is no sheen or residue present or if the site is not the source of the sheen or residue or if the sheen does not consist of petroleum-regulated substances, no further action is required for assessment of this pathway. If a petroleum-regulated substance sheen is present, the pathway is high risk and subject to classification in accordance with rule 567—135.12(455B).

(2) For designated use segments, as provided in 567—subrules 61.3(1) and 61.3(5), if projected concentrations of chemicals of concern and actual contaminant concentrations at the point of compliance do not exceed the target level adjacent to the surface water, and the groundwater professional determines there is no sheen or residue present, no further action is required for assessment of this pathway.

g. *Corrective action response.* Unless the pathway is classified as no further action, corrective action for this pathway must be conducted as provided in 567—135.12(455B). For surface water bodies failing the visual inspection criteria, corrective action must eliminate the sheen and reduce concentrations to below the site specific target level in accordance with 567—135.12(455B).

135.10(11) *Tier 2 submission and review procedures.*

a. Owners and operators must submit a Tier 2 site cleanup report within 180 days of the date the department approves or is deemed to approve a Tier 1 assessment report under 135.9(12). If the owner or operator has elected to conduct a Tier 2 assessment instead of a Tier 1, or a Tier 2 assessment is required due to the presence of free product under 135.7(5), the Tier 2 site cleanup report must be submitted within 180 days of the date the release was confirmed. The department may establish an alternative schedule for submittal.

b. Site cleanup report completeness and accuracy. A Tier 2 site cleanup report is considered to be complete if it contains all the information and data required by this rule and the department's Tier 2 guidance. The report is considered accurate if the information and data are reasonably reliable based first on the standards in these rules and department guidance, and second, on generally accepted industry standards.

c. The certified groundwater professional responsible for completion of the Tier 2 site assessment and preparation of the report must accompany each Tier 2 site cleanup report with a certification as set out below:

I, _____, groundwater professional certification number _____, am familiar with all applicable requirements of Iowa Code section 455B.474 and all rules and procedures adopted thereunder including, but not limited to, the Department of Natural Resources' Tier 2 guidance. Based on my knowledge of those documents and the information I have prepared and reviewed regarding this site, UST registration number _____, LUST No._____, I certify that this document is complete and accurate as provided in 135.10(11) and meets the applicable requirements of the Tier 2 site cleanup report.

Signature

Date

d. Upon receipt of the groundwater professional's certified Tier 2 report, the groundwater professional's proposed site classification for the site shall be determinative unless, within 90 days of receipt, the department identifies material information in the report that is inaccurate or incomplete. Material information may be data found to be inaccurate or incomplete or a report that lacks information

which, if accurate and complete, would result in a different site or pathway classification than proposed by the certified groundwater professional. If the department determines that the site cleanup report is inaccurate or incomplete, the department shall notify the groundwater professional of the inaccurate or incomplete information within 90 days of receipt of the report and shall work with the groundwater professional and the party responsible for cleanup to obtain correct information or additional information necessary to appropriately classify the site. If the groundwater professional recommends proceeding to Tier 3, the groundwater professional's site classification and any pathway classification recommendations subject to or influenced by a Tier 3 assessment shall not be considered determinative until the Tier 3 report is submitted for review as provided in 567—135.11(455B).

e. If a "no action required" site classification is proposed, the department shall review the report in accordance with 135.12(6) and the review standards in paragraph 135.10(11)*"d."*

f. The department may, in the interest of minimizing environmental or public health risks and promoting a more effective cleanup, require owners and operators to begin cleanup of soil and groundwater before the Tier 2 site cleanup report is approved.

g. *Review of the public water supply receptor risk assessment.* Rescinded IAB 3/11/09, effective 4/15/09.

[**ARC 7621B**, IAB 3/11/09, effective 4/15/09; **ARC 9011B**, IAB 8/25/10, effective 9/29/10; **ARC 9331B**, IAB 1/12/11, effective 2/16/11; **ARC 5625C**, IAB 5/19/21, effective 6/23/21]

567—135.11(455B) Tier 3 site assessment policy and procedure.

135.11(1) *General.* Tier 3 site assessment. Unless specifically limited by rule or an imminent hazard exists, an owner or operator may choose to prepare a Tier 3 site assessment as an alternative to completion of a Tier 2 assessment under 567—135.10(455B) or as an alternative to completion of a corrective action design report under 567—135.12(455B). Prior to conducting a Tier 3 site assessment, a groundwater professional must submit a work plan to the department for approval. The work plan must contain an evaluation of the specific site conditions which justify the use of a Tier 3 assessment, an outline of the proposed Tier 3 assessment procedures and reporting format and a method for determining a risk classification consistent with the policies underlying the risk classification system in 567—135.12(455B). Upon approval, the groundwater professional may implement the assessment plan and submit a report within a reasonable time designated by the department.

135.11(2) *Tier 3 site assessment.* A Tier 3 assessment may include but is not limited to the use of more site-specific or multidimensional models and assessment data, methods for calibrating Tier 2 models to make them more predictive of actual site conditions, and more extensive assessment of receptor construction and vulnerability to contaminant impacts. If use of Tier 2 models is proposed with substitution of other site-specific data (as opposed to the Tier 2 default parameters), the groundwater professional must adequately justify how site-specific data is to be measured and why it is necessary. The groundwater professional must demonstrate that the proposal has a proven applicability to underground storage tank sites or similar conditions or has a strong theoretical basis for applicability and is not biased toward underestimating assessment results. The Tier 3 assessment report shall make a recommendation for site classification as high risk, low risk or no action required, at least two corrective action response technologies and provide justification consistent with the standards and policies underlying risk classification and corrective action response under 567—135.12(455B) and Iowa Code chapter 455B, Division 4, Part 8.

135.11(3) *Review and submittal.* The department will review the Tier 3 assessment for compliance with the terms of the approved work plan and based on principles consistent with these rules and Iowa Code chapter 455B, Division IV, Part 8. Upon approval of the Tier 3 assessment, the department may require corrective action in accordance with 567—135.12(455B).

567—135.12(455B) Tier 2 and 3 site classification and corrective action response.

135.12(1) *General.* 1995 Iowa Code section 455B.474(1)*"d"*(2) provides that sites shall be classified as high risk, low risk and no action required. Risk classification is accomplished by comparing actual contaminate concentrations to the concentrations that are predicted by the use of models. Concentrations must be compared to the simulation model which uses the maximum concentrations

at a source and predicts at what levels actual or potential receptors could be impacted in the future. Concentrations must also be compared to the site-specific target level line which assumes a target level concentration at the point of exposure and is used to predict the reduction in concentration that must be achieved at the source in order to meet the applicable target level at the point of exposure. These models not only predict concentrations at points of exposure or a point of compliance at a source but also predict a distribution of concentrations between the source and the point of exposure which may also be points of compliance. The comparison of contaminate concentrations with these distribution curves primarily is considered for purposes of judging whether the modeled data is reasonably predictive and what measures such as monitoring are prudent to determine the reliability of modeled data and actual contaminate concentrations.

For the soil vapor to enclosed space and soil to water line pathways, there are no horizontal transport models to use for predicting future impacts. Therefore, for these pathways, sites are classified as high risk, low risk or no action required based on specified criteria below and in rule 567—135.10(455B).

135.12(2) *High risk classification.* Except as provided below, sites shall be classified as high risk if, for any pathway, any actual contaminate concentrations exceed the site-specific target level line at any point for an actual receptor.

a. For the soil vapor to enclosed space and soil to water line pathways, sites shall be classified as high risk if the target levels for actual receptors are exceeded as provided in 135.10(7) and 135.10(9).

b. For the soil vapor or groundwater vapor to enclosed space pathways, sites shall be classified as high risk if the explosivity levels at applicable points of compliance are exceeded as provided in 135.10(6) and 135.10(7).

c. Generally, sites are classified as low risk if only potential receptor points of compliance are exceeded. The following is an exception. For the soil leaching to groundwater ingestion pathway for potential receptor conditions, the site shall be classified as high risk if the groundwater concentration(s) exceeds the groundwater Tier 1 level for potential receptor and the soil concentration exceeds the soil leaching site-specific target level at the source.

135.12(3) *High risk corrective action response.*

a. Objectives. The primary objectives of corrective action in response to a high risk classification are both short-term and long-term. The short-term goal is to eliminate or reduce the risk of exposure at actual receptors which have been or are imminently threatened with exposure above target levels. The longer term goal is to prevent exposure to actual receptors which are not currently impacted or are not imminently threatened with exposure. To achieve these objectives, it is the intent of these rules that concentrations of applicable chemicals of concern be reduced by active remediation to levels below the site-specific target level line at all points between the source(s) and the point(s) of exposure as well as to undertake such interim corrective action as necessary to eliminate or prevent exposure until concentrations below the SSTL line are achieved. If it is shown that concentrations at all applicable points have been reduced to below the SSTL line, the secondary objective is to establish that the actual chemical concentrations can be reasonably relied upon to predict future conditions at points of exposure rather than reliance on the modeled data. Reliance on actual contaminant concentrations is achieved by establishing through monitoring that concentrations within the contaminant plume are steady or declining. Institutional controls and technological controls may be used to sever pathways or control the risk of receptor impacts.

b. For the groundwater to water line and soil to water line receptors, these objectives are achieved by active remediation, replacement or relocation of high risk water line receptors in the actual and modeled plume areas. If water lines and gaskets are replaced in an area of contamination, they must be replaced with water line materials and gasket materials of appropriate construction in accordance with current department standards set forth in 567—Chapter 43 and with no less than nitrile or FKM gaskets or as otherwise approved by the department.

c. In areas of free product, all water lines, regardless of construction material, must be relocated unless there is no other option and the department has approved an alternate plan of construction. Refer to subparagraph 135.7(5) *"d"* (11). If a service line remains in the area of LNAPL, a backflow preventer shall be installed to prevent impacts to the larger water distribution system.

d. For the soil vapor pathway, these objectives are achieved by active remediation of soil contamination below the target level at the point(s) of exposure or other designated point(s) of compliance using the same measurement methods for receptor evaluation under 135.10(7) and 135.10(9).

e. For a site classified as high risk or reclassified as high risk for the soil leaching to groundwater ingestion pathway, these objectives are achieved by active remediation of soil contamination to reduce the soil concentration to below the site-specific target level at the source.

f. A corrective action design report (CADR) must be submitted by a certified groundwater professional for all high risk sites unless the terms of a corrective action plan are formalized in a memorandum of agreement within a reasonable time frame specified by the department. The CADR must be submitted on a form provided by the department and in accordance with department CADR guidance within 60 days of site classification approval as provided in 135.10(11). The CADR must identify at least two principally applicable corrective action options designed to meet the objectives in 135.12(3), an outline of the projected timetable and critical performance benchmarks, and a specific monitoring proposal designed to verify its effectiveness and must provide sufficient supporting documentation consistent with industry standards that the technology is effective to accomplish site-specific objectives. The CADR must contain an analysis of its cost-effectiveness in relation to other options. The department will review the CADR in accordance with 135.12(9).

g. *Interim monitoring.* From the time a Tier 2 site cleanup report is submitted and until the department determines a site is classified as no action required, interim monitoring is required at least annually for all sites classified as high risk. Groundwater samples must be taken: (1) from a monitoring well at the maximum source concentration; (2) from a transition well, meaning a monitoring well with detected levels of contamination closest to the leading edge of the groundwater plume as defined to the pathway-specific target level, and between the source(s) and the point(s) of exposure; and (3) from a guard well, meaning a monitoring well between the source(s) and the point(s) of exposure with concentrations below the SSTL line. If a receptor is located within an actual plume contoured to the applicable target level for that receptor, the point of exposure must be monitored. If concentrations at the receptor already exceed the applicable target level for that receptor, corrective actions must be implemented as soon as practicable. Monitoring conducted as part of remediation or as a condition of establishing a no action required classification may be used to the extent it meets these criteria. Soil monitoring is required at least annually for all applicable pathways in accordance with 135.12(5)*"d."* All drinking water wells and non-drinking water wells within 100 feet of the largest actual plume (defined to the appropriate target level for the receptor type) must be tested annually for chemicals of concern. Actual plumes refer to groundwater plumes for all chemicals of concern.

h. Remediation monitoring. Remediation monitoring during operation of a remediation system is required at least four times each year to evaluate effectiveness of the system. A remediation monitoring schedule and plan must be specified in the corrective action design report and approved by the department.

i. Technological controls. The purpose of a technological control is to effectively sever a pathway by use of technologies such that an applicable receptor could not be exposed to chemicals of concern above an applicable target risk level. Technological controls are an acceptable corrective action response either alone or in combination with other remediation systems. The purpose of technological controls may be to control plume migration through use of containment technologies, barriers, etc., both as an interim or permanent corrective action response or to permanently sever a pathway to a receptor. Controls may also be appropriate to treat or control contamination at the point of exposure. Any technological control proposed as a permanent corrective action option without meeting the reduction in contaminant concentrations objectives must establish that the pathway to a receptor will be permanently severed or controlled. The effectiveness of a technological control must be monitored under a department approved plan until concentrations fall below the site-specific target level line or its effectiveness as a permanent response is established, and no adverse effects are created.

j. Following completion of corrective action, the site must meet exit monitoring criteria to be reclassified as no action required as specified in 135.12(6)*"c."* At any point where an institutional or

technological control is implemented and approved by the department, the site may be reclassified as no action required consistent with 135.12(6).

135.12(4) *Low risk classification.* A site shall be classified as low risk if none of the pathways are high risk and if any of the pathways are low risk. A pathway shall be classified low risk if it meets one of the following conditions:

a. For actual and potential receptors, if the modeled data and the actual concentrations are less than the site-specific target level line, and any of the actual concentrations are greater than the simulation line.

b. For potential receptors, if any actual concentrations exceed the site-specific target level line at any point.

c. For the soil leaching to groundwater ingestion pathway where modeling predicts that the Tier 1 levels for potential receptors would be exceeded in groundwater at applicable potential receptor points of compliance and the soil concentration exceeds the soil leaching to groundwater site-specific target level but groundwater concentrations are currently below the Tier 1 level for potential receptors, the site shall be initially classified as low risk and subject to monitoring under subparagraph 135.12(5)*"d"*(2). If at any time during the three-year monitoring period, groundwater concentrations exceed the Tier 1 level for potential receptors, the site shall be classified as high risk requiring soil remediation in accordance with paragraph 135.12(3)*"d."*

135.12(5) *Low risk corrective action response.*

a. Purpose. For sites or pathways classified as low risk, the purpose of monitoring is to determine if concentrations are decreasing such that reclassification to no action required may be appropriate or if the contaminant plume is stable such that reclassification to no action required can be achieved with implementation of an institutional control in accordance with 135.12(8), or if concentrations are increasing above the site-specific target level line such that reclassification to high risk is appropriate. Monitoring is necessary to evaluate impacts to actual receptors and assess the continued status of potential receptor conditions. Low risk monitoring shall be conducted and reported by a certified groundwater professional.

b. For sites or pathways classified as low risk, provide a best management practices plan. The plan must include maintenance procedures, schedule of activities, prohibition of practices, and other management practices, or a combination thereof, which, after problem assessment, are determined to be the most effective means of monitoring and preventing additional contamination of the groundwater and soil. The plan will also contain a contamination monitoring proposal containing sufficient sampling points to ensure the detection of any significant movement of or increase in contaminant concentration.

c. Groundwater monitoring. For groundwater pathways, samples must be taken at a minimum of once per year: (1) from a monitoring well at the maximum source concentration; (2) a transitional well meaning a well with detected levels of contamination closest to the leading edge of the groundwater plume as defined to the pathway-specific target level and between the source and the receptor; and (3) a guard well meaning a monitoring well between the source and the point of exposure with concentrations below the SSTL line. (NOTE: Monitoring under this provision may be used to satisfy exit monitoring if it otherwise meets the criteria in 135.12(6).)

d. Soil monitoring.

(1) For the soil vapor to enclosed space pathway potential receptors, soil gas samples must be taken at a minimum of once per year in the area(s) of expected maximum vapor concentrations where an institutional control is not in place.

(2) For the soil leaching to groundwater pathway potential receptors, annual groundwater monitoring is required for a minimum of three years as provided in *"c"* above. If groundwater concentrations are below the applicable SSTL line for all three years, no further action is required. If groundwater concentrations exceed the applicable SSTL line in any of the three years, corrective action is required to reduce soil concentrations to below the Tier 1 levels for soil leaching to groundwater. Therefore, annual monitoring of soil is not applicable.

(3) For the soil to water line pathway potential receptors, notification of the utility company is required. Notification will result in reclassification to no action required. Therefore, annual monitoring of soil is not applicable.

e. Receptors must be evaluated at least annually to ensure no actual or modeled data are above the site-specific target level line for any actual receptors. Potential receptor areas of concern must be evaluated at least annually and the presence of no actual receptors confirmed. If actual receptors are present or reasonably expected to be brought into existence, the owner or operator must report this fact to the department as soon as practicable. Annual monitoring which also meets the exit criteria under 135.12(6) may be used for that purpose.

f. The site or pathway must meet exit monitoring criteria to be reclassified as no action required as specified in 135.12(6)*"b."* If concentrations for actual receptors increase above the site-specific target level line or potential receptor status changes to actual receptor status, the site must be reclassified as high risk and further corrective action required in accordance with 135.12(3).

135.12(6) *No action required classification.* A site shall be classified as no action required if all of the pathways are classified as no action required as provided below:

a. Soil pathways shall be classified as no action required if samples are less than the applicable target levels as defined for each pathway and confirmational sampling requirements have been met.

b. For initial classification, groundwater pathways shall be classified as no action required if the contaminant concentrations are below the site-specific target level line and all concentrations are at or less than the simulation line, and confirmation monitoring has been completed successfully. Confirmation sampling for groundwater is a second sample which confirms the no action required criteria.

c. A groundwater pathway shall be reclassified from high risk to no action required if all contaminant concentrations are below the site-specific target level and if exit monitoring criteria have been met. Exit monitoring criteria means that the three most recent consecutive groundwater samples from all monitoring wells must show a steady or declining trend and the most recent samples are below the site-specific target level. Other criteria include the following: The first of the three samples for the source well and transition well must be more than detection limits; concentrations cannot increase more than 20 percent from the first of the three samples to the third sample; concentrations cannot increase more than 20 percent of the previous sample; and samples must be separated by at least six months.

d. A low risk site shall be reclassified as "no action required" if contaminant concentrations are below the site-specific target level and if exit monitoring criteria have been met pursuant to paragraph 135.12(6)*"c"* or if the site has maintained less than the applicable target level for four consecutive sampling events separated by at least six months as defined in the monitoring plan regardless of exit monitoring criteria and guidance.

e. Confirmation sampling for soil gas and indoor vapor. For the enclosed space pathways, confirmation sampling is required to reasonably establish that the soil gas and indoor vapor samples represent the highest expected levels. A groundwater professional must obtain two samples taken at least two weeks apart. One of the samples should be collected beneath the frost line depth during a seasonal period of lowest groundwater elevation.

f. As a condition of obtaining site classification as no action required, all groundwater monitoring wells must be properly plugged in accordance with 567—Chapters 39 and 49 unless the department requires selected wells to be maintained or a written request with justification and a plan for properly maintaining the wells are submitted to the department for approval. Approval to maintain wells shall be deemed granted if not disapproved with reason within 30 days of request.

g. Prior to acceptance of a request to classify the site as no action required, and in the event there is a question of validity of the data or sampling methods, laboratory analysis procedures, indication of plume movement, or the department obtains information about new conditions at the site, the department may conduct or require the owner to conduct confirmation sampling of the soil, groundwater, soil gas, or indoor vapor to confirm that the no action required criteria have been met.

h. The department may waive, at its discretion, the exit monitoring criteria based on a certified groundwater professional's written justification to support a no action required classification for the site based on a reasoned assessment of data, trends, receptor status, and corrective actions performed. One example is when steady and declining criteria have not been met due solely to variations among a laboratory's lowest achievable detection limits.

135.12(7) *Reclassification.* Any site or pathway which is classified as high risk may be reclassified to low risk if in the course of corrective action the criteria for low risk classification are established. Any site or pathway which is classified as low risk may be reclassified to high risk if in the course of monitoring the conditions for high risk classification are established. Sites subject to department-approved institutional or technological controls are classified as no action required if all other criteria for no action required classification are satisfied.

135.12(8) *Use of institutional and technological controls.*

a. Purpose. The purpose of an institutional control is to restrict access to or use of property such that an applicable receptor could not be exposed to chemicals of concern for as long as the target level is exceeded at applicable points of exposure and compliance. Institutional controls include:

1. A law of the United States or the state;
2. A regulation issued pursuant to federal or state laws;
3. An ordinance or regulation of a political subdivision in which real estate subject to the institutional control is located;
4. An environmental covenant as provided in 2005 Iowa Code Supplement section 455B.474(1)*"f"*(4)(f) and in accordance with the provisions of 2005 Iowa Code Supplement chapter 455I and 567—Chapter 14;
5. Any other institutional control the owner or operator can reasonably demonstrate to the department will reduce the risk from a release throughout the period necessary to ensure that no applicable target level is likely to be exceeded.

b. Modification or termination of institutional and technological controls. At a point when the department determines that an institutional or technological control has been removed or is no longer effective for the purpose intended, regardless of the issuance of a no further action certification or previous site classification, it may require owners and operators to undertake such reevaluation of the site conditions as necessary to determine an appropriate site classification and corrective action response. If the owner or operator is in control of the affected property, the department may require reimplementation of the institutional or technological control or may require a Tier 2 assessment of the affected pathway(s) be conducted to reevaluate the site conditions and determine alternative corrective action response. An owner or operator subject to an institutional or technological control may request modification or termination of the control by conducting a Tier 2 assessment of the affected pathway or conduct such other assessment as required by the department to establish that the control is no longer required given current site conditions.

c. If the owner or operator is not in control of the affected property or cannot obtain control and the party in control refuses to continue implementation of an institutional control, the department may require the owner or operator to take such legal action as available to enforce institution of the control or may require the owner or operator to undertake a Tier 2 assessment to determine site classification and an alternative corrective action response. If a person in control of the affected property appears to be contractually obligated to maintain an institutional or technological control, the department may, but is not required to, attempt enforcement of the contractual obligation as an alternative to requiring corrective action by the owner or operator.

d. If a site is classified no action required, subject to the existence of an institutional control or technological control, the holder of the fee interest in the real estate subject to the institutional control or technological control may request, at any time, that the department terminate the institutional control or technological control requirement. The department shall terminate the requirement for an institutional control if the holder demonstrates by completion of a Tier 2 assessment of the applicable pathway or other assessment as required by the department that the site conditions warranting the control no longer exist and that the site or pathway has met exit criteria for no action required classification under 135.12(6).

135.12(9) *Corrective action design report submission and review procedures.*

a. Owners and operators must submit a corrective action design report (CADR) within 60 days of the date the department approves or is deemed to approve a Tier 2 assessment report under 135.10(11) or a Tier 3 assessment is to be conducted. The department may establish an alternative schedule for submittal. As an alternative to submitting a CADR, owners or operators may participate in a corrective action

meeting process to develop a corrective action plan which would be incorporated into a memorandum of agreement or other written agreement approved by the department. Owners or operators shall implement the terms of an approved CADR, memorandum of agreement or other corrective action plan agreement.

b. Corrective action design report completeness and accuracy. A CADR is considered to be complete if it contains all the information and data required by this rule and the department's guidance. The report is considered accurate if the information and data are reasonably reliable based first on the standards in these rules and department guidance, and second, on generally accepted industry standards.

c. The certified groundwater professional responsible for completion of the CADR must provide the following certification with the CADR:

I, _____, groundwater professional certification number _____, am familiar with all applicable requirements of Iowa Code section 455B.474 and all rules and procedures adopted thereunder including, but not limited to, the Department of Natural Resources' guidance and specifications for corrective action design reports. Based on my knowledge of those documents and the information I have prepared and reviewed regarding this site, UST registration number _____, LUST No._____, I certify that this document is complete and accurate as provided in 135.12(9) and meets the applicable requirements of the corrective action design report, and that the recommended corrective action can reasonably be expected to meet its stated objectives.

Signature

Date

d. Review. A CADR submitted by a groundwater professional shall be accepted by the department and shall be primarily relied upon by the department to determine the corrective action response requirements of the site. However, if within 90 days of receipt of a CADR, the department identifies material information in the CADR that is inaccurate or incomplete, and if based upon information in the report the appropriate corrective action response cannot be reasonably determined by the department based on industry standards, the department may reject the report and require modifications. If the department does not reject the report within 90 days of receipt, the report shall be deemed approved as submitted unless changes to the report are requested by the groundwater professional. The department shall work with the groundwater professional and the owner or operator to correct any materially inaccurate information or to obtain the additional information necessary to determine the appropriate corrective action response as soon as practicable.

e. Memorandums of agreement. Owners or operators that fail to implement the actions or meet the activity schedule in a memorandum of agreement resulting from a corrective action meeting or other written corrective action plan agreement or that fail to implement the actions or meet the schedule outlined in an approved CADR are subject to legal action.

135.12(10) *Monitoring certificates and no further action certificates.*

a. Monitoring certificate. The department of natural resources will issue a monitoring certificate to the owner or operator of an underground storage tank from which a release has occurred, the current property owner, or other responsible party who has undertaken the corrective action warranting issuance of the certificate. Sites classified as low risk or sites classified as high risk/monitoring shall be eligible for a monitoring certificate. The monitoring certificate will be valid until the site is reclassified to a high risk requiring active remediation or no action required site. A site which has been issued a monitoring certificate shall not be eligible to receive a certificate evidencing completion of remediation until the site is reclassified as no action required. The monitoring certificate will be invalidated and the site reclassified to high risk if it is determined by the department that the owner of the site is not in compliance with the requirements specified in the monitoring certificate.

b. No further action certificate. When the no action required site classification has been determined based on a recommendation of the certified groundwater professional as provided in subrules 135.9(11), 135.10(11) and 135.12(6) (see also Iowa Code section 455B.474(1)*"a"*(8)(a) and (c)), the department shall issue a no further action certificate.

The department will issue a no further action certificate to an owner or operator of an underground storage tank from which a release has occurred, the current property owner, or other responsible party

who has undertaken the corrective action warranting classification of the site as no action required. Prior to the issuance of a no further action certificate, an accurate legal description of the property on which the underground storage tanks are or were formerly located shall be submitted to the department. The following conditions apply:

(1) If free product is present, the department shall not issue a no further action certificate until the department has approved termination of all free product assessment and recovery in accordance with 135.7(5).

(2) The site has been determined by a certified groundwater professional not to present an unreasonable risk to the public health and safety or the environment.

(3) A person issued the certificate or a subsequent purchaser of the site cannot be required to perform further corrective action because action standards are changed at a later date. Action standards refer to applicable standards under this rule.

(4) The certified groundwater professional has certified that all groundwater monitoring wells have been permanently closed in accordance with 135.12(6)*"f"* with the exception of wells that are allowed to be maintained pursuant to 135.12(6)*"f."* Wells not properly maintained shall be referred to the water supply section of the department that enforces 567—Chapter 39 and 567—Chapter 49.

(5) The certificate shall not prevent the department from ordering remediation of a release identified subsequent to the release for which the no further action certificate was issued. The certificate shall not prevent the department from requiring corrective action of a release of a regulated substance from an unregulated tank.

(6) The certificate will not constitute a warranty of any kind to any person as to the condition, marketability or value of the described property.

(7) The certificate shall reflect any institutional control utilized to ensure compliance with any applicable Tier 2 level; and may include a notation that the classification is based on the fact that designated potential receptors are not in existence.

(8) The certificate shall be in a form which is recordable in accordance with Iowa Code section 558.1 et seq., and substantially in the form as provided in Appendix C.

(9) The owner or operator or other persons conducting corrective action shall be responsible for recording the no further action certificate with the county recorder and return a file-stamped copy to the department within 30 days of the issue date. At its discretion, the department may record the no further action certificate with the appropriate county recorder as authorized in Iowa Code section 455B.474(1)*"a"*(8)(c).

c. The department shall modify any issued no further action certificates containing institutional controls once the owner, operator or their successor or assign has demonstrated that the institutional control is no longer necessary to meet the applicable Tier 2 level as provided in 135.12(10).

135.12(11) *Expedited corrective action.* An owner, operator or responsible party of a site at which a release of regulated substance is suspected to have occurred may carry out corrective actions at the site so long as the department receives notice of the expedited cleanup activities prior to 30 calendar days of their commencement; the owner, operator, or responsible party complies with the provisions of these rules; and the corrective action does not include active treatment of groundwater other than:

a. As previously approved by the department; or

b. Free product recovery pursuant to subrule 135.7(5).

c. Soil overexcavation. When undertaking overexcavation of contaminated soils, adequate field screening methods must be used to identify maximum concentrations during excavation. At a minimum one soil sample must be taken for field screening every 100 square feet of the base and each sidewall. Soil samples must be taken for laboratory analysis at least every 400 square feet of the base and each sidewall of the excavated area to confirm remaining concentrations are below Tier 1 levels. If the excavation is less than 400 square feet, a minimum of one sample must be analyzed for each sidewall and the base. The owner or operator must maintain adequate records of the excavation area to document compliance with this procedure unless submitted to the department and must provide it to the department upon request.

[**ARC 9011B**, IAB 8/25/10, effective 9/29/10; **ARC 9331B**, IAB 1/12/11, effective 2/16/11; **ARC 5625C**, IAB 5/19/21, effective 6/23/21]

567—135.13(455B) Public participation.

135.13(1) For each confirmed release that is classified as high or low risk, the department must provide notice to the public by means designated to reach those members of the public directly affected by the release and the recommended corrective action response. This notice may include, but is not limited to, public notice in local newspapers, block advertisements, public service announcements, publication in a state register, letters to individual households, or personal contacts by the staff.

135.13(2) The department must ensure site release information and decisions concerning the Tier 1 assessment report, Tier 2 and Tier 3 site cleanup reports are made available to the public for inspection upon request.

135.13(3) Before approving the Tier 2 or Tier 3 site cleanup report, the department may hold a public meeting to consider comments on the proposed corrective action response if there is sufficient public interest, or for any other reason.

135.13(4) The department must give a public notice that complies with subrule 135.13(1) above if the implementation of the approved Tier 2 or Tier 3 site cleanup report does not achieve the established cleanup levels in the report and the termination of that report is under consideration by the department.

567—135.14(455B) Action levels. The following corrective action levels apply to petroleum-regulated substances as regulated by this chapter. These action levels shall be used to determine if further corrective action under rules 567—135.6(455B) through 567—135.12(455B) or rule 567—135.15(455B) is required as the result of tank closure sampling under subrule 135.15(3) or other analytical results submitted to the department. The contaminant concentrations must be determined by laboratory analysis as stated in rule 567—135.16(455B). Final cleanup determination is not limited to these contaminants. The contamination corrective action levels are:

	Soil (mg/kg)	**Groundwater (ug/L)**
Benzene	0.54	5
Toluene	3.2	1,000
Ethylbenzene	15	700
Xylenes	52	10,000
Total Extractable Hydrocarbons—Diesel	3,800	1,200
Total Extractable Hydrocarbons—Waste Oil		400

[**ARC 9011B**, IAB 8/25/10, effective 9/29/10; **ARC 5625C**, IAB 5/19/21, effective 6/23/21]

567—135.15(455B) Out-of-service UST systems, temporary closure, and permanent closure.

135.15(1) *Out-of-service UST systems and temporary closure.*

a. UST systems not meeting either the performance standards in subrule 135.3(1) for new UST systems or the upgrading requirements in subrule 135.3(2) by December 22, 1998, must be permanently closed according to subrule 135.15(2). The tanks cannot be brought back into use.

b. When a UST system in compliance with new tank standards is out of service for less than three months, owners and operators must:

(1) Continue operation and maintenance of corrosion protection in accordance with subrule 135.4(2);

(2) Continue operation and maintenance of any release detection in accordance with rule 567—135.5(455B) unless the system is empty. The UST system is empty when all materials have been removed using commonly employed practices. No more than 2.5 centimeters (1 inch) of residue, or 0.3 percent by weight of the total capacity of the UST system, may remain in the system;

(3) Comply with rules 567—135.6(455B) to 567—135.12(455B) if a release is suspected or confirmed;

(4) Maintain financial responsibility (e.g., insurance) in accordance with 567—Chapter 136. If at any time financial responsibility coverage is or will be terminated, a site check for contamination must be completed before coverage is terminated. A site check must use the closure-in-place sampling procedures in paragraphs 135.15(3)*"b"* and *"d"* or the Tier 1 site assessment in rule 567—135.9(455B). If the tanks are located in a contaminated area with active monitoring and remediation, the tank owner may request the department waive the site check providing justification.

(5) Continue to pay the tank management fee as required in subrule 135.3(5).

(6) Continue to have compliance inspections conducted as required in rule 567—135.20(455B).

c. When a UST system is out of service for three months or more, an owner must submit a notification of temporary closure form to the department. Owners and operators must complete the requirements in paragraph 135.15(1)*"b"* for temporary closure and certify the following:

(1) The UST system is empty of all regulated substances (e.g., receipt of product removal).

(2) Vent lines are open and functioning.

(3) All other piping, pumps, accesses, and ancillary equipment are capped and locked.

(4) The corrosion protection system is being maintained in accordance with subrule 135.4(2). Include documentation that electricity is being maintained to operate the impressed current cathodic protection system if present.

(5) For lined tanks, provide a copy of the last internal inspection.

(6) Provide proof of financial responsibility (e.g., insurance) according to 567—Chapter 136.

d. When a tank system is temporarily closed for more than 12 months, the owner must remain in compliance with the department's temporary closure requirements in paragraph 135.15(1)*"c."* The department may provide an extension to the 12-month temporary closure period. Owners and operators must complete a site check in accordance with paragraph 135.6(3)*"b"* before such an extension can be applied for.

e. If a tank system is temporarily closed for more than 12 months, but the tank system has not been temporarily closed according to the requirements of paragraph 135.15(1)*"c,"* or the owner or operator has failed to maintain out-of-service requirements in paragraph 135.15(1)*"b,"* the UST system must be permanently closed in accordance with subrule 135.15(2).

f. Prior to returning a temporarily closed tank back into service, the owner or operator must complete and submit the department's return-to-service form signed by a licensed installer and provide the following documentation. The tank system cannot be operated or receive fuel until current tank tags have been issued.

(1) Documentation that the tanks were temporarily closed in accordance with subrule 135.15(1).

(2) Where applicable, documentation that corrosion protection has been maintained continuously in accordance with subrule 135.4(2). The owner or operator must provide an inspection log of the cathodic protection system and the inspection report of the cathodic protection system completed by an Iowa-licensed corrosion tester.

(3) For lined tanks, provide a lining and tank integrity inspection report.

(4) Results of precision tightness tests (0.1 gph) conducted on tanks in accordance with rule 567—135.5(455B).

(5) Results of precision tightness tests (0.1 gph) conducted on lines in accordance with rule 567—135.5(455B). This includes piping used for remote fill.

(6) Function test (3.0 gph) results of mechanical or electronic leak detectors conducted in accordance with rule 567—135.5(455B).

NOTE: Function tests are not required on confirmed "safe suction" dispensing lines.

(7) Tank and piping leak detection is operational and in good condition.

(8) Secondary containment is installed where necessary in accordance with subrule 135.3(9).

(9) Spill containment, overfill prevention and all containment sumps are in good condition and operating in accordance with subrule 135.4(1). Tightness tests conducted within the last 12 months must be provided for secondary containment of tanks, piping, sumps, under dispenser containment and spill containment.

(10) Copy of the financial responsibility (e.g., UST insurance) mechanism in accordance with 567—Chapter 136.

(11) Certification from an Iowa-licensed installer that the UST system and equipment are installed correctly, are in good operable condition and meet all regulatory requirements for startup and operation.

(12) Copies of Class A and Class B operator training certificates.

(13) Change of ownership form (if the UST facility was sold).

135.15(2) *Permanent closure and changes-in-service.* Permanent closure of an underground storage tank system must be conducted by an Iowa-licensed tank remover. Closure sampling must be conducted by or under the supervision of an Iowa-certified groundwater professional.

a. At least 30 days before beginning either permanent closure or a change-in-service under paragraphs *"b"* and *"c"* below, owners and operators must notify the department of their intent to permanently close or make the change-in-service. An owner or operator must seek prior approval to permanently close a tank in a time frame shorter than the 30-day notice. The required assessment of the excavation zone under 135.15(3) must be performed after notifying the department but before completion of the permanent closure or a change-in-service.

b. To permanently close a tank or piping, owners and operators must empty and clean them by removing all liquids and accumulated sludge. All tanks taken out of service permanently must also be removed from the ground, filled with an inert solid material, or closed in place by a method approved by the department. Piping must be removed from the ground or have the ends plugged with an inert solid material.

When permanently closing a tank by filling with inert solid material, the tank may not be filled until a closure report is approved by the department. The tank must be filled within 30 days after department approval. The owner and operator must notify the department within 15 days after filling the tank with inert solid material.

c. Continued use of a UST system to store a nonregulated substance is considered a change-in-service. Before a change-in-service, owners and operators must empty and clean the tank by removing all liquid and accumulated sludge and conduct a site assessment in accordance with 135.15(3).

d. Permanent closure procedures must be followed in the replacement of tanks or piping. Notification must be made using DNR Form 542-1308, "Notification of Tank Closure or Change-in-Service." The form must include the date scheduled for the closure. Oral confirmation of the closure date must be given to the DNR field office 24 hours prior to the actual closure. The required assessment of the excavation zone under subrule 135.15(3) must be performed after notifying the department but before completion of the permanent closure or change-in-service.

NOTE: The following cleaning and closure procedures may be used to comply with subrule 135.15(2):

- American Petroleum Institute Recommended Practice RP 1604, "Closure of Underground Petroleum Storage Tanks";
- American Petroleum Institute Standard 2015, "Safe Entry and Cleaning of Petroleum Storage Tanks, Planning and Managing Tank Entry From Decommissioning Through Recommissioning";
- American Petroleum Institute Recommended Practice 2016, "Guidelines and Procedures for Entering and Cleaning Petroleum Storage Tanks";
- American Petroleum Institute Recommended Practice RP 1631, "Interior Lining and Periodic Inspection of Underground Storage Tanks," may be used as guidance for compliance with this subrule;
- National Fire Protection Association Standard 326, "Standard for the Safeguarding of Tanks and Containers for Entry, Cleaning, or Repair"; and
- National Institute for Occupational Safety and Health Publication 80-106, "Criteria for a Recommended Standard...Working in Confined Space" may be used as guidance for conducting safe closure procedures at some hazardous substance tanks.

135.15(3) *Assessing the site at closure or change-in-service.*

a. Before permanent closure or a change-in-service is completed, owners or operators must measure for the presence of a release where contamination is most likely to be present at the UST site. This soil and groundwater closure investigation must be conducted or supervised by a groundwater professional certified under 567—Chapter 134, Part A, unless the department in its discretion grants

an exemption and provides direct supervision of the closure investigation. In selecting the sample types, sample locations, and measurement methods, owners and operators must consider the method of closure, the nature of the stored substance, the type of backfill, the depth to groundwater, and other factors appropriate for identifying the presence of a release.

At UST sites with a history of petroleum storage, soil and groundwater samples shall in every case be analyzed for benzene, toluene, ethylbenzene, and xylenes (BTEX) with each compound reported separately in accordance with rule 567—135.16(455B). If there has been a history or suspected history of petroleum storage other than gasoline or gasoline blends (i.e., all grades of diesel fuels, fuel oil, kerosene, oil and mineral spirits), or such storage history is unknown or uncertain, soil and groundwater samples shall also be analyzed for total extractable hydrocarbons in accordance with rule 567—135.16(455B).

All such samples shall be collected separately and shipped to a laboratory certified under 567—Chapter 83 within 72 hours of collection. Samples shall be refrigerated and protected from freezing during shipment to the laboratory.

When a UST is removed from an area of confirmed contamination, the department may waive closure sampling if written documentation is submitted with the closure notification. Documentation should include laboratory analytical reports and a site map showing tank and piping locations along with contamination plume and sampling locations.

b. For all permanent tank and piping closures or changes-in-service, at least one water sample must be taken from the first saturated groundwater zone via a developed monitoring well except as provided in paragraph 135.15(3)*"g."* The well must be located downgradient from and as close as possible to the UST system but no farther away than 20 feet from system components. At some tank and piping closures, a minimum of one monitoring well may not be sufficient to represent a release where it is most likely to be present. An additional groundwater monitoring well or wells may be necessary.

If, however, the first saturated groundwater zone is not encountered within 10 feet below the lowest elevation of the tank excavation, the requirement for groundwater sampling shall not apply unless:

(1) Sands or highly permeable soils are encountered within 10 feet below the lowest level of the tank excavation which together with the underlying geology would, in the judgment of the department, pose the reasonable possibility that contamination may have reached groundwaters deeper than 10 feet below the lowest level of the tank excavation. The method of determining highly permeable soil is found in the departmental guidance documents entitled "Underground Storage Tank Closure Procedures for Tank and Piping Removal" and "Underground Storage Tank Closure for Filling in Place."

(2) Indications of potential groundwater contamination, including petroleum products in utility lines, petroleum products in private wells, petroleum product vapors in basements or other structures, occur in the area of the tank installation undergoing closure or change-in-service.

c. For permanent closure by tank removal, the departmental guidance document entitled "Underground Storage Tank Closure Guidance" must be followed. The minimum number of soil samples that must be taken depends on the tank size and length of product piping. Samples must be taken at a depth of 1 to 2 feet beneath the tank fill area below the base of the tank along the tank's centerline. Soil samples must also be taken at least every 10 feet along the product piping at a depth of 1 to 2 feet beneath the piping fill area below the piping, unless alternate sampling is approved by the department.

If sands or other highly permeable soils are encountered, alternative sampling methods may be required.

If contamination is suspected or found in any area within the excavation (i.e., sidewall or bottom), a soil sample must be taken at that location.

The numbers of samples required for tanks are as follows:

Nominal Tank Capacity (gallons)	Number of Samples	Location on Centerline
1,000 or less	1	center of tank
1,001 - 8,000	2	1/3 from ends
8,001 - 30,000	3	5 feet from ends and at center of tank
30,001 - 40,000	4	5 and 15 feet from ends
40,001 and more	5	5 and 15 feet from ends and at center of tank

d. For closing a tank in place by filling with an inert solid material or for a change-in-service, the departmental guidance document entitled "Underground Storage Tank Closure for Filling in Place" must be followed. The minimum number of soil borings required for sampling depends on the size of the tank and the length of the product piping. Soil samples must be taken within 5 feet of the sides and ends of the tank at a depth of 2 to 4 feet below the base of the tank, but outside the backfill material, at equal intervals around the tank. Soil samples must also be taken at least every 10 feet along the product piping at a depth of 1 to 2 feet beneath the piping fill area below the piping, unless alternate sampling is approved by the department. If sands or other highly permeable soils are encountered, alternative sampling methods may be required.

The minimum numbers of soil borings and samples required are as follows:

Nominal Tank Capacity (gallons)	Number of Samples	Location of Samples
6,000 or less	4	1 each end and each side
6,001 - 12,000	6	1 each end and 2 each side
12,001 or more	8	1 each end and 3 each side

e. A closure report in a format prescribed by the department must be submitted to the department within 45 days of the tank removal or sampling for a closure in place. Refer to the Underground Storage Tank Closure Guidance for reporting format. The tank tags must be returned with the closure report.

f. The requirements of this subrule are satisfied if one of the external release detection methods allowed in 135.5(4)*"e"* and *"f"* is operating in accordance with the requirements in 135.5(4) at the time of closure and indicates no release has occurred.

g. If contaminated soils, contaminated groundwater, or free product as a liquid or vapor is discovered during the site assessment or by any other manner, contact the department in accordance with 135.6(1). Normal closure procedures no longer apply. Owners and operators must begin corrective action in accordance with rules 567—135.7(455B) to 567—135.12(455B).

Identification of free product requires immediate response in accordance with 135.7(5). If contamination appears extensive or the groundwater is known to be contaminated, a full assessment of the contamination will be required. When a full assessment is required or anticipated, collection of the required closure samples is not required. If contamination appears limited to soils, overexcavation of the contaminated soils in accordance with 135.15(4) may be allowed at the time of closure.

135.15(4) *Overexcavation of contaminated soils at closure.*

a. If contaminated soils are discovered while assessing a site at closure in accordance with 135.15(3), owners and operators may overexcavate up to one foot of the contaminated soils surrounding the tank pit. The contamination and overexcavation must be reported to the department in accordance with the requirements of 135.6(4)*"a"* prior to backfilling the excavation. If excavation is limited to one foot of contaminated soils, a soil sample shall be taken and laboratory analyzed in accordance with 567—135.16(455B) from the area showing the greatest contamination. Any overexcavation of contaminated soils beyond one foot of contaminated soils is considered expedited corrective action and must be conducted by a certified groundwater professional in accordance with the procedures in 135.12(11).

b. Excavated contaminated soils must be properly disposed in accordance with 567—Chapters 100, 101, 102, 120, and 121, Iowa Administrative Code.

c. A report must be submitted to the department within 30 days of completion of the laboratory analysis. The report must include the requirements of 135.15(3)*"e"* and a dimensional drawing showing the depth and area of the excavation prior to and after overexcavation. The area of contamination must be shown.

135.15(5) *Applicability to previously closed UST systems.* When directed by the department, the owner and operator of a UST system permanently closed before October 24, 1988, must assess the excavation zone and close the UST system in accordance with this rule if releases from the UST may, in the judgment of the department, pose a current or potential threat to human health and the environment.

135.15(6) *Closure records.* Owners and operators must maintain records in accordance with 135.4(5) that are capable of demonstrating compliance with closure requirements under this rule. The results of the excavation zone assessment required in 135.15(3) must be maintained for at least three years after completion of permanent closure or change-in-service in one of the following ways:

a. By the owners and operators who took the UST system out of service;

b. By the current owners and operators of the UST system site; or

c. By mailing these records to the department if they cannot be maintained at the closed facility.

135.15(7) *Applicability to pre-1974 USTs.* The closure provisions of rule 567—135.15(455B) are not applicable to USTs which have been out of operation prior to January 1, 1974. For purposes of this subrule, out of operation means that no regulated substance has been deposited into or dispensed from the tanks and that the tanks do not currently contain an accumulation of regulated substances other than a de minimis amount as provided in paragraph 135.15(1)*"a."*

Owners and operators or other interested parties are not required to submit documentation that USTs meet the exemption conditions and may rely on this subrule as guidance. However, should a question arise as to whether USTs meet the exemption, or owners and operators or other interested parties request acknowledgment by the department that USTs are exempt, they must submit an affidavit on a form provided by the department. The affiant must certify that based on a reasonable investigation and to the best of the affiant's knowledge, the USTs were taken out of operation prior to January 1, 1974, the USTs have not contained a regulated substance since January 1, 1974, and the USTs do not currently contain an accumulation of regulated substances.

If the department has a reasonable basis to suspect a release has occurred, the release investigation and confirmation steps of rule 567—135.6(455B) and the corrective action requirements as provided in rules 567—135.7(455B) through 567—135.12(455B) shall apply.

[**ARC 8124B**, IAB 9/9/09, effective 10/14/09; **ARC 5625C**, IAB 5/19/21, effective 6/23/21]

567—135.16(455B) Laboratory analytical methods for petroleum contamination of soil and water.

135.16(1) *General.* When analyzing for petroleum or hazardous substances, owners and operators of UST systems must use a laboratory certified under 567—Chapter 83. In addition they must ensure that all samples are properly preserved and shipped within 72 hours of collection to a laboratory certified under 567—Chapter 83. This rule provides acceptable analytical procedures for petroleum substances and required information that must be provided in all laboratory reports.

135.16(2) *Laboratory report.* All laboratory reports must contain the following information:

a. Laboratory name, address, telephone number and Iowa laboratory certification number. If analytical work is subcontracted to another laboratory, the analytical report from the certified lab which analyzed the sample must be submitted and include the information required in this subrule.

b. Medium sampled (soil, water).

c. Client submitting sample (name, address, telephone number).

d. Sample collector (name, telephone number).

e. UST site address.

f. Clients sample location identifier.

g. Date sample was collected.

h. Date sample was received at laboratory.

i. Date sample was analyzed.

j. Results of analyses and units of measure.

k. Detection limits.

l. Methods used in sample analyses (preparation method, sample detection method, and quantitative method).

m. Laboratory sample number.

n. Analyst name.

o. Signature of analyst's supervisor.

p. Condition in which the sample was received at the laboratory and whether it was properly sealed and preserved.

q. Note that analytical results are questionable if a sample exceeded an established holding time or was improperly preserved. (The recommended holding time for properly cooled and sealed petroleum contaminated samples is 14 days, except for water samples containing volatile organic compounds which have a 7-day holding time unless acid-preserved.)

r. Laboratory reports required by this chapter for tank closure investigations under 567—135.15(455B) and site checks under 135.6(3) or Tier 1 or Tier 2 assessments under 567—135.9(455B) to 567—135.11(455B) must include a copy of the chromatograms and associated quantitation reports for the waste oil, diesel and gasoline standard used by the laboratory in analyzing submitted samples. The laboratory analytical report for each sample must state whether the sample tested matches the laboratory standard for waste oil, diesel or gasoline or that the sample cannot be reliably matched with any of these standards. A copy of the chromatograms and associated quantitation reports for only the soil and groundwater samples with the maximum concentrations of BTEX and TEH must be included.

135.16(3) *Analysis of soil and water for high volatile petroleum compounds (i.e., gasoline, benzene, ethylbenzene, toluene, xylene).* Sample preparation and analysis shall be by Method OA-1, "Method for Determination of Volatile Petroleum Hydrocarbons (gasoline)," revision 12/01/2019, state hygienic laboratory at the University of Iowa, or EPA Method 8260D, "Test Methods for Evaluating Solid Waste," 3rd Edition–Update 6, July 2018. Copies of Method OA-1 are available from the department.

135.16(4) *Analysis of soil and water for low volatile petroleum hydrocarbon contamination (i.e., all grades of diesel fuel, fuel oil, kerosene, oil, and mineral spirits).* Sample preparation and analysis shall be by Method OA-2, "Determination of Extractable Petroleum Products (and Related Low Volatility Organic Compounds)," revision 12/01/2019, state hygienic laboratory at the University of Iowa. Copies of Method OA-2 are available from the department.

135.16(5) *Analysis of soil gas for volatile petroleum hydrocarbons.* Analysis of soil gas for volatile petroleum hydrocarbons shall be conducted in accordance with the National Institute for Occupational Safety and Health (NIOSH) Method 1501, Issue 3, March 15, 2003, or a department-approved equivalent method.

135.16(6) *Analytical methods for methyl tertiary-butyl ether (MTBE).* Analysis of water for MTBE must be conducted by a laboratory certified under 567—Chapter 83 for petroleum analyses.

a. Sample preparation and analysis shall be by U.S. Environmental Protection Agency Method 8260D, "Test Methods for Evaluating Solid Waste," 3rd Edition–Update 6, July 2018.

b. Laboratories performing the analyses must run standards for MTBE on a routine basis, and standards for other possible compounds like ethyl tertiary-butyl ether (ETBE), tertiary-amyl methyl ether (TAME), di-isopropyl ether (DIPE), and tertiary-butyl alcohol (TBA) to be certain of their identification should they be detected.

c. Laboratories must run a method detection limit study and an initial demonstration of capability for MTBE. These records must be kept on file.

d. The minimum detection level for MTBE in water is 15 ug/L.

[**ARC 5625C**, IAB 5/19/21, effective 6/23/21]

567—135.17(455B) Evaluation of ability to pay.

135.17(1) General. The ability to pay guidance procedures referenced in this rule will be used by the department when an owner or operator of an underground storage tank (UST) claims to be financially unable to comply with corrective action requirements under 567—135.7(455B) to 567—135.12(455B) or closure investigation requirements under 567—135.15(455B). If an owner or operator of a regulated UST claims to be financially unable to meet these departmental requirements, that responsible party must provide documentation of the party's finances on forms provided by the department in order for the department to act on the claim of financial inability. The department may request additional financial documentation to verify or supplement reported information.

135.17(2) Individual claims. The financial ability of individual owners and operators of USTs, with or without an active business (including but not limited to sole proprietorships and general partnerships), may be evaluated using the most current version of "INDIPAY" developed by the U.S. Environmental Protection Agency and generally accepted principles of financial analysis. This guidance is only one tool the department may use in evaluating claims of financial inability.

135.17(3) Corporate claims. The financial ability of corporate owners and operators of USTs may be evaluated using the most current version of "ABEL" developed by the U.S. Environmental Protection Agency and generally accepted principles of financial analysis. This guidance is only one tool the department may use in evaluating claims of financial inability.

135.17(4) Federal LUST Trust Fund. The financial ability of owners and operators of USTs shall be evaluated for the purpose of determining if the department is authorized to use Federal LUST Trust Fund moneys as provided in the current cooperative agreement with the U.S. Environmental Protection Agency, Region VII. A determination of financial inability does not create an entitlement or any expectation interest on behalf of an owner or operator that Federal LUST Trust Fund moneys will be used for corrective action at any individual site.

135.17(5) The evaluation of financial ability will also be used by the department in making other administrative planning decisions including but not limited to decisions as to whether to pursue and when to pursue administrative or judicial enforcement of regulatory and statutory duties and the assessment of penalties. A determination of financial inability does not create an entitlement or expectation interest that enforcement actions will be deferred or suspended. The evaluation of this factor is only one of many affecting the department's fully discretionary decisions regarding enforcement options and program planning.

135.17(6) An evaluation of financial inability as provided in this rule does not relieve any owner or operator of legal liability to comply with department rules or Iowa Code chapter 455B or provide a defense to any legal actions to establish liability or enforce compliance.

[**ARC 5625C**, IAB 5/19/21, effective 6/23/21]

567—135.18(455B) Transitional rules.

135.18(1) *Risk-based corrective action assessment reports, corrective action plans, and corrective action design reports accepted before August 6, 2008.* Any owner or operator who had a Tier 2 site cleanup report, Tier 3 report, or corrective action design report approved by the department before August 6, 2008, may elect to submit a Tier 2 site cleanup report using the Appendix B revised model, department-developed software and rules in effect as of August 6, 2008. The owner or operator shall notify the department that the owner or operator wishes to evaluate the leaking underground storage tank site with the Appendix B revised model, software and rules. If the owner or operator so elects, the site shall be assessed, classified, and, if necessary, remediated, in accordance with the rules of the department as of August 6, 2008. If the leaking underground storage tank site is undergoing active remediation, the remediation system shall remain operating until the reevaluation is completed and accepted or as otherwise approved by the department. Once a site has been evaluated using the Appendix B revised model, software and rules in effect as of August 6, 2008, it can no longer be evaluated with the Appendix B-1 old model and software and rules in effect prior to August 6, 2008.

135.18(2) *Risk-based corrective action assessment reports, corrective action plans, and corrective action design reports in the process of preparation with a submittal schedule established prior to August 6, 2008.* The owner or operator shall notify the department that the owner or operator wishes to use the

Appendix B revised model and department software and rules in effect as of August 6, 2008, to evaluate the leaking underground storage tank site before submitting the next report, and prior to expiration of the previously established submittal schedule. Once a site has been evaluated using the Appendix B revised model, software and rules in effect as of August 6, 2008, it can no longer be evaluated with the Appendix B-1 old model, software and rules existing just prior to August 6, 2008.

135.18(3) *Risk-based corrective action assessment reports, corrective action plans, and corrective action design reports received by the department but not yet reviewed.* The owner or operator will notify the department within 60 days of August 6, 2008, whether the owner or operator is electing to complete a risk-based corrective action assessment using Appendix B revised model, department software and rules effective as of August 6, 2008, or proceeding with the risk-based corrective action assessment using Appendix B-1 old model and department software and rules existing prior to August 6, 2008. Once a site has been evaluated using the Appendix B revised model, software and rules it can no longer be evaluated with the previous Appendix B-1 old model, software and rules.

567—135.19(455B) Analyzing for methyl tertiary-butyl ether (MTBE).

135.19(1) *General.* The objective of analyzing for MTBE is to determine its presence in water samples collected as part of investigation and remediation of contamination for underground storage tank facilities.

135.19(2) *Required MTBE testing.* Water samples must be analyzed for MTBE when collected for risk-based corrective action as required in rules 567—135.8(455B) through 567—135.12(455B). These sampling requirements include but are not limited to Tier 2 and Tier 3 assessments where groundwater ingestion pathway evaluation and subsequent monitoring is required.

135.19(3) *MTBE testing not required.* Analysis for MTBE is not required for the following:

a. Closure sampling under rule 567—135.15(455B).

b. Site checks under subrule 135.6(3).

c. If prior analysis under subrule 135.19(2) has not shown MTBE present.

d. If the department determines MTBE analysis is no longer needed at a site.

135.19(4) *Reporting.* The analytical data must be submitted in a format prescribed by the department.

[**ARC 5625C**, IAB 5/19/21, effective 6/23/21]

567—135.20(455B) Compliance inspection of UST system.

135.20(1) The owner or operator must have the UST system inspected and an inspection report submitted to the department by a UST compliance inspector certified by the department under 567—Chapter 134, Part B. An initial compliance site inspection shall be conducted within two years after new tank installation. All subsequent compliance site inspections conducted after the initial compliance site inspection shall be conducted within 24 months of the prior compliance site inspection. Compliance site inspections must be separated by at least six months.

135.20(2) Compliance inspection requirements. The owner or operator is responsible to ensure the department receives ten days' prior notice by the compliance inspector of the date of a site inspection and the name of the inspector as provided in 567—134.14(455B). The owner and operator must comply with the following as part of the inspection process.

a. Review and respond to the inspection report provided by the certified compliance inspector and complete the corrective actions specified in the compliance inspection report within the specified time frames.

b. Provide all records and documentation required by the certified compliance inspector and this chapter.

c. Upon notification of a suspected release by the certified compliance inspector pursuant to 567—subrule 134.14(1), report the condition to the department and undertake steps to investigate and confirm the suspected release as provided in 567—135.6(455B).

d. Ensure that the compliance inspector completes and submits an electronic inspection form in accordance with 567—134.14(455B).

135.20(3) The owner and operator shall do the following upon receipt of a compliance inspection report as provided in 567—subrule 134.14(1) which finds violations of the department's rules:

a. Take all actions necessary to correct any compliance violations or deficiencies in accordance with this chapter. Corrective action must be taken within the time frame established by rule or, if no time frames are established by rule, within 60 days of receipt of the inspector's report or another reasonable time period approved by the department. The granting of time to remedy a violation does not preclude the department from exercising its discretion to assess penalties for the violation.

b. Within 60 days of receipt of the inspector's report, provide documentation to the compliance inspector that the violation or deficiencies have been corrected.

c. Conduct a follow-up inspection in instances where there are serious problems or a history of repeated violations when required by the department.

135.20(4) Conflict of interest. A compliance site inspection must be conducted by a certified compliance inspector who is not the owner or operator of the UST system being inspected, an employee of the owner or operator of the UST system being inspected, or a person having daily on-site responsibility for the operation and maintenance of the UST system.

[**ARC 8124B**, IAB 9/9/09, effective 10/14/09; **ARC 5625C**, IAB 5/19/21, effective 6/23/21]

567—135.21(455B) UST systems with field-constructed tanks and airport hydrant fuel distribution systems.

135.21(1) *General requirements.*

a. Implementation of requirements. Owners and operators must comply with the requirements of this rule for UST systems with field-constructed tanks and airport hydrant systems as follows:

(1) For UST systems installed on or before June 23, 2021, the requirements are effective according to the following schedule:

Requirement	Effective Date
Upgrading UST systems, general operating requirements, and operator training	October 13, 2021
Release detection	October 13, 2021
Release reporting, response, and investigation; closure; financial responsibility and notification (except as provided in paragraph 135.21(1)*"b"*)	June 23, 2021

(2) For UST systems installed after June 23, 2021, the requirements apply at installation.

b. All owners of previously deferred UST systems must submit a registration form provided by the department. Owners and operators of UST systems must demonstrate financial responsibility at the time of submission of the registration form.

c. Except as provided in subrule 135.21(2), owners and operators must comply with the requirements of rules 567—135.1(455B) through 567—135.20(455B) and 567—Chapter 136.

d. In addition to the codes of practice listed in subrule 135.3(1), owners and operators may use military construction criteria, such as Unified Facilities Criteria (UFC) 3-460-01, Petroleum Fuel Facilities, when designing, constructing, and installing airport hydrant systems and UST systems with field-constructed tanks.

135.21(2) *Additions, exceptions, and alternatives for UST systems with field-constructed tanks and airport hydrant systems.*

a. Exception to piping secondary containment requirements. Owners and operators may use single-walled piping when installing or replacing piping associated with UST systems with field-constructed tanks greater than 50,000 gallons and piping associated with airport hydrant systems. Piping associated with UST systems with field-constructed tanks less than or equal to 50,000 gallons not part of an airport hydrant system must meet the secondary containment requirement when installed or replaced.

b. Upgrade requirements. Not later than October 13, 2021, airport hydrant systems and UST systems with field-constructed tanks where installation commenced on or before June 23, 2021, must meet the following requirements or be permanently closed pursuant to rule 567—135.15(455B).

(1) Corrosion protection. UST system components in contact with the ground that routinely contain regulated substances must meet one of the following:

1. Except as provided in paragraph 135.21(2)*"a,"* the new UST system performance standards for tanks in paragraph 135.3(1)*"a"* and for piping in paragraph 135.3(1)*"b"*; or

2. Be constructed of metal and cathodically protected according to a code of practice developed by a nationally recognized association or independent testing laboratory, and meet the requirements of paragraphs 135.3(1)*"a"*(2)"3" and "4" for tanks, and subparagraphs 135.3(1)*"a"*(2), (3) and (4) for piping. A tank greater than ten years old without cathodic protection must be assessed to ensure the tank is structurally sound and free of corrosion holes prior to adding cathodic protection. The assessment must be by internal inspection or another method determined by the department to adequately assess the tank for structural soundness and corrosion holes.

NOTE regarding paragraph 135.21(2)*"b"*: The following codes of practice may be used to comply with this paragraph:

- NACE International Standard Practice SP 0285, "External Control of Underground Storage Tank Systems by Cathodic Protection";
- NACE International Standard Practice SP 0169, "Control of External Corrosion on Underground or Submerged Metallic Piping Systems";
- National Leak Prevention Association Standard 631, Chapter C, "Internal Inspection of Steel Tanks for Retrofit of Cathodic Protection"; or
- American Society for Testing and Materials Standard G158, "Standard Guide for Three Methods of Assessing Buried Steel Tanks."

(2) Spill and overfill prevention equipment. To prevent spilling and overfilling associated with product transfer to the UST system, all UST systems with field-constructed tanks and airport hydrant systems must comply with new UST system spill and overfill prevention equipment requirements specified in paragraph 135.3(1)*"c."*

c. Walkthrough inspections. In addition to the walkthrough inspection requirements in subrule 135.4(13), owners and operators must inspect the following additional areas for airport hydrant systems at least once every 30 days if confined space entry according to the Occupational Safety and Health Administration (see 29 CFR part 1910) is not required or at least annually if confined space entry is required and keep documentation of the inspection according to paragraph 135.4(13)*"e."*

(1) Hydrant pits: visually check for any damage; remove any liquid or debris; and check for any leaks, and

(2) Hydrant piping vaults: check for any hydrant piping leaks.

d. Release detection. Owners and operators of UST systems with field-constructed tanks and airport hydrant systems must begin meeting the release detection requirements described in this subrule not later than October 13, 2021.

(1) Methods of release detection for field-constructed tanks. Owners and operators of field-constructed tanks with a capacity less than or equal to 50,000 gallons must meet the release detection requirements in rule 567—135.5(455B).

(2) Owners and operators of field-constructed tanks with a capacity greater than 50,000 gallons must meet either the requirements in rule 567—135.5(455B) (except paragraphs 135.5(4)*"e"* and *"f"* must be combined with inventory control as stated below) or use one or a combination of the following alternative methods of release detection:

1. Conduct an annual tank tightness test that can detect a 0.5 gallon per hour leak rate;

2. Use an automatic tank gauging system to perform release detection at least every 30 days that can detect a leak rate less than or equal to 1 gallon per hour. This method must be combined with a tank tightness test that can detect a 0.2 gallon-per-hour leak rate performed at least every three years;

3. Use an automatic tank gauging system to perform release detection at least every 30 days that can detect a leak rate less than or equal to 2 gallons per hour. This method must be combined with a tank tightness test that can detect a 0.2 gallon-per-hour leak rate performed at least every two years;

4. Perform vapor monitoring (conducted in accordance with paragraph 135.5(4)*"e"* for a tracer compound placed in the tank system) capable of detecting a 0.1 gallon-per-hour leak rate at least every two years;

5. Perform inventory control (conducted in accordance with Department of Defense Directive 4140.25; ATA Airport Fuel Facility Operations and Maintenance Guidance Manual; or equivalent procedures) at least every 30 days that can detect a leak equal to or less than 0.5 percent of flow-through; and

- Perform a tank tightness test that can detect a 0.5 gallon per hour leak rate at least every two years; or
- Perform vapor monitoring or groundwater monitoring (conducted in accordance with paragraph 135.5(4)*"e"* or *"f,"* respectively, for the stored regulated substance) at least every 30 days; or

6. Another method approved by the department if the owner and operator can demonstrate that the method can detect a release as effectively as any of the methods allowed in subparagraph 135.21(2)*"d"*(2). In comparing methods, the department shall consider the size of release that the method can detect and the frequency and reliability of detection.

(3) Methods of release detection for piping. Owners and operators of underground piping associated with field-constructed tanks less than or equal to 50,000 gallons must meet the release detection requirements in rule 567—135.5(455B). Owners and operators of underground piping associated with airport hydrant systems and field-constructed tanks greater than 50,000 gallons must follow either the requirements in rule 567—135.5(455B) (except paragraphs 135.5(4)*"e"* and *"f"* must be combined with inventory control as stated below) or use one or a combination of the following alternative methods of release detection:

1. Perform a semiannual or annual line tightness test at or above the piping operating pressure in accordance with the table below.

Maximum Leak Detection Rate Per Test Section Volume

Test Section Volume (Gallons)	**Semiannual Test— Leak Detection Rate Not to Exceed (Gallons Per Hour)**	**Annual Test— Leak Detection Rate Not to Exceed (Gallons Per Hour)**
< 50,000	1.0	0.5
≥ 50,000 to < 75,000	1.5	0.75
≥ 75,000 to < 100,000	2.0	1.0
≥ 100,000	3.0	1.5

Piping segment volumes ≥ 100,000 gallons not capable of meeting the maximum 3.0 gallon per hour leak rate for the semiannual test may be tested at a leak rate up to 6.0 gallons per hour according to the following schedule:

Phase in for Piping Segments ≥ 100,000 Gallons in Volume

First test	Not later than October 13, 2021 (may use up to 6.0 gph leak rate)
Second test	Between October 13, 2021, and October 13, 2024 (may use up to 6.0 gph leak rate)
Third test	Between October 13, 2024, and October 13, 2025 (must use 3.0 gph for leak rate)
Subsequent tests	After October 13, 2025, begin using semiannual or annual line testing according to the Maximum Leak Detection Rate Per Test Section Volume table above

2. Perform vapor monitoring (conducted in accordance with paragraph 135.5(4)*"e"* for a tracer compound placed in the tank system) capable of detecting a 0.1 gallon per hour leak rate at least every two years;

3. Perform inventory control (conducted in accordance with Department of Defense Directive 4140.25, ATA Airport Fuel Facility Operations and Maintenance Guidance Manual; or equivalent procedures) at least every 30 days that can detect a leak equal to or less than 0.5 percent of flow-through, and

- Perform a line tightness test (conducted in accordance with paragraph 135.21(2)*"d"*(3)"1" using the leak rates for the semiannual test) at least every two years; or
- Perform vapor monitoring or groundwater monitoring (conducted in accordance with paragraph 135.5(4)*"e"* or *"f,"* respectively, for the stored regulated substance) at least every 30 days; or

4. Another method approved by the department if the owner and operator can demonstrate that the method can detect a release as effectively as any of the methods allowed in paragraphs 135.21(2)*"d"*(3)"1" to "3." In comparing methods, the department shall consider the size of release that the method can detect and the frequency and reliability of detection.

(4) Record keeping for release detection. Owners and operators must maintain release detection records according to the recordkeeping requirements in subrule 135.5(6).

e. Applicability of closure requirements to previously closed UST systems. When directed by the department, the owner and operator of a UST system with field-constructed tanks or airport hydrant system permanently closed before June 23, 2021, must assess the excavation zone and close the UST system in accordance with rule 567—135.15(455B) if releases from the UST may, in the judgment of the department, pose a current or potential threat to human health and the environment.

[**ARC 5625C**, IAB 5/19/21, effective 6/23/21]

Appendix A - Tier 1 Table, Assumptions, Equations and Parameter Values

Iowa Tier 1 Look-Up Table

Media	Exposure Pathway	Receptor	Group 1				Group 2: TEH	
			Benzene	Toluene	Ethylbenzene	Xylenes	Diesel*	Waste Oil
Groundwater (µg/L)	Groundwater Ingestion	Actual	5	1,000	700	10,000	1,200	400
		Potential	290	7,300	3,700	73,000	75,000	40,000
	Groundwater Vapor to Enclosed Space	All	1,540	20,190	46,000	NA	2,200,000	NA
	Groundwater to Water Line	PVC or Gasketed Mains	7,500	6,250	40,000	48,000	75,000	40,000
		PVC or Gasketed Service Lines	3,750	3,120	20,000	24,000	75,000	40,000
		PE/PB/AC Mains or Service Lines	200	3,120	3,400	19,000	75,000	40,000
	Surface Water	All	290	1,000	3,700	73,000	75,000	40,000
Soil (mg/kg)	Soil Leaching to Groundwater	All	0.54	42	15	NA	3,800	NA
	Soil Vapor to Enclosed Space	All	1.16	48	79	NA	47,500	NA
	Soil to Water Line	All	2.0	3.2	45	52	10,500	NA

NA: Not applicable. There are no limits for the chemical for the pathway, because for groundwater pathways the concentration for the designated risk would be greater than the solubility of the pure chemical in water, and for soil pathways the concentration for the designated risk would be greater than the soil concentration if pure chemical were present in the soil.

TEH: Total Extractable Hydrocarbons. The TEH value is based on risks from naphthalene, benzo(a)pyrene, benz(a)anthracene, and chrysene. Refer to Appendix B for further details.

Diesel*: Standards in the Diesel column apply to all low volatile petroleum hydorcarbons except waste oil.

Assumptions Used for Iowa Tier 1 Look-Up Table Generation

1. Groundwater ingestion pathway. The maximum contaminant levels (MCLs) were used for Group 1 chemicals. The target risk for carcinogens for actual receptors is 10^{-6} and for potential receptors is 10^{-4}. A hazard quotient of one, and residential exposure and building parameters are assumed.

2. Groundwater vapor to enclosed space pathway. Residential exposure and residential building parameters are assumed; no inhalation reference dose is used for benzene; the capillary fringe is assumed to be the source of groundwater vapor; and the hazard quotient is 1 and target risk for carcinogens is $1x10^{-4}$.

3. Groundwater to water line. This pathway uses the same assumptions as the groundwater ingestion pathway for potential receptors, including a target risk for carcinogens of 10^{-4}.

4. Surface water. This pathway uses the same assumptions as the groundwater ingestion pathway for potential receptors, including a target risk for carcinogens of 10^{-4}, except for toluene which has a chronic level for aquatic life of 1,000 as in the definition for surface water criteria in 567—135.2(455B).

5. Soil leaching to groundwater. This pathway assumes the groundwater will be protected to the same levels as the groundwater ingestion pathway for potential receptors, using residential exposure and a target risk for carcinogens of 10^{-4}.

6. Soil vapor to enclosed space pathway. The target risk for carcinogens is $1x10^{-4}$; the hazard quotient is 1; no inhalation reference dose is used for benzene; residential exposure factors are assumed; and the average of the residential and nonresidential building parameters is assumed.

7. Soil to water line pathway. This pathway uses the soil leaching to groundwater model with nonresidential exposure and a target risk for carcinogens of 10^{-4}.

In addition to these assumptions, the equations and parameter values used to generate the Iowa Tier 1 Look-Up Table are described below.

Groundwater Ingestion Equations

Carcinogens:

$$RBSL_w \left[\frac{mg}{L - H_2O}\right] = \frac{TR \times BW \times AT_c \times \frac{365\ days}{year}}{SF_o \times IR_w \times EF \times ED}$$

Noncarcinogens:

$$RBSL_w \left[\frac{mg}{L - H_2O}\right] = \frac{THQ \times RfD_o \times BW \times AT_n \times \frac{365\ days}{year}}{IR_w \times EF \times ED}$$

Soil Leaching to Groundwater Equations

$$RBSL_{sl} \left[\frac{mg}{kg - soil}\right] = \frac{RBSL_w \left[\frac{mg}{L - H_2O}\right]}{LF}$$

$$LF \left[\frac{mg/L - H_2O}{mg/kg - soil}\right] = \frac{\rho_s}{(\theta_{ws} + k_s\rho_s + H\theta_{as})\left(1 + \frac{U\delta}{IW}\right)}$$

Soil Vapor to Enclosed Space Equations

$$RBSL_{sv}\left[\frac{mg}{kg-soil}\right] = \frac{RBSL_{air}\left[\frac{\mu g}{m^3-air}\right]}{VF_{sv}}\left(\frac{mg}{1000\ \mu g}\right)$$

$$VF_{sv}\left[\frac{(mg/m^3-air)}{(mg/kg-soil)}\right] = \frac{\frac{H\rho_s}{(\theta_{ws}+k_s\rho_s+H\theta_{as})}\left[\frac{D_s^{eff}/L_s}{ER\ L_B}\right]}{1+\left[\frac{D_s^{eff}/L_s}{ER\ L_B}\right]+\left[\frac{D_s^{eff}/L_s}{\left(D_{crack}^{eff}/L_{crack}\right)\eta}\right]}\left(10^3\ \frac{cm^3-kg}{m^3-g}\right)$$

$$D_{crack}^{eff}\left[\frac{cm^2}{s}\right] = D^{air}\ \frac{\theta_{acrack}^{3.33}}{\theta_T^2} + D^{wat}\frac{1}{H}\frac{\theta_{wcrack}^{3.33}}{\theta_T^2}$$

$$D_s^{eff}\left[\frac{cm^2}{s}\right] = D^{air}\ \frac{\theta_{as}^{3.33}}{\theta_T^2} + D^{wat}\frac{1}{H}\frac{\theta_{ws}^{3.33}}{\theta_T^2}$$

Indoor Air Inhalation Equations

Carcinogens:

$$RBSL_{air}\left[\frac{\mu g}{m^3\text{ - air}}\right] = \frac{TR \times BW \times AT_c \times \frac{365\text{ days}}{year} \times \frac{1000\ \mu g}{mg}}{SF_i \times IR_{air} \times EF \times ED}$$

Noncarcinogens:

$$RBSL_{air}\left[\frac{\mu g}{m^3\text{ - air}}\right] = \frac{THQ \times RfD_i \times BW \times AT_n \times \frac{365\ kdays}{year} \times \frac{1000\ \mu g}{mg}}{IR_{air} \times EF \times ED}$$

Groundwater Vapor to Enclosed Space Equations

$$RBSL_{gw}\left[\frac{mg}{L - H_2O}\right] = \frac{RBSL_{air}\left[\frac{\mu g}{m^3 - air}\right]}{VF_{gw}}\left(\frac{mg}{1000\ \mu g}\right)$$

$$VF_{gw}\left[\frac{(mg/m^3 - air)}{(mg/L - H_2O)}\right] = \frac{H\left[\frac{D_s^{eff}/L_{gw}}{ER\ L_B}\right]}{1 + \left[\frac{D_s^{eff}/L_{gw}}{ER\ L_B}\right] + \left[\frac{D_s^{eff}/L_{gw}}{\left(D_{crack}^{eff}/L_{crack}\right)\eta}\right]}\left(\frac{10^3 L}{m^3}\right)$$

Variable Definitions

δ	groundwater mixing zone thickness (cm)
η	areal fraction of cracks in foundation/wall (cm^2-cracks/cm^2-area)
ρ_s	soil bulk density (g/cm^3)
θ_{acrack}	volumetric air content in foundation/wall cracks (cm^3-air/cm^3-soil)
θ_{as}	volumetric air content in vadose zone (cm^3-air/cm^3-soil)
θ_T	total soil porosity (cm^3-voids/cm^3-soil)
θ_{wcrack}	volumetric water content in foundation/wall cracks (cm^3-H_2O/cm^3-soil)
θ_{ws}	volumetric water content in vadose zone (cm^3-H_2O/cm^3-soil)
AT_c	averaging time for carcinogens (years)
AT_n	averaging time for noncarcinogens (years)
BW	body weight (kg)
D^{air}	chemical diffusion coefficient in air (cm^2/s)
D^{wat}	chemical diffusion coefficient in water (cm^2/s)
D^{eff}_{crack}	effective diffusion coefficient through foundation cracks (cm^2/s)
D^{eff}_{s}	effective diffusion coefficient in soil based on vapor-phase concentration (cm^2/s)
ED	exposure duration (years)
EF	exposure frequency (days/year)
ER	enclosed space air exchange rate (s^{-1})
f_{oc}	fraction organic carbon in the soil (kg-C/kg-soil)
H	henry's law constant (L-H_2O)/(L-air)
i	groundwater head gradient (cm/cm)
I	infiltration rate of water through soil (cm/year)
IR_{air}	daily indoor inhalation rate (m^3/day)
IR_w	daily water ingestion rate (L/day)
K	hydraulic conductivity (cm/year)
K_{oc}	carbon-water sorption coefficient (L-H_2O/kg-C)
k_s	soil-water sorption coefficient (L-H_2O/kg-soil), f_{oc} x K_{oc}
L_B	enclosed space volume/infiltration area ratio (cm)
L_{crack}	enclosed space foundation or wall thickness (cm)
LF	leaching factor from soil to groundwater ((mg/L-H_2O)/(mg/kg-soil))
L_{gw}	depth to groundwater from the enclosed space foundation (cm)
L_s	depth to subsurface soil sources from the enclosed space foundation (cm)
$RBSL_{air}$	Risk-Based Screening Level for indoor air ($\mu g/m^3$-air)
$RBSL_{gw}$	Risk-Based Screening Level for vapor from groundwater to enclosed space air inhalation (mg/L-H_2O)
$RBSL_{sl}$	Risk-Based Screening Level for soil leaching to groundwater (mg/kg-soil)
$RBSLs_v$	Risk-Based Screening Level for vapors from soil to enclosed space air inhalation (mg/kg-soil)
$RBSL_w$	Risk-Based Screening Level for groundwater ingestion (mg/L-H_2O)
RfD_i	inhalation chronic reference dose ((mg/(kg-day))
RfD_o	oral chronic reference dose ((mg/(kg-day))
SF_i	inhalation cancer slope factor ((kg-day)/mg)
SF_o	oral cancer slope factor ((kg-day)/mg)
THQ	target hazard quotient for individual constituents (unitless)
TR	target excess individual lifetime cancer risk (unitless)
U	groundwater Darcy velocity (cm/year), U=Ki
VF_{gw}	volatilization factor for vapors from groundwater to enclosed space ((mg/m^3-air)/(mg/L-H_2O))
VF_{sv}	volatilization factor for vapors from soil to enclosed space ((mg/m^3-air)/(mg/kg-soil))
W	width of soil source area parallel to groundwater flow direction (cm)

Soil and Groundwater Parameter Values Used for Iowa Tier 1 Table Generation

Parameter		Iowa Tier 1 Table Value
K	hydraulic conductivity	16060 cm/year
i	groundwater head gradient	0.01 cm/cm
W	width of soil source area parallel to groundwater flow direction	1500 cm
I	infiltration rate of water through soil	7 cm/year
δ	groundwater mixing zone thickness	200 cm
ρ_s	soil bulk density	1.86 g/cm^3
θ_{as}	volumetric air content in vadose zone	0.2 cm^3-air/cm^3-soil
θ_{ws}	volumetric water content in vadose zone	0.1 cm^3-H_2O/cm^3-soil
θ_{acrack}	volumetric air content in foundation/wall cracks	0.2 cm^3-air/cm^3-soil
θ_{wcrack}	volumetric water content in foundation/wall cracks	0.1 cm^3-H_2O/cm^3-soil
θ_T	total soil porosity	0.3 cm^3-voids/cm^3-soil
f_{oc}	fraction organic carbon in the soil	0.01 kg-C/kg-soil
L_s	depth to subsurface soil sources from the enclosed space foundation	1 cm
L_{gw}	depth to groundwater from the enclosed space foundation	1 cm

Exposure Factors Used in Iowa Tier 1 Table Generation

Parameter		Residential	Nonresidential
AT_c (years)	averaging time for carcinogens	70	70
AT_n (years)	averaging time for noncarcinogens	30	25
BW (kg)	body weight	70	70
ED (years)	exposure duration	30	25
EF (days/year)	exposure frequency	350	250
IR_{air} (m^3/day)	daily indoor inhalation rate	15	20
IR_w (L/day)	daily water ingestion rate	2	1
THQ (unitless)	target hazard quotient for individual constituents	1.0	1.0

Building Parameters Used in Iowa Tier 1 Table Generation

Parameter		Residential	Nonresidential
ER (s^{-1})	enclosed space air exchange rate	0.00014	0.00023
L_B (cm)	enclosed space volume/infiltration area ratio	200	300
L_{crack} (cm)	enclosed space foundation or wall thickness	15	15
η	areal fraction of cracks in foundation/wall	0.01	0.01

Chemical-Specific Parameter Values Used for Iowa Tier 1 Table Generation

Chemical	D^{air} (cm^2/s)	D^{wat} (cm^2/s)	H (L-air/L-water)	log(K_{oc}), L/kg
Benzene	0.093	1.1e-5	0.22	1.58
Toluene	0.085	9.4e-6	0.26	2.13
Ethylbenzene	0.076	8.5e-6	0.32	1.98
Xylenes	0.072	8.5e-6	0.29	2.38
Naphthalene	0.072	9.4e-6	0.049	3.11
Benzo(a)pyrene	0.050	5.8e-6	5.8e-8	5.59
Benz(a)anthracene	0.05	9.0e-6	5.74e-7	6.14
Chrysene	0.025	6.2e-6	4.9e-7	5.30

Saturation Values Used to Determine "NA" for the Iowa Tier 1 Table

Chemical	Solubility in Water (mg/L) S	Saturation in Soil (mg/kg) C_s^{sat}
Benzene	1,750	801
Toluene	535	765
Ethylbenzene	152	159
Xylenes	198	492
Naphthalene	31	401
Benzo(a)pyrene	0.0012	4.69
Benz(a)anthracene	0.014	193.3
Chrysene	0.0028	5.59

The maximum solubility of the pure chemical in water is listed in the table above. The equation below is used to calculate the soil concentration (C_s^{sat}) at which dissolved pore-water and vapor phases become saturated. Tier 1 default values are used in the equation. "NA" (for not applicable) is used in the Tier 1 table when the risk-based value exceeds maximum solubility for water (S) or maximum saturation for soil (C_s^{sat}).

$$C_s^{sat}(\text{mg/kg-soil}) = S/\rho_s \times (H\theta_{as} + \theta_{ws} + k_s \rho_s)$$

Slope Factors and Reference Doses Used for Iowa Tier 1 Table Generation

Chemical	SF_i ((kg-day)/mg)	SF_o ((kg-day)/mg)	RfD_i (mg/(kg-day))	RfD_o (mg/(kg-day))
Benzene	0.029	0.029	—	—
Toluene	—	—	0.114	0.2
Ethylbenzene	—	—	0.286	0.1
Xylenes	—	—	2.0	2.0
Naphthalene	—	—	0.004	0.004
Benzo(a)pyrene	6.1	7.3	—	—
Benz(a)anthracene	0.61	0.73	—	—
Chrysene	0.061	0.073	—	—

[**ARC 9011B**, IAB 8/25/10, effective 9/29/10]

Appendix B – Tier 2 Equations and Parameter Values (Revised Model)

All Tier 1 equations and parameters apply at Tier 2 except as specified below.

Equation for Tier 2 Groundwater Contaminant Transport Model

Equation (1)

$$C(x) = C_s \exp\left(\frac{x_m}{2\alpha_x}\left[1-\sqrt{1+\frac{4\lambda\alpha_x}{u}}\right]\right) erf\left(\frac{S_w}{4\sqrt{\alpha_y x_m}}\right) erf\left(\frac{S_d}{4\sqrt{\alpha_z x_m}}\right)$$

Equation (2)

Where $x_m = ax + bx^c$

The value of X_m is computed from Equation (2), where the values for a, b and c in Equation (2) are given in Table 1.

Table 1. Parameter Values for Equation (2)

Chemical	a	b	c
Benzene	1	0.000000227987	3.929438689
Toluene	1	0.000030701	3.133842393
Ethylbenzene	1	0.0001	2.8
Xylenes	1	0.0	0.0
TEH-Diesel	1	0.000000565	3.625804634
TEH-Waste Oil	1	0.000000565	3.625804634
Naphthalene	1	0	0

Variable definitions

x: distance in the x direction downgradient from the source
erf( ): the error function
C(x): chemical concentration in groundwater at x
C_s: Source concentration in groundwater (groundwater concentration at x=0)
S_w: width of the source (perpendicular to x)
S_d: vertical thickness of the source
u: groundwater velocity (pore water velocity); u=Ki/θe
K: hydraulic conductivity
i: groundwater head gradient
θe: effective porosity
λ: first order decay coefficient, chemical specific
αx, αy, αz: dispersivities in the x, y and z directions, respectively

For the following lists of parameters, one of three is required: site-specific measurements, defaults or the option of either (which means the default may be used or replaced with a site-specific measurement).

Soil parameters

Parameter		Default Value	Required
ρ_s	soil bulk density	1.86 g/cm^3	option
f_{oc}	fraction organic carbon in the soil	0.01 kg-C/kg-soil	option
θ_T	total soil porosity	0.3cm^3-voids/cm^3-soil	option
θ_{as}	volumetric air content in vadose zone	0.2cm^3-air/cm^3-soil	default
θ_{ws}	volumetric water content in vadose zone	0.1cm^3-H_2O/cm^3-soil	default

Parameter		Default Value	Required
θ_{acrack}	volumetric air content in foundation/wall cracks	0.2cm^3-air/cm^3-soil	default
I	infiltration rate of water through soil	7 cm/year	default

If the total porosity is measured, assume 1/3 is air filled and 2/3 is water filled for determining the water and air fraction in the vadose zone soil and floor cracks.

Groundwater Transport Modeling Parameters

Parameter		Default Value	Required
K	hydraulic conductivity	16060 cm/year	site-specific
i	groundwater head gradient	0.01 cm/cm	site-specific
S_w	width of the source	use procedure specified in 135.10(2)	site-specific
S_d	vertical thickness of the source	3 m	default
αx	dispersivity in the x direction	0.1x	default
αy	dispersivity in the y direction	$0.33\alpha x$	default
αz	dispersivity in the z direction	$0.05\alpha x$	default
θe	effective porosity	0.1	default

where $u=Ki/\theta e$

First-order Decay Coefficients

Chemical	Default Valueλ (d-1)	Required
Benzene	0.000127441	default
Toluene	0.0000208066	default
Ethylbenzene	0.0	default
Xylenes	0.0005	default
Naphthalene	0.00013	default
TEH-Diesel	0.0000554955	default
TEH-Waste Oil	0.0000554955	default

Other Parameters for Groundwater Vapor to Enclosed Space

Parameter		Default Value	Required
Lgw	depth to groundwater from the enclosed space foundation	1 cm	option
L_B	enclosed space volume/infiltration area ratio	200 cm	option
ER (s-1)	enclosed space air exchange rate	0.00014	default
Lcrack	enclosed space foundation or wall thickness	15 cm	default
η	areal fraction of cracks in foundation/wall	0.01	default

Other Parameters for Soil Vapor to Enclosed Space

Parameter		Default Value	Required
L_s	depth to subsurface soil sources from the enclosed space foundation	1 cm	option
L_B	enclosed space volume/infiltration area ratio	250 cm *	option
ER (s-1)	enclosed space air exchange rate	0.000185 *	default
Lcrack	enclosed space foundation or wall thickness	15 cm	default
η	areal fraction of cracks in foundation/wall	0.01	default

*These values are an average of residential and nonresidential factors.

Soil Leaching to Groundwater

Parameter		Default Value	Required
δ	groundwater mixing zone	2 m	default

Building Parameters for Iowa Tier 2

Parameter		Residential	Nonresidential
ER (s-1)	enclosed space air exchange rate	0.00014	0.00023
L_B	enclosed space volume/infiltration area ratio	200 cm	300 cm

Other Parameters

For Tier 2, the following are the same as Tier 1 values (refer to Appendix A): chemical-specific parameters, slope factors and reference doses, and exposure factors (except for those listed below).

Exposure Factors for Tier 2 Groundwater Vapor to Enclosed Space Modeling:

Potential Residential: use residential exposure and residential building parameters.

Potential Nonresidential: use nonresidential exposure and nonresidential building parameters.

Diesel and Waste Oil

Diesel and Waste Oil			Chemical-Specific Values for Tier 1			
Media	Exposure Pathway	Receptor	Naphthalene	Benzo(a) pyrene	Benz(a) anthracene	Chrysene
Groundwater (ug/L)	Groundwater Ingestion	actual	150	0.012	0.12	1.2
		potential	150	1.2	12.0	NA
	Groundwater Vapor to Enclosed Space	all	4,440	NA	NA	NA
	Groundwater to Water Line	all	150	1.2	12.0	NA
	Surface Water	all	150	1.2	12.0	NA
Soil (mg/kg)	Soil Leaching to Groundwater	all	7.6	NA	NA	NA
	Soil Vapor to Enclosed Space	all	95	NA	NA	NA
	Soil to Water Line	all	21	NA	NA	NA

Due to difficulties with analytical methods for the four individual chemicals listed in the above table, Total Extractable Hydrocarbon (TEH) default values were calculated for each chemical, using the assumption that diesel contains 0.2% napthalene, 0.001% benzo(a)pyrene, 0.001% benz(a)anthracene, and 0.001% chrysene. Resulting TEH Default Values are shown in the following table.

Diesel			TEH Default Values			
Media	Exposure Pathway	Receptor	Naphthalene	Benzo(a) pyrene	Benz(a) anthracene	Chrysene
Groundwater (ug/L)	Groundwater Ingestion	actual	75,000	1,200	12,000	120,000
		potential	75,000	120,000	1,200,000	NA
	Groundwater Vapor to Enclosed Space	all	2,200,000	NA	NA	NA
	Groundwater to Water Line	all	75,000	120,000	1,200,000	NA
	Surface Water	all	75,000	120,000	1,200,000	NA
Soil (mg/kg)	Soil Leaching to Groundwater	all	3,800	NA	NA	NA
	Soil Vapor to Enclosed Space	all	47,500	NA	NA	NA
	Soil to Water Line	all	10,500	NA	NA	NA

The lowest TEH default value for each pathway (shown as a shaded box) was used in the Tier 1 Table.

Due to difficulties with analytical methods for the four individual chemicals, Total Extractable Hydrocarbon (TEH) default values were calculated for each chemical, using the assumption that waste oil contains no naphthalene, 0.003% benzo(a)pyrene, 0.003% benz(a)anthracene, and 0.003% chrysene. Resulting TEH Default Values are shown in the following table.

Waste Oil			TEH Default Values			
Media	Exposure Pathway	Receptor	Naphthalene	Benzo(a) pyrene	Benz(a) anthracene	Chrysene
Groundwater (ug/L)	Groundwater Ingestion	actual	NA	400	4,000	40,000
		potential	NA	40,000	400,000	NA
Groundwater (ug/L)	Groundwater Vapor to Enclosed Space	all	NA	NA	NA	NA
	Groundwater to Water Line	all	NA	40,000	400,000	NA
	Surface Water	all	NA	40,000	400,000	NA
Soil (mg/kg)	Soil Leaching to Groundwater	all	NA	NA	NA	NA
	Soil Vapor to Enclosed Space	all	NA	NA	NA	NA
	Soil to Water Line	all	NA	NA	NA	NA

The lowest TEH default value for each pathway (shown as a shaded box) was used in the Tier 1 Table.

Water Line Calculations

Explanation of Target Levels for
Petroleum Fuel-Derived BTEX Compounds in Groundwater and Soil

GROUNDWATER

PVC or Gasketed Mains

Benzene: 7,500 µg/L
Gasoline-saturated groundwater was considered to be an extreme condition of environmental contamination, and it was considered unacceptable to leave water lines, regardless of material, in contact with this level of benzene contamination. While Ong et al. (2008) showed that gasoline-saturated groundwater would not pose a significant risk of permeation exceeding the 5 µg/L MCL for benzene of gasketed DI or PVC water mains, a safety factor of 1/8th was applied to the level of benzene in premium gasoline-saturated water determined by Ong et al. (2008). A 1/2 safety factor was compounded for each of four potential safety risks: material defects in the pipe (= 1/2), presence of service line taps (= 1/4), stagnation of water (= 1/6), and water line breaks (= 1/8). This was an average of 67.5 mg/L ± 4.9 mg/L for multiple preparations of gasoline-saturated water and was rounded to 60.0 mg/L to conservatively account for the statistical uncertainty. Hence,

$$\textit{Target Level} = \frac{1}{8} \times 60{,}000\ \mu g/L = 7{,}500\ \mu g/L\ \textit{benzene}$$

Toluene: 6,250 µg/L
The target level for toluene was determined similarly to that for benzene. The level of toluene in premium gasoline-saturated water was determined by Ong et al. (2008) to be 56.2 mg/L ± 4.9 mg/L and conservatively rounded to 50.0 mg/L. Hence,

$$\textit{Target Level} = \frac{1}{8} \times 50{,}000\ \mu g/L = 6{,}250\ \mu g/L\ \textit{toluene}$$

Ethylbenzene: 40,000 µg/L
The target level was set to be double that for PVC or Gasketed Service Lines (20,000 µg/L – see below).

Total Xylenes: 48,000 µg/L
The target level was set to be double that for PVC or Gasketed Service Lines (24,000 µg/L – see below).

PVC or Gasketed Service Lines

Benzene: 3,750 µg/L
The target level was set to be one-half of that for PVC or Gasketed Mains (7,500 µg/L as above) since service lines tend to be of higher risk than mains owing to their smaller diameter and greater potential for stagnation.

Toluene: 3,120 µg/L
Similar to benzene, the target level was set to be one-half of that for PVC or Gasketed Mains (6,250 µg/L as above) since service lines tend to be of higher risk than mains owing to their smaller diameter and greater potential for stagnation. Odd-even rounding to 3 significant figures was applied.

Ethylbenzene: 20,000 µg/L
The target level was based on two observations by Ong et al. (2008): (1) premium gasoline-saturated water has an average concentration of 3.4 mg/L ethylbenzene and (2) ethylene permeates high density polyethylene 46 times slower than does benzene (presumably, this is reasonably representative of other materials such as rubber gaskets). The 1/8 safety factor was also applied, as above. Odd-even rounding to 2 significant figures was applied. Hence:

$$\textit{Target Level} = 3{,}400\ \mu g/L \times 46x \times \frac{1}{8} = 19{,}550\ \mu g/L = 20{,}000\ \mu g/L$$

Total Xylenes: 24,000 µg/L
Similar to ethylbenzene, the target level was based on (1) premium gasoline-saturated water has an average concentration of 19 mg/L total xylenes and (2) total xylenes permeate high density polyethylene 10 times slower than does benzene. The 1/8 safety factor was also applied, as above. Odd-even rounding to 2 significant figures was applied. Hence:

$$\textit{Target Level} = 19{,}000\ \mu g/L \times 10x \times \frac{1}{8} = 23{,}750\ \mu g/L = 24{,}000\ \mu g/L$$

PE/PB/AC

Benzene: 200 µg/L
The target level was set at the concentration of benzene in groundwater surrounding a 1″ HDPE service line (SIDR 9 IPS) that would result in a concentration of 2 µg/L benzene in the service line after a 24 hr stagnation period. This level was chosen because 2 µg/L is generally the minimum reportable concentration of benzene in laboratory reports received by the department.

The permeation rate is a function of the concentration of benzene in the groundwater as described by Ong et al. (2008), equation 3.4a:

$$P_m = 0.0079 C_{bulk}^{1.1323}$$

where P_m is the benzene permeation rate in µg/cm^2/day through the pipe described above (cm^2 refers to the inner surface of the pipe) and C_{bulk} is the concentration of benzene in the groundwater (mg/L).

For any length of exposed 1″ SIDR 9 IPS pipe, l (cm), the concentration in the pipe after 24 hr stagnation, C_{24hr} (µg/L), can be computed from P_m and the ratio of the inner surface of the pipe to the internal volume:

$$C_{24hr} = P_m \times \left(\frac{2\pi r l}{\pi r^2 l/1000}\right) = 0.0079 C_{bulk}^{1.1323} \times \frac{2000}{r}$$

where r is the inside radius of the pipe (cm), l is the length of exposed pipe (cm), and dividing by 1000 converts from cm^3 to liters (and, therefore, 2000/r converts µg/cm^2/day to µg/L/day).

Solving for C_{bulk} (mg/L) with C_{24hr}= 2 µg/L and r = 1.28 cm (per manufacturer's specifications):

$$C_{bulk}^{1.1323} = \frac{2 \times 1.28}{0.0079 \times 2000}$$

and

$$C_{bulk} = \sqrt[1.1323]{0.162} = 0.200 mg/L = 200 \mu g/L$$

While the target level is expressed as 200 µg/L for clarity, the underlying data support only two significant figures. In a stricter treatment of the data, this would be expressed as 20×10^1 µg/L.

Toluene: 3,120 µg/L
The target level was set to be equal to that for PVC or Gasketed Service Lines. Calculations similar to those used above for benzene (Ong et al. (2008), equation 3.4b) indicate that 3,120 µg/L toluene in groundwater would result in 50 µg/L inside a 1" SIDR 9 IPS HDPE pipe after 24 hours of stagnation, which is 1/20th of the 1,000 µg/L MCL for toluene.

Ethylbenzene: 3,400 µg/L
The target level was set to be equal to the concentration of ethylbenzene in premium gasoline-saturated water (see discussion above for PVC or Gasketed Mains/Benzene). Unlike other target levels based on contaminant concentrations in gasoline-saturated water, the 1/8th safety factor was not applied because of the very low permeation rate of ethylbenzene through HDPE, the relatively low solubility of ethylbenzene in water, and the relatively high MCL (700 µg/L). Ong et al. (2008) found that permeation of HDPE by aqueous ethylbenzene was minimal and of no consequence for public health.

Total Xylenes: 19,000 µg/L
The target level was set to be equal to the concentration of ethylbenzene in premium gasoline-saturated water following the same reasoning for ethylbenzene (above). The permeation rate and water solubility are also very low, and the MCL is 10,000 µg/L. Ong et al. (2008) found that permeation of HDPE by aqueous xylenes was minimal and of no consequence for public health.

SOIL

Target levels for soil were set to be the same for mains and service lines of any material discussed above under "Groundwater." The underlying data support two significant figures for target levels in soil. Odd-even rounding was applied where appropriate.

Benzene: 2.0 mg/Kg
The target level was derived from the concentration of benzene (mg/Kg) that would result if soil that was 10% moisture and 1% organic matter was equilibrated with premium gasoline-saturated water (60 mg/L benzene – as per discussion of PVC or Gasketed Mains/Benzene above). The equilibrium concentration in soil was calculated using the approach of Chiou et al. (1983). The 1/8th safety factor discussed previously for groundwater was applied. Accordingly:

$$C_T = C_W K_d + C_W \theta$$

where C_T is the total concentration of benzene in soil (mg/Kg), θ is the fraction of moisture in the soil (Kg/Kg), and K_d is the partition coefficient from water to soil (L/Kg). Further:

$$K_d = K_{om} f_{om}$$

where K_{om} is the partition coefficient from water to organic matter in the soil, which is 16.8 L/Kg for benzene in soils with naturally occurring organic matter (Chiou et al. (1983)), and f_{om} is the fraction of organic matter in the dry soil (Kg/Kg).

For soil containing 1% naturally occurring organic matter and 10% moisture, the total concentration of benzene upon exposure to premium gasoline-saturated groundwater (60 mg/L benzene, as per above discussion of PVC or Gasketed Mains) would be:

$$C_T = \left(\frac{60\ mg}{L} \times \left(\frac{16.8\ L}{Kg} \times \frac{0.01\ Kg}{Kg}\right)\right) + \left(\frac{60\ mg}{L} \times \frac{0.1\ Kg}{Kg}\right) = \frac{16\ mg}{Kg}$$

Applying the 1/8th safety factor:

$$Target\ Level = \frac{1}{8} \times \frac{16\ mg}{Kg} = \frac{2.0\ mg}{Kg}$$

Toluene: 3.2 mg/Kg

The target level was derived in the same manner as for benzene except that the concentration of toluene in premium gasoline-saturated water is 50 mg/L and K_{om} is 42 L/Kg. Accordingly:

$$C_T = \left(\frac{50\ mg}{L} \times \left(\frac{42\ L}{Kg} \times \frac{0.01\ Kg}{Kg}\right)\right) + \left(\frac{50\ mg}{L} \times \frac{0.1\ Kg}{Kg}\right) = \frac{26\ mg}{Kg}$$

and

$$Target\ Level = \frac{1}{8} \times \frac{26\ mg}{Kg} = \frac{3.2\ mg}{Kg}$$

Ethylbenzene: 45 mg/Kg

The target level was based on the target level set for Groundwater/PVC or Gasketed Mains (40,000 µg/L, rounded from 39,100 µg/L, or 39.1 mg/L) and the principles of Chiou et al. (1983) discussed above. In a manner similar to that for benzene in soil, C_W was 3.4 mg/L, K_d was 0.106 L/Kg, and C_T was calculated to be 3.9 mg/Kg. The target level for soil that is equivalent to the target level set for groundwater was calculated as follows:

$$Target\ Level\ mg/Kg = 39.1\ mg/L \times \frac{3.9\ mg/Kg}{3.4\ mg/L} = 45\ mg/Kg$$

Total Xylenes: 52 mg/Kg

The target level was set in the same manner as for ethylbenzene (above), based on the groundwater target level of 48,000 µg/L (rounded from 47.5 mg/L). C_W was 19 mg/L, K_d was 1.001 L/Kg (assuming a mixture of m-, o-, and p-xylenes which is 60%, 20%, and 20%, respectively, which is typical of xylenes derived from petroleum), and C_T was calculated to be 21 mg/Kg. Hence:

$$Target\ Level\ mg/Kg = 47.5\ mg/L \times \frac{21\ mg/Kg}{19\ mg/L} = 52\ mg/Kg$$

NOTE: The 1/8th safety factor was applied above to the target levels for ethylbenzene and total xylenes for Groundwater, PVC or Gasketed Service Lines, thence the target levels for Groundwater, PVC or Gasketed Mains, were derived. Consequently, the 1/8th safety factor has also been applied to the target levels for both ethylbenzene and total xylenes in soil.

REFERENCES

Chiou, C. T., P. E. Porter and D. W. Schmedding. 1983. Partition equilibria of nonionic organic compounds between soil organic matter and water. Environ. Sci. Technol., 17(4)227-231.

Ong, S. K., J. A. Gaunt, F. Mao, C. L. Cheng, L. Esteve-Agelet, and C. R. Hurburgh. 2008. Impact of hydrocarbons on PE/PVC pipes and pipe gaskets, Publication 91204. Awwa Research Foundation (presently Water Research Foundation), Denver, CO.

Appendix B-1 – Tier 2 Equations and Parameter Values (Old Model)

All Tier 1 equations and parameters apply at Tier 2 except as specified below.

Equation for Tier 2 Groundwater Contaminant Transport Model

$$C(x) = C_s \exp\left(\frac{x}{2\alpha_x}\left[1-\sqrt{1+\frac{4\lambda\alpha_x}{u}}\right]\right) \operatorname{erf}\left(\frac{S_w}{4\sqrt{\alpha_y x}}\right) \operatorname{erf}\left(\frac{S_d}{4\sqrt{\alpha_z x}}\right)$$

Variable definitions

x: distance in the x direction downgradient from the source
erf( ): the error function
C(x): chemical concentration in groundwater at x
C_s: Source concentration in groundwater (groundwater concentration at x=0)
S_w: width of the source (perpendicular to x)
S_d: vertical thickness of the source
u: groundwater velocity (pore water velocity); u=Ki/θe
K: hydraulic conductivity
i: groundwater head gradient
θe: effective porosity
λ: first-order decay coefficient, chemical specific
αx, αy, αz: dispersivities in the x, y and z directions, respectively

For the following lists of parameters, one of three is required: site-specific measurements, defaults or the option of either (which means the default may be used or replaced with a site-specific measurement).

Soil parameters

Parameter		Default Value	Required
ρ_s	soil bulk density	1.86 g/cm^3	option
f_{oc}	fraction organic carbon in the soil	0.01 kg-C/kg-soil	option
θ_T	total soil porosity	0.3cm^3-voids/cm^3-soil	option
θ_{as}	volumetric air content in vadose zone	0.2cm^3-air/cm^3-soil	default
θ_{ws}	volumetric water content in vadose zone	0.1cm^3-H_2O/cm^3-soil	default
θ_{acrack}	volumetric air content in foundation/wall cracks	0.2cm^3-air/cm^3-soil	default
θ_{wcrack}	volumetric water content in foundation/wall cracks	0.1cm^3-H_2O/cm^3-soil	default
I	infiltration rate of water through soil	7 cm/year	default

If the total porosity is measured, assume 1/3 is air filled and 2/3 is water filled for determining the water and air fraction in the vadose zone soil and floor cracks.

Groundwater Transport Modeling Parameters

Parameter		Default Value	Required
K	hydraulic conductivity	16060 cm/year	site-specific
i	groundwater head gradient	0.01 cm/cm	site-specific
S_w	width of the source	use procedure specified in 135.10(2)	site-specific
S_d	vertical thickness of the source	3 m	default
αx	dispersivity in the x direction	0.1x	default
αy	dispersivity in the y direction	$0.33\alpha x$	default
αz	dispersivity in the z direction	$0.05\alpha x$	default
θe	effective porosity	0.1	default

where $u=Ki/\theta e$

First-order Decay Coefficients

Chemical	Default Valueλ (d-1)	Required
Benzene	0.0005	default
Toluene	0.0007	default
Ethylbenzene	0.00013	default
Xylenes	0.0005	default
Naphthalene	0.00013	default
Benzo(a)pyrene	0	default
Benz(a)anthracene	0	default
Chrysene	0	default

Other Parameters for Groundwater Vapor to Enclosed Space

Parameter		Default Value	Required
Lgw	depth to groundwater from the enclosed space foundation	1 cm	option
L_B	enclosed space volume/infiltration area ratio	200 cm	option
ER (s-1)	enclosed space air exchange rate	0.00014	default
Lcrack	enclosed space foundation or wall thickness	15 cm	default
η	areal fraction of cracks in foundation/wall	0.01	default

Other Parameters for Soil Vapor to Enclosed Space

Parameter		Default Value	Required
L_s	depth to subsurface soil sources from the enclosed space foundation	1 cm	option
L_B	enclosed space volume/infiltration area ratio	250 cm *	option
ER (s-1)	enclosed space air exchange rate	0.000185 *	default
Lcrack	enclosed space foundation or wall thickness	15 cm	default
η	areal fraction of cracks in foundation/wall	0.01	default

*These values are an average of residential and nonresidential factors.

Soil Leaching to Groundwater

Parameter		Default Value	Required
δ	groundwater mixing zone	2 m	default

Building Parameters for Iowa Tier 2

Parameter		Residential	Nonresidential
ER (s-1)	enclosed space air exchange rate	0.00014	0.00023
L_B	enclosed space volume/infiltration area ratio	200 cm	300 cm

Other Parameters

For Tier 2, the following are the same as Tier 1 values (refer to Appendix A): chemical-specific parameters, slope factors and reference doses, and exposure factors (except for those listed below).

Exposure Factors for Tier 2 Groundwater Vapor to Enclosed Space Modeling:
Potential Residential: use residential exposure and residential building parameters.
Potential Nonresidential: use nonresidential exposure and nonresidential building parameters.

Diesel and Waste Oil

Diesel and Waste Oil			Chemical-Specific Values for Tier 1			
Media	Exposure Pathway	Receptor	Naphthalene	Benzo(a) pyrene	Benz(a) anthracene	Chrysene
Groundwater (ug/L)	Groundwater Ingestion	actual	150	0.012	0.12	1.2
		potential	150	1.2	12.0	NA
	Groundwater Vapor to Enclosed Space	all	4,440	NA	NA	NA
	Groundwater to Plastic Water Line	all	150	1.2	12.0	NA
	Surface Water	all	150	1.2	12.0	NA
Soil (mg/kg)	Soil Leaching to Groundwater	all	7.6	NA	NA	NA
	Soil Vapor to Enclosed Space	all	95	NA	NA	NA
	Soil to Plastic Water Line	all	21	NA	NA	NA

Due to difficulties with analytical methods for the four individual chemicals listed in the above table, Total Extractable Hydrocarbon (TEH) default values were calculated for each chemical, using the assumption that diesel contains 0.2% napthalene, 0.001% benzo(a)pyrene, 0.001% benz(a)anthracene, and 0.001% chrysene. Resulting TEH Default Values are shown in the following table.

Diesel			TEH Default Values			
Media	Exposure Pathway	Receptor	Naphthalene	Benzo(a) pyrene	Benz(a) anthracene	Chrysene
Groundwater (ug/L)	Groundwater Ingestion	actual	75,000	1,200	12,000	120,000
		potential	75,000	120,000	1,200,000	NA
	Groundwater Vapor to Enclosed Space	all	2,200,000	NA	NA	NA
	Groundwater to Plastic Water Line	all	75,000	120,000	1,200,000	NA
	Surface Water	all	75,000	120,000	1,200,000	NA
Soil (mg/kg)	Soil Leaching to Groundwater	all	3,800	NA	NA	NA
	Soil Vapor to Enclosed Space	all	47,500	NA	NA	NA
	Soil to Plastic Water Line	all	10,500	NA	NA	NA

The lowest TEH default value for each pathway (shown as a shaded box) was used in the Tier 1 Table.

Due to difficulties with analytical methods for the four individual chemicals, Total Extractable Hydrocarbon (TEH) default values were calculated for each chemical, using the assumption that waste oil contains no naphthalene, 0.003% benzo(a)pyrene, 0.003% benz(a)anthracene, and 0.003% chrysene. Resulting TEH Default Values are shown in the following table.

Waste Oil			TEH Default Values			
Media	Exposure Pathway	Receptor	Naphthalene	Benzo(a) pyrene	Benz(a) anthracene	Chrysene
Groundwater (ug/L)	Groundwater Ingestion	actual	NA	400	4,000	40,000
		potential	NA	40,000	400,000	NA
Groundwater (ug/L)	Groundwater Vapor to Enclosed Space	all	NA	NA	NA	NA
	Groundwater to Plastic Water Line	all	NA	40,000	400,000	NA
	Surface Water	all	NA	40,000	400,000	NA
Soil (mg/kg)	Soil Leaching to Groundwater	all	NA	NA	NA	NA
	Soil Vapor to Enclosed Space	all	NA	NA	NA	NA
	Soil to Plastic Water Line	all	NA	NA	NA	NA

The lowest TEH default value for each pathway (shown as a shaded box) was used in the Tier 1 Table.
[**ARC 9011B**, IAB 8/25/10, effective 9/29/10]

APPENDIX C
DECLARATION OF RESTRICTIVE COVENANTS
Rescinded IAB 7/19/06, effective 8/23/06

APPENDIX D
IOWA DEPARTMENT OF NATURAL RESOURCES

NO FURTHER ACTION CERTIFICATE

This document certifies that the referenced underground storage tank site has been classified by the Iowa Department of Natural Resources (IDNR) as "no action required" as provided in the 1995 Iowa Code Supplement 455B.474(1)"h"(1). This certificate may be recorded as provided by law.

ISSUED TO: OWNERS/OPERATORS OF TANKS
DATE OF ISSUANCE:
IDNR FILE REFERENCES: LUST # REGISTRATION #
LEGAL DESCRIPTION OF UNDERGROUND STORAGE TANK SITE:

Issuance of this certificate does not preclude the IDNR from requiring further corrective action due to new releases and is based on the information available to date. The department is precluded from requiring additional corrective action solely because governmental action standards are changed. See 1995 Iowa Code Supplement 455B.474(1)"h"(1).

This certificate does not constitute a warranty or a representation of any kind to any person as to the environmental condition, marketability or value of the above referenced property other than that certification required by 1995 Iowa Code Supplement 455B.474(1)"h".

These rules are intended to implement Iowa Code sections 455B.304, 455B.424 and 455B.474.

[Filed emergency 9/20/85—published 10/9/85, effective 9/20/85]
[Filed emergency 11/14/86—published 12/3/86, effective 12/3/86]
[Filed emergency 12/29/86—published 1/14/87, effective 1/14/87]
[Filed 5/1/87, Notice 1/14/87—published 5/20/87, effective 7/15/87][1]
[Filed emergency 9/22/87—published 10/21/87, effective 9/22/87]
[Filed 2/19/88, Notice 11/18/87—published 3/9/88, effective 4/13/88]
[Filed emergency 10/24/88—published 11/16/88, effective 10/24/88]
[Filed 7/21/89, Notice 2/22/89—published 8/9/89, effective 9/13/89]
[Filed emergency 8/25/89—published 9/20/89, effective 8/25/89]
[Filed 8/31/90, Notice 3/21/90—published 9/19/90, effective 10/24/90]
[Filed 2/1/91, Notice 11/14/90—published 2/20/91, effective 3/27/91]
[Filed emergency 3/29/91—published 4/17/91, effective 3/29/91]
[Filed emergency 8/28/91—published 9/18/91, effective 8/28/91]
[Filed emergency 2/21/92 after Notice 9/18/91—published 3/18/92, effective 2/21/92]
[Filed 9/24/93, Notice 3/17/93—published 10/13/93, effective 11/17/93]
[Filed 12/1/95, Notice 8/16/95—published 12/20/95, effective 1/24/96]
[Filed emergency 6/25/96—published 7/17/96, effective 8/15/96]
[Filed emergency 12/20/96 after Notice 7/17/96—published 1/15/97, effective 12/20/96]
[Filed emergency 6/25/99—published 7/14/99, effective 7/1/99]
[Filed 10/1/99, Notice 7/14/99—published 10/20/99, effective 11/24/99]

[Filed emergency 9/29/00—published 10/18/00, effective 9/29/00]
[Filed 1/19/01, Notice 10/18/00—published 2/7/01, effective 3/14/01]
[Filed 12/19/01, Notice 10/17/01—published 1/9/02, effective 2/13/02]
[Filed 3/23/06, Notice 11/9/05—published 4/12/06, effective 5/17/06]
[Filed 6/28/06, Notice 3/15/06—published 7/19/06, effective 8/23/06]
[Filed emergency 7/6/07—published 8/1/07, effective 7/6/07]
[Filed 10/4/07, Notice 8/1/07—published 10/24/07, effective 11/28/07]
[Filed 6/12/08, Notice 2/13/08—published 7/2/08, effective 8/6/08][2]
[Editorial change: IAC Supplement 7/30/08]
[Editorial change: IAC Supplement 11/5/08]
[Filed ARC 7621B (Notice ARC 7400B, IAB 12/3/08), IAB 3/11/09, effective 4/15/09]
[Filed ARC 8124B (Notice ARC 7854B, IAB 6/17/09), IAB 9/9/09, effective 10/14/09]
[Filed ARC 8469B (Notice ARC 7854B, IAB 6/17/09), IAB 1/13/10, effective 2/17/10][3]
[Editorial change: IAC Supplement 2/24/10]
[Editorial change: IAC Supplement 5/5/10]
[Filed ARC 9011B (Notice ARC 8676B, IAB 4/7/10), IAB 8/25/10, effective 9/29/10]
[Filed ARC 9331B (Notice ARC 9152B, IAB 10/20/10), IAB 1/12/11, effective 2/16/11]
[Filed Emergency ARC 0559C, IAB 1/9/13, effective 12/19/12]
[Filed ARC 1100C (Notice ARC 0560C, IAB 1/9/13; Amended Notice ARC 0836C, IAB 7/24/13), IAB 10/16/13, effective 11/20/13]
[Editorial change: IAC Supplement 11/27/13]
[Filed ARC 5625C (Notice ARC 5316C, IAB 12/16/20), IAB 5/19/21, effective 6/23/21]

[1] July 15, 1987, effective date of 135.9(4) delayed 70 days by Administrative Rules Review Committee at its June 1987 meeting.

[2] August 6, 2008, effective date of **ARC 6892B** delayed 70 days by Administrative Rules Review Committee at its July 2008 meeting. At its meeting held October 14, 2008, the Committee delayed until adjournment of the 2009 Session of the General Assembly the following provisions: **567—135.2(455B)**, definition of "Sensitive area"; **135.9(4)"f"**; **135.10(4)"a,"** last sentence: "A public water supply screening and risk assessment must be conducted in accordance with 135.10(4)"f" for this pathway" and **135.10(4)"b,"** last sentence of the first paragraph: "The certified groundwater professional or the department may request additional sampling of drinking water wells and non-drinking water wells as part of its evaluation"; **135.10(4)"f"**; **135.10(11)"h."**

[3] February 17, 2010, effective date of 135.5(1)"e" delayed 70 days by the Administrative Rules Review Committee at its meeting held February 8, 2010. At its meeting held April 13, 2010, the Committee delayed the effective date of 135.5(1)"e" until adjournment of the 2011 Session of the General Assembly.

CHAPTER 137
IOWA LAND RECYCLING PROGRAM AND RESPONSE ACTION STANDARDS

567—137.1(455H) Authority, purpose and applicability.

137.1(1) *Authority.* This chapter is adopted under the authority of Iowa Code Supplement chapter 455H. These rules establish the policy and procedures for the voluntary enrollment of contaminated property in the "land recycling program" established under chapter 455H. These rules also establish the response action standards which participants must meet in order to qualify for a no further action certificate and the statutory protections and immunities which follow from it.

137.1(2) *Purpose.* Consistent with the declaration of policy stated in Iowa Code Supplement section 455H.104, these rules are intended to achieve the dual objective of addressing the current and future risks associated with contaminated property and thereby enhancing the market conditions which can lead to development of these properties into their highest productive use. These objectives can in part be met through a program which encourages voluntary participation by persons who may have a legal duty to address, in whole or in part, the contamination within an affected area as well as persons who might not have a legal obligation but who have an interest in development of enrolled sites. These rules attempt to provide a degree of certainty in the response action process as an incentive to participants and as a means of assisting participants in quantifying their financial investment. The following statement of principles is intended as a guide both in the interpretation of these rules and as a statement of the department's regulatory philosophy.

a. It is the objective of the department and these rules to establish a collaborative process between the participant(s) and department staff as the most effective means of achieving consensus and resolving disputes on issues which are not or cannot be fully defined and anticipated by rule.

b. Although participation in this program is voluntary, these rules establish basic standards which must be met in order to obtain regulatory closure from the department through issuance of a no further action certificate.

c. Although the scope of the response actions addressed under these rules may not in every case address all known or unknown releases within an affected area, it should be the objective of both the department and the participants to work together and to use all resources available to address all known releases within an affected area in the interest of protecting public health, safety and the environment as well as achieving regulatory finality.

137.1(3) *Applicability.* These rules shall apply only to releases of contaminants which are being addressed at enrolled sites. The department may in its discretion apply the response action rules in 137.4(455H) through 137.10(455H) to releases of contaminants at sites which are not enrolled. These rules do not in any way limit the statutory liabilities of participants or nonparticipants except as expressly provided within the context of enrollment and Iowa Code Supplement chapter 455H. Consistent with Iowa Code Supplement section 455H.505, these rules do not limit the authority of the department or the responsibility of statutorily responsible persons to provide notice of hazardous conditions under 567—Chapter 131 or to respond to new releases and undertake emergency response actions under 567—Chapter 133. For sites which are not enrolled, 567—Chapter 133 rules will remain in effect and for enrolled sites 567—Chapter 133 shall apply to the extent it is not inconsistent with this chapter.

567—137.2(455H) Definitions.

"Affected area" means any real property affected, suspected of being affected, or modeled to be likely affected by a release occurring at an enrolled site.

"Affiliate" means a corporate parent, subsidiary, or predecessor of a participant, a co-owner or co-operator of a participant, a spouse, parent, or child of a participant, an affiliated corporation or enterprise of a participant, or any other person substantially involved in the legal affairs or management of a participant as defined by the department.

"Background standard" means a standard which represents concentrations of contaminants which are naturally occurring or are generally present and not related to a readily identifiable release.

"Carcinogenic health risk" means the incremental risk of a person developing cancer over a lifetime (70 years) as a result of exposure to a hazardous substance, expressed as a probability such as one in a million (10^{-6}). The contaminant level for the probability value is derived from application of certain designated exposure assumptions and a slope factor.

"Contaminant" means any hazardous substance found in the various media of the environment.

"Contaminant of concern" means specific hazardous substances that are identified for evaluation in the risk assessment process. Identification can be based on their historical and current use at the site, detected concentrations in environmental media and their mobility, toxicity, and persistence in the environment.

"Cumulative risk" means a summation of cancer and noncancer risks, determined separately, based on exposure to multiple contaminants from the same medium and exposure of the same individual to contaminants in multiple media.

"Enrolled site" means any property which has been or is suspected to be the site of or affected by a release and which has been enrolled pursuant to this chapter by a participant.

"Environmental protection easement" means an institutional control created under Iowa Code Supplement section 455H.206 which is a statutorily authorized restriction on land use.

"Exposure pathway" means the course a contaminant of concern may take from its source area to an exposed organism. Each exposure pathway includes a source or release from a source, a point of exposure, and an exposure route.

"Exposure route" means the manner in which a contaminant of concern comes in contact with an organism (e.g., ingestion, inhalation, dermal contact).

"Free product" means a hazardous substance that is present as a nonaqueous phase liquid (e.g., liquid not dissolved in water) or is present as a solid in its original form as a product or waste material.

"Gross contamination" means contamination present at concentrations in an amount sufficient to reasonably expect that institutional or technological controls will not be adequately protective of human health or the environment.

"Group A, B, C, D and E chemicals" means hazardous substances which have been classified based on the weight of evidence of human carcinogenicity. Group A substances are carcinogenic to humans. Group B substances are likely to be carcinogenic to humans. Group C substances have suggestive evidence of human carcinogenicity, but not sufficient evidence to assess human carcinogenic potential. Data are inadequate to assess human carcinogenic potential for Group D substances. Group E substances are not likely to be carcinogenic to humans.

"Hazardous substance" means any substance or mixture of substances that presents a danger to the public health or safety and includes, but is not limited to, a substance that is toxic, corrosive, or flammable, or that is an irritant or that generates pressure through decomposition, heat, or other means. "Hazardous substance" may include any hazardous waste identified or listed by the administrator of the United States Environmental Protection Agency under the Solid Waste Disposal Act as amended by the Resource Conservation and Recovery Act of 1976, or any toxic pollutant listed under Section 307 of the federal Water Pollution Control Act as amended to January 1, 1977, or any hazardous substance designated under Section 311 of the federal Water Pollution Control Act as amended to January 1, 1997, or any hazardous material designated by the Secretary of Transportation under the Hazardous Materials Transportation Act.

"Hydraulic conductivity" means a measure of the capacity of a porous medium (rock or soil) to transmit water. It is expressed as the volume of water that will flow through a unit length of a unit cross-sectional area of the porous medium in a unit time with a unit head loss.

"Institutional controls" means a nonphysical action which restricts land use to reduce or eliminate exposure to the contaminants of an affected area.

"Lifetime health advisory level (HAL)" means an advisory level established by the United States Environmental Protection Agency which represents the concentration of a single contaminant in drinking water which is not expected to cause adverse health effects over lifetime exposure.

"Maximum contaminant level (MCL)" means a standard for drinking water established by the United States Environmental Protection Agency under the Safe Drinking Water Act which is the maximum permissible level of a contaminant in water which is delivered to any user of a public water supply.

"No further action certificate" means the same as no further action letter in Iowa Code Supplement section 455H.301. It is a document issued by the department to the participant certifying no further response action is required at an enrolled site for those conditions classified as no further action except the monitoring or the maintenance of institutional or technological controls when required.

"No further action certification" means the department has determined an enrolled site has met all standards applicable for the identified hazardous substances and no further response action is required except the monitoring or the maintenance of institutional or technological controls when required.

"Noncancer health risk" means the potential for adverse systemic or toxic effects caused by exposure to noncarcinogenic hazardous substances expressed as the hazard quotient for a hazardous substance. A hazard quotient is the ratio of the level of exposure of a hazardous substance over a specified time period to a reference dose derived for a similar time period.

"Nonresidential land-use area" means any area that is not a residential land-use area.

"Participant" means any person who enrolls property pursuant to this chapter. A participant is a participant only to the extent the participant complies with the requirements of this chapter.

"Point of compliance" means a location selected within the affected area where the concentration of contaminants of concern must be at or below the target levels established for that point.

"Point of exposure" means the location at which an individual or population may come in contact with a contaminant of concern from the enrolled site.

"Protected groundwater source" means a saturated bed, formation, or group of formations which has a hydraulic conductivity of at least 0.44 meters per day (m/d) and a total dissolved solids concentration of less than 2,500 milligrams per liter (mg/l).

"Receptor" means an individual or population that is or may be affected by a release from the enrolled site.

"Reference dose," expressed in units of milligrams per day exposure to the contaminant per kilogram of body weight of the exposed individual, means the amount of contaminant that an individual can ingest on a daily basis for a lifetime that is not likely to result in adverse noncancer health effects. A reference dose is protective of the entire human population, including sensitive subpopulations.

"Release" means any spilling, leaking, pouring, emitting, emptying, discharging, injecting, escaping, leaching, dumping, or disposing into the environment of a hazardous substance, including the abandonment or discarding of barrels, containers, and other closed receptacles containing any hazardous substance, but excludes all of the following:

1. Any release which results in exposure to persons solely within a workplace, with respect to a claim which such persons may assert against the employer of such persons.
2. Emission from the engine exhaust of a motor vehicle, rolling stock, aircraft, vessel, or pipeline pumping station engine.
3. The release of source, by-product, or special nuclear material from a nuclear incident, as those terms are defined in the federal Atomic Energy Act of 1954, if such release is subject to requirements with respect to financial protection established by the Nuclear Regulatory Commission under 42 U.S.C. § 2210 or, for the purposes of 42 U.S.C. § 9604 or any other response action, any release of source, by-product, or special nuclear material from any processing site designated under 42 U.S.C. § 7912(a)(1) or § 7942(a).
4. The use of pesticides in accordance with the product label.

"Residential land-use area" means an area zoned for residential use or an area where residential use currently exists, is planned, or is not otherwise precluded. In addition, a residential land-use area includes other areas where frequent, long-term, close contact with soils is likely to occur (e.g., playgrounds, sport fields, gardens, child care facilities).

"Response action" means an action taken to reduce, minimize, eliminate, clean up, control, assess, or monitor a release to protect the public health and safety or the environment. "Response action" includes, but is not limited to, investigation, excavation, removal, disposal, cleaning of groundwaters or

surface waters, natural biodegradation, institutional controls, technological controls, or site management practices.

"Risk evaluation/response action document" means a document based on the site assessment for the enrolled site which includes a risk evaluation, proposed response action, and proposed compliance verification strategy for the enrolled site.

"Site assessment plan" means the optional plan submitted to the department which lays out the rationale and the steps to be followed in the conduct of a site assessment for the enrolled site.

"Site assessment report" means the report of the site assessment which defines the nature and extent of contamination, identifies likely exposure pathways, and allows for characterizing potential and current exposure risks posed by the enrolled site.

"Site-specific standard" means a standard for a specific site which represents a concentration of a contaminant in a media of an affected area at which exposure through a specific pathway is considered unlikely to pose a threat to human health, safety, or the environment given site-specific factors related to contaminant transport and likely exposure.

"Slope factor" means an upper bound estimate that approximates a 95 percent confidence limit of the increased cancer risk from a lifetime exposure to a contaminant. This estimate is expressed in units of the proportion of a population that is affected per milligram per day exposure to the contaminant per kilogram of body weight of the exposed individual.

"Statewide standard" means a standard which represents a concentration of a contaminant in a specific media of an affected area at which normal, unrestricted exposure through a specific exposure pathway is considered unlikely to pose a threat to human health, safety, or the environment.

"Surface water" means general use segments as provided in 567—paragraph 61.3(1)*"a"* and designated use segments of water bodies as provided in 567—paragraph 61.3(1)*"b"* and 567—subrule 61.3(5).

"Target level" means a concentration of a contaminant of concern required to establish compliance with background, statewide or site-specific standards.

"Target organ" means the biological organ(s) most adversely affected from exposure to the contaminant of concern. A "reference dose" used to calculate noncancer health risk is normally established based on adverse impact to a target organ or organs from exposure to the contaminant of concern.

"Technological control" means a physical action whose main purpose is to reduce or eliminate exposure to the contaminants of an affected area.

567—137.3(455H) Enrollment in land recycling program.

137.3(1) *Property eligible for enrollment.* Unless excluded by statute or this rule and subject to eligibility conditions specified in this chapter, property which has been or is suspected to be the site of or affected by a release of a hazardous substance as defined in Iowa Code Supplement section 455H.103 is eligible for enrollment beginning October 27, 1998. The following sites shall not be enrolled in the land recycling program:

a. Property with petroleum releases associated with underground storage tanks subject to regulation under Iowa Code chapter 455B, division IV, part 8; and department rules under 567—Chapter 135. (However, property affected by releases of "regulated substances" from underground storage tanks other than petroleum as defined in rule 567—135.2(455B) subject to regulation under 567—Chapter 135 may be enrolled under this chapter.) Property enrolled and affected by a release from underground storage tanks of regulated substances other than petroleum will be subject to the response action standards in this chapter rather than those in 567—135.8(455B) through 135.12(455B). See also 567—paragraph 135.1(3)*"e."*

b. Property which has been placed or is proposed to be included on the national priorities list established pursuant to the federal Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA), 42 U.S.C. Section 9601 et seq. A property will be considered proposed at the time that a public notice of intent to list the property on the national priorities list is published in the Federal Register in accordance with 40 CFR 300.425.

c. An animal feeding operation structure as defined in Iowa Code section 455B.161.

d. Properties subject to administrative or judicial enforcement action by the department or the Environmental Protection Agency or subject to an administrative or judicial consent order addressing environmental conditions. These properties may be eligible for enrollment only with the written approval of and under such terms as determined by the enforcing agency.

e. Eligible properties which are or may be affected by or commingled with ineligible releases or conditions will be evaluated on a case-by-case basis to determine their appropriateness for enrollment. Only the eligible property and participant(s) will be afforded the benefits and immunities available under Iowa Code Supplement chapter 455H. Any protections provided by issuance of a no further action certificate will be limited by and may be subject to reopening due to future conditions associated with the ineligible release. Considerations for enrollment or exclusion include but are not limited to the following:

(1) The extent to which eligible releases and site conditions can be assessed and response action(s) designed and implemented independent of the ineligible releases and property.

(2) The extent to which the liability and other protections offered by Iowa Code Supplement chapter 455H and the conditions of a no further action certificate can reasonably be defined to apply to the eligible site without consideration of or dependence on future conditions associated with the ineligible release and property.

(3) The extent to which a participant is willing to conduct all response action(s) necessary to address the health, safety and environmental conditions implicated by both eligible and ineligible releases and conditions. The extent to which a nonparticipant responsible for the ineligible release and property can establish an intention and ability to cooperatively address and share costs associated with the commingled conditions and satisfy both the standards in this chapter and any other regulatory standards applicable to the ineligible release or condition.

137.3(2) *Enrollment policy and procedures.* Prior to enrollment, the applicant/participant(s) should have conducted sufficient preliminary site investigation and project planning to be prepared to show that a site is eligible for enrollment and the participant(s) is ready and capable of initiating and completing a response action in accordance with these rules. The applicant/participant(s) must submit a completed program application and participation agreement form as supplied by the department. The program application shall contain at least the following information.

a. An acknowledgment of access/control of the site signed by the participant if that person is a fee titleholder in the affected property; if the applicant/participant(s) is not a fee titleholder, then an acknowledgment by the fee titleholder of the affected property. If acknowledgment of access cannot be obtained, the participant must describe efforts to obtain access and reasons why it has been refused.

b. The name, address and other relevant information of each current and anticipated participant(s). The description should include a brief statement of the reasons for each person's participation including but not limited to that person's interest in and legal relationship to the property enrolled and the expected role and scope of any participation. Other persons who are not participants but who may have an interest in the project should be identified, such as state and local development agencies, community groups, and financing sources.

c. The applicant/participant(s) must demonstrate the presence of hazardous substances at concentrations that warrant response action(s) under the standards in this chapter. At a minimum the environmental condition to be addressed must be documented by the submission of a report which includes the following:

(1) Soil and groundwater samples of hazardous substances which have been analyzed by a laboratory certified under 567—Chapter 83 for the analytes being tested. The laboratory analysis should establish the presence of hazardous substances under conditions which exceed or are likely to exceed a statewide standard, if a statewide standard is available. Copies of the laboratory analytical report, boring logs and a site diagram showing the location of the sampling points in relation to the site should be included.

(2) A description of the current and historical uses of the property based on a reasonable and diligent inquiry. This must include a description of the following: known sources and probable locations of hazardous substances and probable location of the sources at the property which the participant proposes

to address as part of the project; a general description of the historical uses of the property and probable hazardous substances which could reasonably be associated with past land use; and a general description of the surface characteristics of the property and surrounding areas such as current zoning, residential, commercial and industrial uses, and current uses of adjoining properties.

d. Any assessments or other reports relating to contamination at the property in excess of a statewide standard or reportable under 567—Chapter 131 which are known to and within the control of the applicant/participant shall be submitted. If the applicant/participant intends to claim that information constitutes a privileged environmental audit as provided in 1998 Iowa Acts, House File 681, the applicant must notify the department of the claim and resolve the issue of privilege prior to submittal. The applicant shall not submit to the department a report or any part of a report which it claims to be privileged and any information submitted under this paragraph shall be deemed a nonprivileged submittal as provided in section 6, paragraph (1)*"a,"* of the Act. This provision does not relieve the applicant/participant of any obligation to notify the department of a hazardous condition as provided in Iowa Code section 455B.386 and rules under 567—Chapter 131.

e. A statement of the project objectives which includes the current use of the property, proposed development activities, and an expected time frame for meeting these objectives. The statement should include a general description of the scope of the proposed environmental condition to be addressed and a proposed schedule for initiation and submittal of site assessment activities pursuant to rule 137.8(455H). The statement should describe any foreseeable barriers toward achieving project objectives such as access to property, financing uncertainties, legal actions, allocation of responsibility amongst parties.

f. A list of all known permits and regulatory actions and directives associated with an environmental condition at the site. If any parcel of the proposed enrolled site is subject to any federal regulatory corrective action directives, administrative orders or judicial actions, these must be explained. The applicant must submit written proof that the appropriate federal regulatory agency has been notified of the applicant's desire to participate in the Iowa land recycling program. Objections, concerns or issues which could lead to disputes regarding dual or conflicting jurisdiction should be resolved prior to application, if possible, and before admission.

g. The department will respond in writing within 60 days of receipt of the enrollment application. The department will notify the applicant/participant(s) whether the site has been accepted and an expected time line for assignment of the project to a manager. If the site is not accepted, the department will notify the applicant of the reason(s). Upon notification of admission, the property shall be considered enrolled. Once the department has assigned the enrolled site to a project manager, the department will enter into a participation agreement with the participant(s).

137.3(3) *Enrollment fees and oversight costs.* A nonrefundable enrollment fee of $750 must be submitted with the program application. This fee is intended to cover the department's cost of reviewing the program application and a minimum amount of subsequent oversight costs. Subsequent fees in excess of the minimum $750 may be assessed for actual oversight costs incurred by the department as provided in this chapter. Department oversight activities may include, but are not limited to: review of documents, meetings with the participant(s), site visits, sampling, and laboratory costs related to verification of submitted materials. The total fees for oversight costs shall not exceed $7,500 per enrolled site. Fees shall be assessed and collected as follows:

a. *Hourly billing rate.* Project oversight fees shall be based on an hourly rate to cover wages and overhead costs of personnel employed by the department in the land recycling program. The department shall calculate and publish on an annual basis an hourly billing rate at which oversight fees shall be calculated.

b. *Quarterly payments.* The department shall bill the participant(s) on a quarterly basis for additional oversight costs beyond the review of the application incurred by the department. The participant(s) shall pay the department within 30 days after receiving the department's quarterly fee statement. If there is more than one participant, each shall be jointly and severally responsible for payment. The department will provide split billings if provided with an enforceable written contract allocating the fees amongst the participants.

c. *Failure to pay required fees.* If the participant(s) fails to pay department oversight fees that are required under this subrule, the department shall cease to provide oversight to the participant(s) and terminate enrollment of the site as described in subrule 137.3(7).

137.3(4) *Participation agreement.* All participants shall enter into a participation agreement. This agreement shall be executed at the time the project is assigned to a project manager. At a minimum, the agreement shall establish the following:

a. A requirement that the participant(s) agree and provide necessary documentation to ensure reasonable access to the affected property by department staff and other authorized representatives of the department.

b. A requirement that the participant(s) reimburse the department for the actual costs assessed as provided in 567—subrule 137.3(3).

c. A requirement that the participant(s) certify that the participant(s) has the financial means to complete the project based on an initial estimate of completion costs. The department may require modification and amendment of the financial certification at any stage in the project and may require the participant(s) to provide financial documentation as necessary to support the certification.

d. A requirement that the participation agreement include a general description of the scope of the project and the goals to be achieved, a general time frame for submission and review of documents in accordance with this chapter, allocation of responsibility amongst multiple participants and other appropriate milestones. Either the participant(s) or the department may request a meeting to develop a statement describing the scope, goals, and time frames for the project.

137.3(5) *Prioritization.* Eligible sites will be enrolled in the order in which they are received. The department reserves the right to elevate the priority of a given site if it determines the threat to the public health or environment or environmental conditions in combination with the development objectives consistent with Iowa Code Supplement section 455H.104 is significantly greater than those of sites with an earlier enrollment date.

137.3(6) *Withdrawal procedures.* Enrollment and continued participation in the program are voluntary. The participant(s) may withdraw the enrolled site and individual participants may withdraw from further participation in the land recycling program at any time upon written notice to the department. Any participant who withdraws an enrolled site from further participation in the program shall not be entitled to any refund or credit for the $750 enrollment fee and shall be liable for any oversight costs actually incurred by the department up to the cap of $7,500 per enrolled site. A participant who withdraws a site prior to completion of all response action(s) required by this chapter and issuance of a no further action certificate in accordance with rule 137.11(455H) forfeits all benefits and immunities provided by this chapter and Iowa Code chapter 455H. Prior to withdrawal, the participant(s) shall submit a plan, which must be approved by the department, for stabilization of conditions at the site or a justification for why further action to stabilize the site is not necessary. Participants shall be required to take such actions as the department determines necessary to stabilize conditions at the site, including, but not limited to, securing or properly abandoning monitoring wells, removing or otherwise properly disposing of all contaminated soil excavations, removing or properly disposing of exposed or exhumed contaminants, filling or properly fencing open excavations, and posting safety notices.

137.3(7) *Termination of enrollment.* Enrollment of the participant(s) may be terminated based on a finding of material noncompliance with department rules and statutory requirements including but not limited to the following:

a. Significant failure, after written notice, to comply with schedules for completion and submission of reports and implementation of response action(s) required by these rules or otherwise agreed upon in writing by the department and participants. Written requests for reasonable schedule extensions may be granted upon a showing of extenuating circumstances beyond the control of the participant(s) and the participant(s) agent/contractor.

b. Failure to proceed in a timely manner after written notice in performing the additional response action required due to a failure of technological and institutional controls pursuant to rule 137.7(455H).

c. Material misstatement or omission of fact in reports submitted to the department by the participant or agents of the participant.

d. Evidence that the site falls under one of the exclusion categories in subrule 137.3(1).

e. Failure to pay required fees to the department as required in subrule 137.3(3).

137.3(8) *Appeal rights.* The department will notify participant(s) of a denial of enrollment or of an intent to terminate enrollment and provide a statement of reasons. The participant(s) shall have a right to appeal the decision to deny enrollment or to terminate enrollment. Upon timely appeal, contested case procedures shall be initiated pursuant to 561—Chapter 7.

567—137.4(455H) Background standards.

137.4(1) *Purpose.* This rule defines the basis and procedure for establishing background standards in groundwater, soil, surface water, and air. Background standards represent concentrations of contaminants that are naturally occurring or generally present and not related to a readily identifiable release. Background standards provide a baseline for assessing impacts of contaminant releases from within the affected area.

137.4(2) *Determination of background standards.* Background standards shall be based on sampling at appropriate site-specific background locations. Background sampling locations shall be outside the influence of any possible contamination associated with releases occurring on the property in which the enrolled site is located. Sufficient supporting information shall be provided to demonstrate the appropriateness of background sampling locations. Appropriateness for background sampling locations has two aspects which shall be addressed:

a. Background samples shall be collected from a location which represents a true background condition with respect to the enrolled site. For example, a background groundwater sample will be collected from an upgradient location relative to groundwater movement.

b. Background samples will represent conditions which are comparable to the contaminated media being addressed. In the case of soils, samples from the affected area and the background areas will be comparable in physical, chemical, and biological attributes.

Sampling conducted for the purpose of establishing a background standard shall meet quality criteria specified for the site assessment, rule 137.8(455H). The minimum number of samples to be collected from the medium of concern for which a background standard is being established shall be consistent with rule 137.10(455H), regarding demonstration of compliance.

567—137.5(455H) Statewide standards.

137.5(1) *Purpose.* This rule defines the basis and procedure for establishing statewide standards for contaminants in groundwater, soil, and surface water. Statewide standards for groundwater and soil represent concentrations of contaminants in these media at which normal exposure via ingestion and dermal contact with soil is considered unlikely to pose a threat to human health. Statewide standards for surface water are based on protection of aquatic life and protection of human health. This rule also describes how air standards are to be addressed.

137.5(2) *Scope.* Statewide standards described herein address what are considered to be the most likely, normal exposure situations. Statewide standards for groundwater address direct exposure via ingestion to individual contaminants in the media of concern only. Statewide standards for soil address direct exposure to individual contaminants via ingestion and dermal contact. In the event exposure to multiple contaminants may occur or exposure from more than one medium may occur, statewide standards alone may not be protective of human health; therefore, cumulative risk standards must be met in accordance with subrule 137.10(7). In addition, the department may deny the use of the statewide standards prescribed herein and require the use of site-specific standards based on site-specific conditions pursuant to subrule 137.6(10).

Examples of exposure concerns not anticipated by the statewide standards might include, but are not limited to:

- Significant plant uptake of contaminants from soil or groundwater;
- Contaminants entering drinking water lines from contact with soil or groundwater;

- Ecological concerns, other than for surface water;
- Groundwater in a nonprotected groundwater source that is used or likely to be used for drinking water or other use.

137.5(3) *Establishment of risk-based contaminant concentrations.*

a. Risk-based concentration formula. Risk-based contaminant concentrations for soil and groundwater, except lead, shall be computed using the following formula, where appropriate:

(Formula I)

$$C = \frac{RF \times AT \times 365 \text{ days/year}}{Abs \times [(ER_c \times EF_c \times ED_c) \div BW_c + (ER_a \times EF_a \times ED_a) \div BW_a] \times CF}$$

NOTE: When a risk-based concentration is computed for two routes of exposure to the same medium (e.g., soil oral exposure and soil dermal exposure), the composite risk-based concentration equals the multiple of the risk-based concentration for each route of exposure divided by the sum of the risk-based concentration for each route of exposure.

Where: C = Concentration of contaminant (soil: mg/kg, water: mg/l)
RF = Risk factor

For protection from cancer health risks:
RF = TR ÷ SF
Where: TR = Target cancer risk (unitless)
SF = Slope factor $[(mg/kg)/day]^{-1}$ for a route of exposure; see paragraph *"c"* for source.

For protection from noncancer health risks:
RF = THQ × RfD
Where: THQ = Target hazard quotient (unitless)
RfD = Reference dose (mg/kg)/day for a route of exposure; see paragraph *"c"* for source.

AT = Averaging time (years); time over which exposure is averaged and potential adverse effects may occur
Abs = Absorption factor (unitless); portion of exposed contaminant absorbed by the body
ER_c = Exposure rate by a child (soil: mg/day, water: l/day)
EF_c = Exposure frequency by a child (days/year)
ED_c = Exposure duration by a child (years)
BW_c = Body weight of exposed child (kg)
ER_a = Exposure rate by an adult (soil: mg/day, water: l/day)
EF_a = Exposure frequency by an adult (days/year)
ED_a = Exposure duration by an adult (years)
BW_a = Body weight of exposed adult (kg)
CF = Conversion factor: 10^{-6} kg/mg for soils; 1 (unitless) for water

b. Carcinogenic classification of chemicals. The potential carcinogenicity of chemicals will be based on the weight-of-evidence classification system utilized by the U.S. Environmental Protection Agency (EPA). Risk-based concentrations will be based on cancer health effects for individual chemicals that are classified as Group A or Group B. The risk-based concentration for an individual chemical will be based on noncancer health effects for chemicals that are classified as Group C, Group D or Group E. In the absence of such classification for a chemical, the Group D classification will be assumed. Noncancer risks for a Group A or Group B chemical will be included in the determination of cumulative noncancer risk in accordance with subrule 137.10(7), if a reference dose exists for that chemical. Cancer

risk associated with a Group C chemical shall be included in the determination of cumulative cancer risk in accordance with subrule 137.10(7), if a cancer slope factor exists for that chemical.

c. Source of toxicity values. EPA's Integrated Risk Information System (IRIS) shall be the primary source of information on toxicity factors (e.g., oral reference doses and oral slope factors), carcinogenic classification for chemicals, and the target organs. Such information that is not available on IRIS shall be obtained from other sources consistent with current EPA guidelines. The Iowa department of public health shall be consulted regarding toxicity values not available on IRIS. Absorption factors for dermal soil exposure shall be based on best available information, which will usually be obtained from EPA guidance documents.

137.5(4) *Statewide standards for groundwater.*

a. Protected groundwater source. Statewide standards for groundwater in a protected groundwater source will be the enforceable Maximum Contaminant Level (MCL) established by the EPA pursuant to the Safe Drinking Water Act, if an MCL exists. If no enforceable MCL exists, the statewide standard for chemicals will be the lifetime health advisory level (HAL) as provided in the latest "Drinking Water Regulations and Health Advisories" by the EPA's Office of Water or equivalent. If no MCL or HAL exists, the statewide standard for a chemical will be calculated using Formula I and input variables for groundwater ingestion in accordance with Table I.

b. Groundwater in a nonprotected groundwater source. The statewide standard for a chemical in groundwater in a nonprotected groundwater source will be five times the statewide standard for the chemical in a protected groundwater source or a risk-based concentration using Formula I with input variables specified in Table I, whichever is larger. The statewide standards for groundwater in a nonprotected groundwater source are based on groundwater ingestion only.

Table I

Input Variables for Risk-Based Statewide Standards for Groundwater from Protected and Nonprotected Groundwater Sources

Parameter	Units	Cancer Group	Protected	Nonprotected
TR	unitless	A, B	5×10^{-6}	1×10^{-4}
SF	$[(mg/kg)/day]^{-1}$	A, B, C	Chem.-spec.	Chem.-spec.*
THQ	unitless	C	0.02	0.1/1*
		D, E	0.2	1
RfD	(mg/kg)/day	C, D, E	Chem.-spec.	Chem.-spec.
AT	years	A - E	70	70
Abs	unitless	A - E	1	1
ER_c	l/day	A - E	1	1
EF_c	days/yr	A - E	0	0
ED_c	years	A - E	6	6
BW_c	kg	A - E	15	15
ER_a	l/day	A - E	2	2
EF_a	days/yr	A - E	365	365
ED_a	years	A - E	70	70
BW_a	kg	A - E	70	70
CF	unitless	A - E	1	1

The risk-based concentration using Formula I for Cancer Group C chemicals that have an SF value established per paragraph 137.5(3)"c"* will be the larger of a value based on the risk factor for protection from noncancer health risks with a THQ = 0.1 or the risk factor for protection from cancer health risks. Risk-based concentrations using Formula I for Cancer Group C chemicals that do not have an SF value

established per paragraph 137.5(3)*"c"* will be a value based on the risk factor for protection from noncancer health risks with a THQ = 1.

137.5(5) *Statewide standards for soil.* Statewide standards for chemicals in soil, except lead, will be calculated using Formula I based on incidental ingestion of soil and dust and dermal contact with soil with input variables in accordance with Table II. The statewide standard for lead in soil shall be 400 mg/kg.

Table II

Input Variables for Statewide Soil Standards

			Route of Exposure	
Parameter	Units	Cancer Group	Oral	Dermal
TR	unitless	A, B	5×10^{-6}	5×10^{-6}
SF	$[(mg/kg)/day]^{-1}$	A, B, C*	Chem.-spec.	Chem.-spec.
THQ	unitless	C*	0.1/1	0.1/1
		D, E	1	1
RfD	(mg/kg)/day	C, D, E	Chem.-spec.	Chem.-spec.
AT	years	A, B	70	70
		C, D, E	6	6
Abs	unitless	A - E	1	Chem.-spec.
ER_c	mg/day	A - E	200	560**
EF_c	days/yr	A - E	350	350
ED_c	years	A - E	6	6
BW_c	kg	A - E	15	15
ER_a	mg/day	A - E	100	400**
EF_a	days/yr	A - E	350	350
ED_a	years	A, B	24	24
		C, D, E	0	0
BW_a	kg	A - E	70	70
CF	kg/mg	A - E	10^{-6}	10^{-6}

The risk-based concentration using Formula I for Cancer Group C chemicals that have an SF value established per paragraph 137.5(3)"c"* will be the larger of a value based on the risk factor for protection from noncancer health risks with a THQ = 0.1 or the risk factor for protection from cancer health risks. Risk-based concentrations using Formula I for Cancer Group C chemicals that do not have an SF value established per paragraph 137.5(3)*"c"* will be a value based on the risk factor for protection from noncancer health risks with a THQ = 1.

**Dermal exposure rate is based on 2,800 cm^2 of exposed skin on a child with 0.2 mg/cm^2 of soil adhering to the child's skin and 5,700 cm^2 of exposed skin on an adult with 0.07 mg/cm^2 of soil adhering to the adult's skin per each dermal exposure event. A dermal exposure event is assumed to be one event per day of exposure.

137.5(6) *Statewide standards for surface water.* Water quality standards pursuant to 567—Chapter 61 shall be considered statewide standards for surface water. If a promulgated water quality standard does not exist for a contaminant of concern, the department may establish an appropriate standard in a manner consistent with 567—Chapter 61.

137.5(7) *Statewide standards for air.* Ambient air quality standards pursuant to 567—Chapter 28 constitute statewide standards for air. Air emission sources must meet air quality emission standards as set forth in 567—Chapters 20 through 31 inclusively, as applicable. Any relevant air quality standard that is subsequently promulgated by statute or rule shall become a statewide standard for air upon the effective date of adoption by the state. In the absence of applicable, adopted standards, site-specific air

standards must be met, in accordance with subrule 137.6(9), when air quality issues are addressed at a site.

137.5(8) *Point of exposure for statewide standards.* The point of exposure associated with the use of only statewide standards in the determination of compliance will be assumed to be anywhere and everywhere, except for surface water. The point of exposure associated with the use of statewide standards for surface water will be assumed to be the point of groundwater or other site runoff immediately before it discharges to the surface water body.

137.5(9) *Practical quantification limits.* In no case will the statewide standard be less than the practical quantification limit, as determined by the department.

137.5(10) *Maintenance of statewide standards.* The toxicity values, absorption factors for dermal exposure to soils, and promulgated standards that are a basis for statewide standards are subject to periodic revision due to actions not governed under this rule. The department in conjunction with the Iowa department of public health will maintain a guidance document that contains a current list of toxicity values, absorption factors for dermal exposure to soils, target organs for cumulative noncarcinogenic health risks, promulgated standards, and the resultant statewide standards that will be readily available to the public. This guidance document will reference all the sources of the information. In the absence of a dermal slope factor or a dermal reference dose for a chemical, the oral slope factor or oral reference dose will be used with adjustments made to account for differences in oral and dermal absorption rates in accordance with current EPA guidance. Statewide standards for individual sites will be locked-in at the beginning of the site assessment process (rule 137.8(455H)). If a statewide standard does not exist for a chemical, it will be the department's responsibility to establish a statewide standard, pursuant to subrules 137.5(4) and 137.5(5), for groundwater and soil, and to add the newly established statewide standard to the comprehensive list of statewide standards in the guidance document maintained by the department.

567—137.6(455H) Site-specific standards.

137.6(1) *Purpose.* As opposed to statewide standards, site-specific standards are derived by applying exposure and risk assumptions applicable to the conditions at a particular site. Like statewide standards, site-specific standards must always be shown to be protective of public health and safety and the environment. Statewide standards may be used in combination with site-specific standards to address different exposure pathways. Site-specific standards may be required to address exposure pathways which the department determines must be evaluated to be protective of human health, safety and the environment and for which statewide standards have not been established under rule 137.5(455H). Site-specific standards may involve development of target levels for contaminants of concern based on site-specific exposure assumptions for use in lieu of background or statewide standards. Site-specific standards may also include consideration of the actual or potential location where exposure to contaminants occurs or may occur, the likelihood of an exposure occurring, and the overall magnitude and extent of contamination. Site-specific standards may involve use of site-specific target levels for contaminants of concern alone or in conjunction with other site-specific criteria, such as the location where the standard is applied.

137.6(2) *General provisions.*

a. This rule establishes a minimum protocol that must be met at all enrolled sites which have not established compliance by application of background or statewide standards. Groundwater ingestion and soil ingestion pathway standards under this rule must be evaluated. Surface water and air quality standards under subrules 137.6(8) and 137.6(9) must be met whenever exposure concerns are evident and the participant or the department determines these pathways may present an unacceptable risk for current or future exposures. This rule is not intended to preclude the department or the participant from addressing other exposure pathways, and the department expressly reserves the right to require evaluation of other exposure pathways and compliance with site-specific standards developed for them, such as dermal contact, ingestion of vegetables containing contaminants from soil or irrigation water, migration of contaminants from groundwater or soil into water distribution lines or into air in a confined space, migration of contaminants from soil to groundwater, and migration of contaminants in a nonprotected groundwater source to a protected groundwater source. Participants must establish compliance with

standards applicable to all exposure pathways required by the department under this rule in order to qualify for no further action classification under rule 137.11(455H) unless granted a variance as provided in Iowa Code section 455H.205.

b. Site-specific standards are subject to the approval of the department. Assurances in the form of technological or institutional controls (rule 137.7(455H)) will be required, as needed, to ensure continued protectiveness of site-specific standards.

c. The following subrules provide options for the site-specific standards. The participant may select any of these options, or combinations thereof, for use as site-specific standards.

137.6(3) *Site-specific groundwater point of exposure.* A site-specific groundwater standard may be an appropriate target level applied at groundwater points of exposure that are limited by technological or institutional controls.

a. A point of exposure for groundwater is a location within the affected area where a well exists or could be placed (potential point of exposure). Where technological or institutional controls are determined to effectively restrict the placement of groundwater wells, the points of exposure apply outside the area of restriction. A sufficient number of points of exposure may be established for determining compliance such that compliance with appropriate target levels at these points will ensure compliance at all points of exposure. Normally a compliance point of exposure will be a location at the boundary of the area restricted by an institutional control where a groundwater well could be installed that would have the highest contaminant concentration. Generally more than one compliance point of exposure must be established due to uncertainties, such as spatial and temporal variabilities in groundwater flow and contaminant occurrence.

b. Target levels. The point of exposure target level for drinking water wells is the statewide standard applicable to groundwater ingestion or an alternative site-specific target level approved under subrule 137.6(10) or 137.6(11). The point of exposure target level for non-drinking water wells is the statewide standard applicable to nonprotected groundwater or an alternative site-specific target level approved under subrule 137.6(10) or 137.6(11). The point of exposure target level for nonused groundwater meeting the conditions in subrule 137.6(5) is the statewide standard for a nonprotected groundwater source.

c. Nonprotected groundwater sources. A nonprotected groundwater source which is affecting or likely to affect an existing drinking water well shall be required to meet the same site-specific standards, including point of exposure target level(s), as applied to a protected groundwater source.

d. Unless conditions can be demonstrated to be stable, predictive techniques in accordance with subrule 137.9(4) must be used to determine the future effects of groundwater contamination on existing drinking and non-drinking water wells and to determine the area predicted to exceed the point of exposure target level(s) where wells could be installed. When using predictive techniques, determining the location(s) where the applicable point of exposure target level is expected to be exceeded may involve comparison of the appropriate numerical standard to the predicted contaminant concentration at a passive monitoring well at the groundwater point of exposure. Alternatively, predictive techniques using site-specific models (paragraph 137.9(4)*"b"*) may involve simulation of pumping at a well located at the point of exposure, in which case the pumping rate used in the simulation shall be the rate that is reasonably possible for the area that yields water with the highest contaminant concentration. In absence of site-specific justification for doing otherwise, long-term pumping will be assumed to be at a rate of 100 gallons per day; the sustainable yield, if less than 100 gallons per day; or a reasonable, higher rate, if such a rate results in higher contaminant concentration.

e. Institutional controls. For a protected groundwater source or a nonprotected groundwater source as described in paragraph *"b"* above, institutional controls must be shown to effectively prohibit the installation of wells for the period of time in which contaminant concentrations might otherwise be expected to result in an exceedance of the appropriate target levels. For a nonprotected groundwater not described as in paragraph *"b"* above, a less stringent standard of effectiveness as well as the type of future well installation to be restricted may be utilized for those areas of potential concern. Unless there is a history of usage of what might otherwise be considered nonprotected groundwater or there is uncertainty as to the uniformity in the hydraulic characteristics of the nonprotected groundwater source,

notice to the authority responsible for permitting private wells under 567—Chapters 39 and 49 may be adequate especially if combined with a municipal or county ordinance prohibiting installation of private wells based on the availability of a public water supply.

137.6(4) *Site-specific groundwater point of compliance.* A site-specific standard may be established for a site-specific groundwater point of compliance that is different from a compliance point of exposure. A site-specific groundwater point of compliance must be used in conjunction with all groundwater compliance points of exposure pursuant to subrule 137.6(3) to provide an alternative monitoring location. Target levels for contaminants of concern at a site-specific groundwater point of compliance must be established using predictive techniques as specified in subrule 137.9(4). A target level established for a groundwater point of compliance must ensure that the appropriate target level at the groundwater compliance points of exposure will be achieved. A groundwater point of compliance shall be located on the contaminant migration path from the contaminant source to the point of exposure to the maximum extent practicable.

137.6(5) *Nonused groundwater in a protected water source.* Statewide standards for groundwater in a nonprotected groundwater source, pursuant to paragraph 137.5(4)*"b,"* may be used as target levels for contaminants in an otherwise protected groundwater source when groundwater in the affected area is not used and is not likely to be used in the future in accordance with the following. It must be demonstrated to the satisfaction of the department that contaminants from the enrolled site do not currently, and likely will not in the future, have an impact on any existing water supply well. Any detection, or predicted detection above the practical quantification limit, of a chemical that can be attributed to a release from the enrolled site will be considered to constitute an impact. In addition, it must be demonstrated to the satisfaction of the department that the impacted or potentially impacted aquifer is not a locally significant water resource. Factors that will go into this determination may include, but are not limited to:

- Existence of a nonimpacted public water supply in the potentially affected area;
- General availability of other water resources in the vicinity;
- Plans for development of public water supplies in the vicinity;
- Potential for use of the impacted aquifer as a water supply (e.g., yield, natural water quality); and
- Identification of the aquifer(s) commonly used for water supply in the vicinity.

A local ordinance prohibiting installation of private drinking water wells or notification to the local water utility and water permitting authority, or both, may constitute acceptable institutional controls for site-specific standards under this subrule.

The target levels that may be used in accordance with this subrule are based solely on groundwater ingestion. Compliance with this site-specific standard will not guarantee that contaminants in groundwater may not cause unacceptable exposure via other pathways (e.g., groundwater to air in a confined space, groundwater to surface water, or groundwater to a water distribution line).

137.6(6) *Site-specific soil standards based on land use and soil depth.* Site-specific soil standards based on land use and soil depth in conjunction with institutional controls may be used. Predetermined site-specific soil exposures based on land use and soil depth are provided in the following paragraphs. Lists of resulting site-specific soil standards for individual contaminants for these land-use and soil-depth categories will be maintained by the department in a guidance document and made readily available to the public. Use of these site-specific soil standards must be supported by appropriate institutional controls. Site-specific soil standards based on land use and soil depth, as described herein, address ingestion of and dermal contact with soil. Compliance with these standards will not guarantee that contaminants in soils may not cause unacceptable exposure via other pathways (e.g., ecological exposure, soil to groundwater, subsurface movement of vapors from soil to indoor air). In addition, the risk factors that form the bases for site-specific soil standards for individual contaminants, with the exception of some Group C chemicals, are the same as acceptable cumulative risk factors allowed for exposure to multiple contaminants in the same medium and multiple media. Therefore, compliance with site-specific soil standards for individual contaminants may not result in compliance with cumulative risk requirements pursuant to rule 137.10(455H).

a. Deep soil in a residential land-use area. Site-specific soil standards for deep soils equaling ten times the statewide standard for soils, except for lead, may be used. The site-specific standard for lead in deep soil in a residential land-use area shall be calculated using the most current version of EPA's Exposure Model for Assessing Risk Associated with Adult Exposures to Lead in Soil. Soils at a depth of ten feet and greater will normally be classified as deep soils. The department may deny the use of a deep soil standard associated with a residential land use or require a modification to the standard due to site-specific considerations including topography, development potential, and actual development plans. The use of a site-specific standard for deep soil in a residential land-use area shall be supported by an institutional control that permanently records the existence of contaminants above statewide standards in deep soils and restricts excavation resulting in deep soils being placed on the surface.

b. Nonresidential land use. The nonresidential land-use designation will be applicable to areas that are not classified as residential. Site-specific soil standards, except for lead, for nonresidential areas may be based on Formula I using the risk and exposure factors shown in Table III. A value of 1,100 mg/kg may be used as a site-specific soil standard for lead in soils less than 2 feet deep in a nonresidential land-use area. In lieu of this default site-specific lead standard, a site-specific standard for lead in soil less than 2 feet deep may be calculated using the most current version of EPA's Exposure Model for Assessing Risk Associated with Adult Exposures to Lead in Soil. The site-specific standard for lead in soils greater than 2 feet deep in a nonresidential land-use area shall be calculated using the most current version of EPA's Exposure Model for Assessing Risk Associated with Adult Exposures to Lead in Soil. The use of a nonresidential land-use classification must be supported by an environmental protection easement that prevents a change in land use to residential.

Table III

Input Variables for Site-Specific Soil Standards for Individual Contaminants for Nonresidential Area Land-Use Designation

Parameter	Units	Cancer Group	Soil Depth (ft.)	
			<2	>2
TR	unitless	A, B	1×10^{-4}	1×10^{-4}
SF (oral)	$[(mg/kg)/day]^{-1}$	A, B, C*	Chem.-spec.	Chem.-spec.
SF (dermal)	$[(mg/kg)/day]^{-1}$	A, B, C*	Chem.-spec.	Chem.-spec.
THQ	unitless	C*	0.1/1	0.1/1
		D, E	1	1
RfD (oral)	(mg/kg)/day	C, D, E	Chem.-spec.	Chem.-spec.
RfD (dermal)	(mg/kg)/day	C, D, E	Chem.-spec.	Chem.-spec.
AT	years	A, B	70	70
		C, D, E	1	1
Abs (oral)	unitless	A - E	1	1
Abs (dermal)	unitless	A - E	Chem.-spec.	Chem.-spec.
ER_c	mg/day	A - E	0	0
EF_c	days/yr	A - E	0	0
ED_c	years	A - E	0	0
BW_c	kg	A - E	15	15
ER_a (oral)	mg/day	A, B	100	330
		C, D, E	330	330
ER_a (dermal)	mg/day	A, B	660**	990**
		C, D, E	660**	990**
EF_a	days/yr	A, B	225	200
		C, D, E	200	200

Parameter	Units	Cancer Group	Soil Depth (ft.)	
			<2	>2
ED_a	years	A, B	25	1
		C, D, E	1	1
BW_a	kg	A - E	70	70
CF	kg/mg	A - E	10^{-6}	10^{-6}

NOTE: Oral and dermal factors are the same unless otherwise noted.

The risk-based concentration using Formula I for Cancer Group C chemicals that have an SF value established per paragraph 137.5(3)"c"* will be the larger of a value based on the risk factor for protection from noncancer health risks with a THQ = 0.1 or the risk factor for protection from cancer health risks. Risk-based concentrations using Formula I for Cancer Group C chemicals that do not have an SF value established per paragraph 137.5(3)*"c"* will be a value based on the risk factor for protection from noncancer health risks with a THQ = 1.

**Dermal exposure rate is based on 3,300 cm^2 of exposed skin on an adult with 0.2 mg/cm^2 of shallow soil adhering to the skin and 0.3 mg/cm^2 of deep soil adhering to the skin per each dermal exposure event. A dermal exposure event is assumed to be one event per day of exposure.

c. Restricted access land use. Rescinded IAB 7/21/04, effective 8/25/04.

137.6(7) *Site-specific cumulative risk for residential exposures to soil.* A cumulative risk standard may be used as a site-specific standard for soil in lieu of statewide standards that are provided in subrule 137.5(5) for individual chemicals and soil. Cumulative risk will be determined using the toxicity values and exposure factors (i.e., the input variables less TR and THQ) from Table II in subrule 137.5(5). Criteria for compliance with the cumulative risk standard are specified in subrule 137.10(7). No institutional control will be required with the use of this site-specific standard.

137.6(8) *Site-specific surface water standards.* The department will establish site-specific surface water standards at the request of the participant. The participant shall provide the department with information necessary to make this determination upon request from the department. Site-specific surface water standards will be generally equivalent to effluent limitations under a National Pollutant Discharge Elimination System (NPDES) permit pursuant to 567—Chapter 62. Mixing zones and allocation of contaminant loads in a surface water body will be considerations in attainment of in-stream water quality standards. If the site-specific surface water quality standards are met, best practical control technology currently available will not be imposed.

137.6(9) *Site-specific air standards.* If there are air quality concerns at a site, they will normally be addressed with site-specific standards until such time as ambient air quality or source-specific standards are adopted for hazardous air pollutants.

a. Explosivity. In no case shall contaminants from the enrolled site cause an explosivity level in a confined space of greater than 10 percent of the lower explosivity limit.

b. Background. In addition to the establishment of a background standard pursuant to rule 137.4(455H), a site-specific air standard may be set at twice the typical background level based on published information for a comparable setting, if approved by the department.

c. Health risk. The U.S. Department of Labor Occupational Safety and Health Administration (OSHA) limits for air contaminants pursuant to 29 CFR 1910, Subpart Z, may be utilized for site-specific standards in workplace settings where the OSHA standards are applicable and the contaminant of concern is used. For locations where OSHA standards are not applicable, site-specific standards for air in a confined space shall be risk-based using the chemical-specific toxicity values of inhalation unit risk (UR) and inhalation reference concentration (RfC) determined in accordance with paragraph 137.5(3)*"c."* Formulas II and III shall be used to calculate risk-based, site-specific air standards based on carcinogenic and noncarcinogenic effects, respectively, where C is the risk-based contaminant concentration in air. If a value for both RfC and UR exists for a compound, the risk-based site-specific standard will be the smaller of C resulting from Formulas II and III.

(Formula II)

$$C = AF \times TR \div UR$$

(Formula III)

$$C = AF \times RfC$$

The UR and RfC toxicity values are based on a continuous exposure of 20 cubic meters per day by a 70 kg adult. The adjustment factor (AF) in Formulas II and III may be used to adjust for site-specific exposure conditions. A target cancer risk (TR) of 10^{-4} shall be used unless another value is approved by the department.

d. Institutional or technological controls. Institutional or technological controls may be used to prevent future exposure to contaminants in air in confined spaces and will be required to prevent residential use of the affected area when a nonresidential air standard is used.

137.6(10) *Site-specific standards based on site-specific factors.* Numerical site-specific standards (i.e., target levels) for groundwater or soil may be established using site-specific exposure factors in Formula I. Site-specific pumping rates greater than specified in paragraph 137.6(3)*"d"* herein may be used when approved by the department. Site-specific exposure factors must be approved by the department. For the department to approve any such site-specific factor there must be well documented rationale for doing so and appropriate institutional or technological controls must be provided.

137.6(11) *Site-specific standards or approaches not anticipated by this rule.* Nothing in this rule precludes the use of site-specific standards derived in some way not anticipated by this rule, provided that the rationale is adequately presented and the approach is both approved by the department and provides a level of protection comparable to standards set forth under this rule.

567—137.7(455H) Institutional and technological controls.

137.7(1) *Technological controls.* The purpose of a technological control is to effectively sever a pathway by use of technologies such that an applicable receptor could not be exposed to hazardous substances above an applicable target risk level. Subject to limitations in this chapter, technological controls are an acceptable response action either alone or in combination with other remediation systems and institutional controls. The purpose of technological controls may be to control plume migration through use of containment technologies, barriers, or other methods, as an interim or permanent response action or to permanently sever a pathway to a receptor. Technological controls may also be appropriate to treat or control contamination at the point of exposure. Any technological control proposed as a permanent response action option without meeting the reduction in contaminant concentrations objectives must establish that the pathway to a receptor will be permanently severed or controlled. The effectiveness of a technological control must be monitored under a department-approved plan. The department may require reasonable proof of financial assurance when necessary to ensure that a technological control remain effective.

137.7(2) *Institutional controls.* The purpose of an institutional control is to restrict access to or use of an affected area such that an existing or future receptor could not be exposed to hazardous substances addressed by the controls for as long as the target level is exceeded at applicable points of exposure and compliance. Single or multiple institutional controls may be used alone or in combination and may also be employed with technological controls and response action to effectively achieve, maintain and enforce an approved level of risk reduction and risk management. The following enumeration of types of institutional and technological controls is not a finding that each is per se an effective control. The effectiveness of any institutional or technological control or combination of controls must be evaluated on a case-by-case basis and in accordance with specified conditions in this chapter. Institutional and technological controls include:

a. A state or federal law or regulation which can be shown to effectively achieve, maintain and enforce the required land-use restrictions and controls.

b. An ordinance of any political subdivision of the state which can be shown to effectively achieve, maintain and enforce the required land-use restrictions and controls.

c. A contractual obligation recorded and executed in a manner satisfying Iowa Code chapter 558. Recorded notices and affidavits, including a no further action letter as provided in rule 137.11(455H),

which do not create rights or obligations or restrict land use but serve to put current and future property owners on notice of present or future conditions within the affected area.

d. A control which the participant demonstrates to the department reduces or manages the risk from a release through the period necessary to comply with the applicable standards, including but not limited to informational devices such as public notices, informational registries, notices to regulatory authorities and continuing site activities such as periodic inspections, equipment repair and maintenance, and soil and groundwater monitoring.

e. An environmental covenant established in accordance with 2005 Iowa Code Supplement chapter 455I, 2005 Iowa Code Supplement section 455H.206, and 567—Chapter 14.

137.7(3) *Environmental covenants.* Participants may submit a draft environmental covenant to the department for review and approval in accordance with 567—Chapter 14.

137.7(4) *Public notification.* The department shall prepare a public notice prior to approval of any no further action classification which is conditioned upon use of institutional or technological control(s). The public notice will describe the results of the risk assessment conducted in the affected area, any proposed or completed response action, the vertical and horizontal extent and concentrations of existing soil and groundwater contamination in the affected area, and the actual and potential pathways of exposure the controls are intended to address. The notice will describe the purpose of the institutional and technological control(s) being proposed and the predicted period of coverage. The notice will provide the opportunity for members of the public to review department files, make written comments and request a public hearing. The department may schedule a public hearing on the basis of requests from the public and when it determines the particular remedial options proposed for a site warrant public consideration, for example, when issues of whether and to what concentrations gross contamination should be allowed to remain within the affected area given the relative effectiveness of institutional controls and other community concerns and development plans.

a. The notice will be served by certified mail on all property owners that the actual or modeled data indicates are or may be affected by the present or future conditions addressed by the control. The notice will be published in a newspaper of general circulation most likely to reach persons in the immediate locality.

b. If the controls are intended to restrict surface or subsurface future land use, the notice shall be sent to each local regulatory body having jurisdiction and control over or a direct interest in regulation of these activities. These may include but are not limited to municipal or county zoning boards, municipal building authorities, public utilities and economic development agencies. If the controls are intended to restrict groundwater use, the notice shall be sent to the county or city board of health responsible for private well permitting.

c. Failure to provide notice to an interested party shall not constitute a basis for invalidating a subsequently approved no further action classification.

137.7(5) *No further action certificates.* Any no further action certificate shall contain a specific reference to any applicable institutional and technological control and shall meet the requirements in rule 137.11(455H). The reference must identify the location of any recorded instrument, contractual agreement or other documents applicable to the control, provide a brief description of the terms of the control and, where appropriate, site diagrams.

137.7(6) *Enforcement of institutional and technological controls.* Institutional and technological controls which have been incorporated into a no further action certificate pursuant to rule 137.10(455H), or have been approved prior to issuance of a no further action certificate, may be enforced in Iowa district court by the department, a political subdivision of this state, the participant or any successor in interest to the participant as provided in Iowa Code section 455H.206(4). Enforcement of the terms of an environmental covenant shall be in accordance with 2005 Iowa Code Supplement chapter 455I, 567—Chapter 14, and the terms of the environmental covenant.

137.7(7) *Failure of an institutional and technological control(s).* The effectiveness of institutional and technological controls may be jeopardized for several reasons including situations where the technological controls are no longer effective in achieving their technical objectives, the validity of technological or institutional control is challenged due to a pending or final administrative or judicial

action or legislative action changing its regulatory effect (e.g., change in an ordinance), or persons fail to comply with the terms of the institutional or technological control. The effect of the failure of a technological or institutional control to achieve its intended purpose is to remove the no further action classification and put all interested parties in the same position had the no further action classification not been made. When the department has reason to believe technological or institutional control(s) is jeopardized or determines that the control is no longer effective, the following policy and procedure shall apply:

a. The department shall make reasonable efforts to provide notice of the failure or noncompliance to the participant(s), protected parties, persons having legal standing to enforce the terms of the controls, other persons who may be legally responsible for contamination at the site and persons legally obligated to comply with the terms of the controls. The notice shall inform these parties of the consequences of failure of the controls and provide the opportunity for one or more of them to correct the deficiency by taking further response action or undertaking enforcement action to obtain compliance with the terms of the controls.

b. The participant(s) and other persons legally responsible for contamination at the site shall have primary responsibility to correct deficiencies or seek enforcement of the terms of controls, if they wish to maintain a no further action classification and any attendant statutory protections. The department may in its discretion seek enforcement of controls where persons fail to comply with the terms when it determines there is a strong likelihood of success, other participant(s) or legally responsible persons are unable or unwilling to undertake enforcement, and utilization of the controls remains consistent with these rules and site conditions currently in effect at the site. However, the department is not obligated to seek enforcement of the terms of any technological or institutional controls nor does the election not to undertake enforcement constitute a defense to further action by responsible parties or a basis for challenging the rescission of the no further action classification.

c. The department may also elect to require statutorily responsible parties to correct the deficiency as an alternative to rescinding the no further action classification.

d. Failure of a participant to timely undertake additional response action and response may result in termination of enrollment and loss of benefits under these rules and Iowa Code Supplement chapter 455H. Any person found to have intentionally violated an environmental protection easement or other institutional or technological control, whether included in a no further action letter or as part of an approved response action, may lose any of the benefits under these rules or Iowa Code Supplement chapter 455H.

137.7(8) *Modification and termination of institutional and technological controls.* A participant or successor in interest to a participant, or an owner of property subject to an institutional or technological control, may seek approval from the department for the removal, discontinuance, modification or termination of an institutional or technological control. The person must demonstrate that the control in its present form is no longer required to ensure compliance with applicable standards. The person seeking revision must undertake sufficient risk assessment and provide sufficient assessment data to establish that the applicable compliance standards can be met based on the proposed modification. The department may also determine based on a revised assessment that the applicable controls are no longer effective to meet compliance standards and may require other response action. The department shall issue an amendment to any previously issued no further action letter specifying the approved modification of the institutional or technological controls. Modification and termination of an environmental covenant shall be consistent with these rules and shall conform with 2005 Iowa Code Supplement chapter 455I and 567—Chapter 14.

567—137.8(455H) Site assessment.

137.8(1) *Purpose.* The purpose of the site assessment is to define the nature and extent of contamination, along with identifying likely exposure pathways, with the aim of characterizing potential, current and future risks and making an informed decision concerning an appropriate response in the context of probable future land uses at the site and in the surrounding area. Assessment is to be conducted with the recognition that contaminant fate and transport may alter the current areal extent

and depth of contamination. It is recognized that the scope of such an assessment may be appropriately varied dependent upon interrelated factors including the nature and severity of the contamination, the complexity of specific details of the site and its setting, and the nature of the chosen response, if known.

137.8(2) *Site assessment plan.* The participant is encouraged, but not required, to submit for department review a site assessment plan, prior to proceeding with the site assessment. Participants choosing to initiate site assessment without department review and approval of a work plan shall notify the department in writing of their intentions. Likewise, participants choosing to proceed to the risk evaluation/response action phase in accordance with rule 137.9(455H) without seeking review of the site assessment report shall give prior notice to the department of their intentions. The notice shall include a schedule for implementation and completion, a description of the area to be assessed and the scope of the proposed assessment to be undertaken, any planned construction activities in the affected area and a proposed date for submission of the site assessment report for department review. If the notice includes an intention to go directly to the risk evaluation/response action phase, it shall also include a general description of the site assessment results, a schedule for submission of the risk evaluation/response action document and the reasons for not requesting department review and approval of the site assessment report.

The plan is intended to lay out the rationale to be followed in the conduct of the site assessment. The purpose for this optional stage is to provide an opportunity for the participant and the department to reach a consensus regarding the appropriate scope of the site assessment. The development of a consensus should serve to diminish the likelihood that the department will find the final site assessment to be deficient and, for the benefit of the participant, to avoid the expenditures and time associated with the collection of what may ultimately prove to be unnecessary data.

In order to accomplish this, it is suggested that the plan should address relevant, known characteristics related to the site and its history as well as plans for addressing pertinent details spelled out in the subsequent sections on the site assessment and the site assessment report. Departmental review may result in suggestions from the department regarding perceived shortcomings or proposed activities which are deemed to be unnecessary.

The participant may find it desirable to conduct some preliminary investigation in order to develop a site assessment plan.

137.8(3) *Site assessment details.* In order to meet the stated purpose of the site assessment, it will be necessary to characterize numerous attributes related to the enrolled site and its setting. The following objectives are intended to provide a framework in which to accomplish this purpose. It is recognized that these objectives may exceed the appropriate scope of some site assessments and that there may be situations in which it may be necessary to define additional objectives. Any such deviation would preferably be addressed in a site assessment plan. The department may also develop guidance documents that recommend more specific procedures for accomplishing site assessment objectives. Such guidance documents will be readily available to the public. In general, an acceptable site assessment should address the following items.

a. Identify and address the medium or media of concern associated with the contamination situation for which the site is enrolled. The regulatory classification or jurisdiction of contaminants shall be indicated if applicable and, if known, e.g., the compound is regulated under the Resource Conservation and Recovery Act (RCRA), Toxic Substances Control Act (TSCA), or Federal Insecticide, Fungicide and Rodenticide Act (FIFRA).

b. Characterize the nature, extent, and degree of contamination in both horizontal and vertical dimensions. This should involve appropriate sample numbers and locations within the contaminated area and beyond the area contaminated in excess of the background or statewide standard. Analyses should be conducted for the contaminants of concern, breakdown products, and other contaminants likely to be present at significant levels. The department may also require analyses for additional contaminants which are not the focus of enrollment in the program, but which may be of special concern. Special concerns might include waste handling or treatment problems posed by the additional contaminants, or unacceptable risks remaining unaddressed within the affected area, due to the presence of the additional contaminants. In the case of groundwater, attention should also be given to the possibility of contaminant

accumulation in strata overlying confining layers and to the possible presence of non-aqueous phase liquids (NAPL). In the case of groundwater, more than one round of sampling shall be incorporated, appropriately separated in time. In the case of soils, particular attention should be given to characterizing shallow soil contamination, from zero to six inches in depth.

c. Characterize the nature of the source of contamination or propose a conceptual model explaining the presence of the contamination of concern.

d. Characterize local contamination maxima or hot spots for the purposes of evaluation against relevant standards and to identify handling or treatment concerns that they may pose.

e. Characterize the stratigraphy. This should be done to a depth extending to the first significant confining layer below the deepest contamination. Descriptions should rely primarily on results gathered in the site assessment, but relevant reference materials or geologic logs from other sources may be incorporated as a supplement.

f. Characterize the hydrologic properties of the site and its vicinity to a distance appropriate to the fate, transport and exposure concerns associated with the site. This characterization should consider both horizontal and vertical components of groundwater movement as well as other influences on groundwater hydrology such as pumping wells, injection wells, surface water bodies, effects of seasonal or precipitation-driven variability, and possible aquifer interconnections, including those related to existing or abandoned wells. Water level measurements, related to a common datum, screening of appropriate depth intervals, and determination of hydraulic conductivity will generally be considered as necessary.

g. Characterize physical and chemical properties of the site and its environs associated with contaminant fate and transport, e.g., percent organic matter, redox potential, soil bulk density, and transmissivity.

h. Characterize topographic and cultural features of the site and its immediate vicinity. Cultural features may include, but not be limited to, buildings, basements, paved areas, roadways, utilities, storage tanks and associated piping, piles, impoundments, wells, and waste disposal systems.

i. Evaluate concerns related to whether the contamination situation is dynamic or stable; if dynamic, address fate and transport and breakdown products appropriately.

j. Identify and characterize receptor or exposure concerns. This most clearly involves concerns for drinking water and exposures to contaminated soils, as suggested by the statewide standards, but additional concerns should be identified and addressed by the participant or the department, as the situation warrants, e.g., vapors to basements, threats to water supply lines, threats to surface waters, or environmental threats.

k. Characterize current and probable future uses of the site and its surroundings. If probable future uses differ significantly from current uses, then characterize them separately and conduct the assessment in a fashion which addresses concerns arising from the possible change in use.

l. Evaluate the potential for contaminants to migrate from one medium to another. The following subparagraphs prescribe requirements for assessing potential migration of contamination from one medium to another. Requirements in the following subparagraphs may be waived if it can be demonstrated in accordance with procedures established in 567—Chapter 135 or the latest version of ASTM Standards related to the Phase II environmental site assessment process that migration of contamination from one medium to another will not cause a violation of the applicable standard in the receiving medium. The assessment activities prescribed in the following subparagraphs are intended to determine if significant migration of contamination from one medium to another has occurred. If evidence of significant migration of contamination from one medium to another (i.e., generally a contaminant concentration in the receiving medium in excess of the statewide standard) is discovered, full-scale characterization of the receiving medium may be required.

(1) The water from any pond or lake on the site or within 300 feet of the site shall be sampled and analyzed for the contaminants of concern, if it is reasonably possible that contaminants from the site could impact the pond or lake. Any surface stream that runs through the site or within 300 feet of the site should be sampled at a location downstream of any potential impact from the site and analyzed

for the contaminants of concern. Depending on the characteristics of the contaminants (e.g., solubility), associated sampling and analysis of sediments may be required.

(2) Groundwater at the location most likely to be impacted by each known substantial area of soil contamination shall be sampled and analyzed for the contaminants of concern. If the area of soil contamination exceeds 10,000 square feet, additional groundwater samples may be required.

(3) Soil vapors in each area that is most likely to be impacted by known groundwater or soil contamination shall be sampled and analyzed for the volatile organic contaminants of concern. If the area of soil or groundwater contamination exceeds 10,000 square feet, additional soil vapor samples may be required. If vapors may be impacting an existing enclosed space, a soil vapor sample shall be collected from a location that is most likely to have vapor contamination adjacent to the enclosed space.

If the potential for the existence of problematic concentrations of the vapors in the enclosed space cannot be dismissed based on soil vapor sampling, sampling and analysis of vapors inside the enclosed space may be conducted to determine whether or not a problem exists. Appropriate measures for distinguishing between contaminant vapors originating from within the enclosed space versus those from the external sources that are under investigation may be made with the approval of the department.

Ambient air sampling may be required if a very large area or extremely high concentrations of highly volatile contaminants exist in shallow soil or evidence of vapor contamination exists, such as odors or a high vapor reading on a vapor-screening instrument.

(4) If a water line exists within the zone of known organic contamination of soil, groundwater or soil vapor and the potential for significant diffusion of contaminants into the water line cannot otherwise be dismissed, a sample from the water line shall be collected at the nearest location where any impact may exist and that sample shall be analyzed for the organic contaminants of concern. All such samples should be collected at times following minimum movement within the water line (e.g., early morning following a weekend).

137.8(4) *Site assessment report.* The site assessment report shall include the presentation of all information gathered relative to the foregoing description of the site assessment, arranged in appropriate sections of the report. It shall include a summary of preliminary information on which the site assessment is based, e.g., background and site history. The report shall discuss the sampling strategy and methods used in the assessment. The department encourages the use of innovative or screening techniques to expedite investigations and to control costs, provided that such techniques are approved by the department and are supported through verification by accepted scientific practices. The report shall also include a description of the quality assurance/quality control (QA/QC) protocols followed during the investigation. QA/QC protocols shall be consistent with accepted scientific practices, including those set forth in appropriate EPA or ASTM guidance or otherwise approved by the department.

The presentation should be organized so as to facilitate the assimilation of information by the reader. Maps to be presented, as appropriate, might include maps illustrating the location of the site in a larger geographical context; maps showing cultural features associated with the site and its environs; maps illustrating the contamination extent and concentration in three dimensions; maps illustrating the site hydrology in three dimensions; and maps illustrating receptors, potential receptors, and relevant pathways of exposure. Cross-sectional diagrams should be included to illustrate stratigraphy, geological boring information, and hydrologic and contaminant factors with depth. Tables and graphs should be designed for the purpose of summarizing data in a meaningful fashion, including information about successive rounds of sampling. Appendices should include well logs, copies of laboratory analytical reports, and raw data used to calculate parameters presented elsewhere in the report. Appended material shall be labeled in a fashion permitting the cross-referencing of appended materials and the body of the report.

137.8(5) *Approval of site assessment report.* The department suggests, but does not require, that the site assessment report be approved prior to proceeding with the subsequent risk evaluation/response action phase. Unless notice has already been given prior to initiation of the site assessment, participants choosing to proceed to the risk evaluation/response action phase without department review and approval of the site assessment report must notify the department in advance as provided in subrule 137.8(2).

137.8(6) *Public notification.* Before or upon completion of the site assessment, the participant shall provide the department with the names and addresses of the owners and occupants of all property adjacent to the site enrolled in the land recycling program and any additional properties where contaminants from the enrolled site have migrated or are likely to migrate in the future. The department shall notify by direct mailing all such property owners and occupants, the city or county in which the property is located, and officials of any potentially impacted public water supply of the site's enrollment in the land recycling program and of the scope of work described in the participation agreement. The department shall give the notified parties the opportunity to obtain updates regarding the status of activities relating to the site that is enrolled in the land recycling program. The department may also require the participant of a site enrolled in the land recycling program to publish public notice in a local newspaper if the department determines that widespread interest in the site exists or is likely to exist. The department may provide additional opportunities for public participation if, after consultation with the participant, the department determines such opportunities are warranted.

567—137.9(455H) Risk evaluation/response action.

137.9(1) *Purpose.* The purpose of risk evaluation/response action is to utilize information from the site assessment as a basis for:

a. Determining whether current exposures result in risks deemed to be excessive, based on evaluation against appropriate background, statewide, or site-specific standards.

b. Determining whether future exposures may result in risks deemed to be excessive, based on evaluation against appropriate background, statewide, or site-specific standards. This will likely include:

(1) Evaluation of potential changes in usage, e.g., installation of a new well, change in land use, or other activities, which result in unacceptable, potential exposures not evaluated as current exposures, and

(2) Evaluation of exposure concerns related to the movement of contamination such that potential exposures might arise which are not considered under current exposure assumptions, e.g., groundwater plume migration creating a potential for future contamination of existing wells or creating newly contaminated areas in which new well installation may result in unacceptable exposures.

c. Proposing an appropriate and acceptable response action or strategy to address the identified, unacceptable exposures or potential exposures.

d. Establishing the test criteria to be applied under rule 137.10(455H) for determining final compliance with the selected standard. In some cases this may consist of proving that standards are currently met; in other cases it may result in an assessment of whether the response action succeeds in bringing about compliance with a selected standard.

The risk evaluation/response action is intended only for application to the specific contaminants and situations for which the site is enrolled.

137.9(2) *Risk evaluation.* The risk evaluation/response action document shall identify all locations or areas, and associated exposure pathways, where exposure currently exceeds a statewide standard or where a statewide standard may be exceeded in the future, due to either a change in exposure-related usage or contaminant migration. Current and future exposure pathways shall be evaluated and presented separately. This evaluation shall not be limited to exposure pathways for which the department has formulated risk-based values in rule 137.5(455H) (the statewide standard) or 137.6(455H) (the site-specific standard) but should include any pathway related to the situation for which the site is enrolled, for which a no further action certificate is sought, or for which an unacceptable risk may now or in the future exist, e.g., high concentrations of volatile compounds in proximity to a confined space, high concentrations of solvents in proximity to a water distribution line, or environmental concerns unrelated to human health.

In a case where a background standard is to be applied and there is no violation of a statewide standard, it will be necessary to identify only locations or areas where the background standard is exceeded.

In some instances it is anticipated that the risk evaluation may be appropriately abbreviated from the preceding description, based on the specific details of the contamination and the proposed response

action. Participants are strongly urged to discuss the appropriate scope of their risk evaluation with the department.

137.9(3) *Establishing cleanup standards.* The risk evaluation/response action document shall identify the cleanup standards to be applied in accordance with rule 137.4(455H), 137.5(455H), or 137.6(455H) of this chapter, outlining respectively the background, statewide, or site-specific standards. These standards may be applied in any combination to address specific components of the contamination problem for which the site is enrolled. If cleanup standards other than those specifically formulated under the statewide standard (rule 137.5(455H)) are to be applied, then the rationale behind the determination of such standards shall be justified, in the document, to the department's satisfaction.

137.9(4) *The use of models.* The department recognizes that the use of numerical models will likely be necessary in order to evaluate potential future exposures or that models may be used to develop target levels.

a. Standard models. Standard models may be used to predict future contaminant concentrations at potential points of exposure to contaminants or at other locations used for determining compliance when such models are appropriate, as determined by the department. Applicable Tier 2 models approved for use in accordance with 567—Chapter 135 for underground storage tanks (USTs) and applicable Tier 2 models provided in American Society for Testing of Materials (ASTM) standards are acceptable standard models. Models which provide a two-dimensional representation of groundwater flow will not be considered to be appropriate when significant three-dimensional components to groundwater flow are anticipated. Default values for input parameters for ASTM and UST Tier 2 models, as provided in applicable ASTM standards and approved for use in accordance with 567—Chapter 135, may be utilized without approval by the department. The department will maintain a guidance document which includes a list of other chemical-specific default values for all chemicals having statewide standards. The use of other, site-specific input parameters is addressed under site-specific modeling in paragraph *"b"* below.

b. Site-specific models. Site-specific models may be used to predict future contaminant concentrations at potential points of exposure to contaminants or at other locations used for determining compliance when such models are appropriate, as determined by the department. Site-specific models may include standard models with site-specific input parameters or models utilizing more sophisticated analytical techniques. The department will utilize versions of A Modular Three-Dimension Finite-Difference Ground-Water Flow Model (MODFLOW) as developed by the United States Geological Survey in conjunction with A Modular Three-Dimensional Transport Model (MT3D) by S.S. Papadopulos & Associates, Inc. as a site-specific model for assessment of potential future exposures to contaminants in groundwater. MODFLOW and MT3D will be considered to be appropriate site-specific groundwater and contaminant transport models for any situation. Other site-specific groundwater and contaminant transport models may be utilized with the approval of the department. In general, a site-specific groundwater model shall have proven reliability and be able to simulate, as needed:

- A fixed contaminant source,
- Groundwater and contaminant flow in three dimensions,
- Groundwater and contaminant flow through as many distinct geologic layers as necessary for the site in question,
- Effects of pumping,
- Effects of groundwater recharge and discharge,
- Impacts of hydrologic boundaries,
- Contaminant advection, dispersion and chemical reactions, as appropriate for the site in question, and
- Other site-specific variables as appropriate.

Default values for input parameters approved for standard models will be approved for use in site-specific models. Otherwise, input parameters used in site-specific models are subject to the department's approval.

137.9(5) *Response action.* The risk evaluation/response action document shall include a proposal for a response action or strategy to achieve and maintain compliance with the selected standard(s). This may consist of activities designed to remove or treat contaminants, prevention of exposure to unacceptable

levels of contamination through technological/institutional controls or monitoring, or it may consist of a combination thereof. If the response action involves the use of a standard which is less stringent than the statewide standard, it will generally be necessary to implement institutional controls to prevent the type of exposure on which the statewide standard is based. It is the intent of the department to permit the participant to identify and carry out those options by which this may be accomplished, insofar as the department deems the selected options to be reasonable, protective of human health and the environment, and consistent with provisions of the rule.

137.9(6) *Free product and gross contamination.* The response action or strategy for an enrolled site shall take into account a stated policy of the Act to encourage environmental cleanup. To this end, the department requires that contaminants present as free product and gross contamination shall not be addressed through the implementation of institutional or technological controls. For purposes of this rule, gross contamination will be considered to be contamination present at concentrations in excess of a standard by an amount sufficient to reasonably expect that institutional or technological controls will not be adequately protective of human health or the environment.

The department recognizes that treatment or removal of free product or gross contamination may not, in some cases, be feasible. In such cases the department may grant a variance to this portion of the rule. It will be the responsibility of the participant to make a sufficient case that such a variance is warranted.

137.9(7) *Compliance verification strategy.* The risk evaluation/response action document shall outline a strategy for determining whether the relevant standards are met by the site and will continue to be met in the future. In some cases this may consist of sampling and statistical tests to verify that the standard has already been met, while in other cases the sampling and statistics may be used to demonstrate that a response action has achieved its stated goals and the site is now in compliance with standards. Some response strategies may also call for longer term monitoring. In this latter case, standard-based values shall be identified which, if exceeded, would indicate a failure of the response action and necessitate the development and implementation of a new response action. The terms under which monitoring may cease should also be proposed. The proposed strategy shall be consistent with rule 137.10(455H), dealing with demonstration of compliance, and shall indicate the standard to be applied and the point of compliance at which it is to be applied, consistent with rules 137.4(455H), 137.5(455H), and 137.6(455H) (the background, statewide, and site-specific standards, respectively).

137.9(8) *Risk evaluation/response action document submission.* A risk evaluation/response action document shall be submitted for review by the department. When considered in conjunction with the site assessment report, these documents shall present a complete picture of the site from its characterization, through the evaluation of risk, to the development of a strategy to address the situation. An effort shall be made to ensure that the reviewer, or other interested parties, can easily move back and forth through the documents to gain an understanding of the existing situation and proposed actions. The risk evaluation/response action document shall include a summary of findings regarding present risks and potential future risks; a pathway-specific identification of the standards to be applied, including the supporting rationale, if appropriate; a discussion of the proposed response actions, including remedial actions to be taken and institutional or technological controls to be implemented; and a discussion of the proposed verification strategy. Any modeling used for purposes of assessing future risk or establishing site-specific standards shall be presented in sufficient detail to permit evaluation of the results by the department. Any permits which will be necessary to implement the response action shall be identified to the department for inclusion in a consolidated standards permit.

137.9(9) *Department review and approval.* It is strongly recommended that the document be submitted for review and approval prior to proceeding with implementation of the response action. The final, department-approved document will be the basis for assessing subsequent activities at the site. Parties choosing to proceed with response actions without prior review and approval by the department proceed at their own risk and may not assume the response action implemented will result in a no further action certificate.

Parties choosing to implement a response action without prior review and approval by the department shall submit to the department a proposed risk evaluation/response action document accompanied by an

explanation of the reason(s) for proceeding without prior approval. Documentation shall also include a schedule for implementation, a description of construction or other activities to be undertaken, and date for submission of the final report demonstrating compliance, as described in rule 137.10(455H).

The department shall provide opportunity to comment on proposed response actions to any party that is potentially impacted by off-site migration of contaminants for which notification is required in accordance with subrule 137.8(6). The department shall consider reasonable comments from potentially impacted parties in determining whether to approve or disapprove a proposed response action or site closure.

567—137.10(455H) Demonstration of compliance.

137.10(1) *Purpose.* The purpose of the demonstration of compliance section is to provide a mechanism by which to verify that:

a. Appropriate and acceptable standards are complied with and that compliance can be reasonably expected to continue in the future;

b. Any and all remedial measures proposed under rule 137.9(455H) have achieved their purpose; and

c. Appropriate institutional and technological controls, or monitoring mechanisms, have been successfully put in place.

In some cases the demonstration of compliance may mark the final step, taken by the participant, prior to the issuance of a no further action certificate. In other cases it may mark the transition to the longer term closure activities associated with the site, such as monitoring, maintenance of technological controls, and continuing enforcement of institutional controls. In this latter case, demonstration of compliance activities may or may not result in the issuance of a no further action certificate, depending on the approach proposed in the response action. In some cases it may be necessary to successfully complete a monitoring program (or to fulfill other agreed-upon obligations) prior to the issuance of the no further action certificate.

In all cases, sampling of environmental media shall comply with QA/QC requirements addressed elsewhere in this rule.

137.10(2) *General requirements for demonstrating compliance with soil standards.*

a. For the standard being applied, the demonstration of compliance shall be at the point of compliance or point of exposure as set forth in rule 137.4(455H), 137.5(455H), or 137.6(455H) relating to background standards, statewide standards, and site-specific standards, and described in a site-specific context pursuant to subrule 137.9(7), relating to risk evaluation/response action.

b. Minimum sample numbers for the demonstration of compliance with the background standard for soils (paragraph 137.10(4)*"b"*) or with the statewide standard when applying subparagraph 137.10(5)*"a"*(1) shall be based on the volume of soil to which the selected standard is being applied as follows:

(1) For volumes less than or equal to 125 cubic yards, a minimum of 8 samples.

(2) For volumes greater than 125 cubic yards, but less than or equal to 3,000 cubic yards, a minimum of 12 samples.

(3) For each additional volume of less than or equal to 3,000 cubic yards, a minimum of 12 additional samples.

(4) Additional samples may be required based on site-specific conditions.

c. When applying the 95 percent upper confidence limit, according to EPA guidance, to demonstrate compliance with the statewide standard for soils (subparagraph 137.10(5)*"a"*(2)) or a site-specific standard for soils (subrule 137.10(6)), the minimum sample number shall be as specified in that guidance.

d. Sample locations for demonstration of compliance shall be selected in a systematic random fashion to be representative, both horizontally and vertically, of the volume of soil being evaluated for compliance.

e. Sampling for the purposes of demonstrating compliance shall be conducted after the completion of site assessment activities and after the implementation of applicable remedial measures.

137.10(3) *General requirements for demonstrating compliance with groundwater standards.*

a. For the standard being applied, the demonstration of compliance shall be at the point of compliance or point of exposure as set forth in rule 137.4(455H), 137.5(455H), or 137.6(455H), relating to background standards, statewide standards, and site-specific standards, and described in a site-specific context pursuant to subrule 137.9(7), relating to risk evaluation/response action.

b. Monitoring wells installed for the purpose of demonstrating compliance shall be of sufficient number and appropriate location to evaluate all hydrologic strata of concern, based on site-specific considerations, as identified pursuant to subrule 137.9(7), relating to risk evaluation/response action.

c. For statistical methods under subparagraph 137.10(5)*"b"*(1), compliance with the statewide groundwater standard shall be based on eight consecutive quarters of groundwater data.

As an alternative, the department may accept four consecutive quarterly sampling events or less with written approval from the department under the following conditions:

(1) There is adequate spatial monitoring of the plume upgradient which indicates a decreasing concentration trend toward the downgradient property boundary.

(2) Parameters affecting the fate and transport of regulated substances within the plume have been fully evaluated.

(3) Concentrations of regulated substances in the plume at the point of compliance monitoring wells along the downgradient property boundary are all less than or equal to the groundwater standard or the limit relating to the PQL, whichever is higher, in all samples collected during the quarters of monitoring.

(4) One of the following is met:

1. The age of the plume is sufficiently well known to permit a judgment to be made regarding its stability.

2. The remediation includes source removal or containment actions which would reduce chemical flux into the plume.

d. When applying the 95 percent upper confidence limit, according to EPA guidance, to demonstrate compliance with the statewide standard for groundwater (subparagraph 137.10(5)*"b"*(2)) or a site-specific standard for groundwater (subrule 137.10(6)), the minimum sample number shall be as specified in that guidance.

e. Sampling for the purposes of demonstrating compliance shall be conducted after the completion of site assessment activities and after the implementation of applicable remedial measures.

137.10(4) *Demonstration of compliance with a background standard.*

a. To apply a background standard the participant shall demonstrate to the department, in writing, that the apparent background contamination at the site is due to widespread or naturally occurring contamination and shall obtain the department's approval to use this subrule. Data collected for the purpose of determining the applicable background standard is subject to department approval, interpretation, and manipulation, if necessary for the purpose of establishing a meaningful background standard.

b. For soil, the minimum sample number to determine the background standard shall be 10 (unless a lesser number is approved by the department) and the number of samples from the affected area shall be based on volume as described in 137.10(2)*"b."* No sample collected from the affected area may exceed the sum of the background arithmetic mean and three times the sample standard deviation, as calculated based on the background sampling.

c. For groundwater, a minimum of 12 locations shall be sampled in the background reference area (unless a lesser number is approved by the department) and an equal number shall be collected from the affected area. In areas involving more than one hydrologic strata, more samples may be required. Sampling shall be conducted concurrently in the background reference area and the affected area. No sample collected from the affected area may exceed the sum of the background arithmetic mean and three times the sample standard deviation, as calculated based on the background sampling.

137.10(5) *Demonstration of compliance with the statewide standard.* The following requirements shall be met in order to demonstrate compliance with the statewide standard. Testing shall be performed individually for each contaminant being addressed and for which a no further action certificate is sought.

a. To demonstrate compliance with the statewide standard for soils in each affected area, in addition to (1) or (2) as follows, all other applicable requirements of this rule shall be met.

(1) Seventy-five percent of all soil samples, collected during a single event, shall be less than or equal to the statewide standard, with no individual sample exceeding 10 times the statewide standard.

(2) In accordance with EPA-approved methods, the 95 percent upper confidence limit of the arithmetic mean of soil sample values from the affected area shall be at or below the statewide standard.

b. To demonstrate compliance with the statewide standard for groundwater in each compliance monitoring well, in addition to (1) or (2) as follows, all other applicable requirements of this rule shall be met.

(1) Seventy-five percent of all samples collected in each compliance monitoring well over time shall be less than or equal to the statewide standard, with no individual sample exceeding 10 times the statewide standard.

(2) In accordance with EPA-approved methods, the 95 percent upper confidence limit of the arithmetic mean of samples collected from a compliance well over time shall be at or below the statewide standard.

137.10(6) *Demonstration of compliance with a site-specific standard.* To demonstrate compliance with a site-specific standard, the participant shall use the tests identified in 137.10(5)*"a"*(2) and 137.10(5)*"b"*(2), except that the 95 percent upper confidence limit of the arithmetic mean for samples from the medium of concern shall be at or below the site-specific standard.

137.10(7) *Compliance with cumulative risk.* In addition to or, for soil only, in lieu of compliance with standards for individual contaminants as prescribed above, cumulative risk criteria must be attained. Cumulative carcinogenic health risks shall not exceed 1 in 10,000. Noncarcinogenic health risks affecting the same target organ shall not exceed a cumulative hazard quotient of 1. Cumulative risk criteria are applicable to multiple contaminants in the same medium and multiple media in which exposure is likely to occur to the same individual. Cumulative risks shall be based on the same exposure assumptions that are used for determining the selected standard.

Risks associated with background levels of contaminants shall not be included in the cumulative risk determination. Background levels of contaminants shall be determined in accordance with subrule 137.10(4) or, if approved by the department, by the use of generally available information on background levels of contaminants.

In situations where the risk associated with exposure to a contaminant at a concentration equal to the selected standard is greater than the acceptable cumulative risk, the cumulative risk may be calculated assuming the risk associated with exposure to the contaminant at a concentration equal to the selected standard is equal to the acceptable cumulative risk criterion. The department will provide a guidance document for calculating cumulative risk and make it readily available to the public.

137.10(8) *Final report.* A final report shall be submitted which documents the accomplishment of all provisions set forth in the risk evaluation/response action document. This shall include, as applicable to the specific situation, discussions related to verification of compliance with selected standards; successful completion of approved remedial actions; implementation of necessary institutional or technological controls; and initiation of any required monitoring strategy. Sufficient details shall be included to permit the department to verify that the terms proposed in the response action have been met with regard to the statistical determination of compliance with standards.

137.10(9) *Department review and approval.* The final report is subject to review and approval by the department. Following review, the department will either approve the report or make a written response indicating the reason(s) why the report is unacceptable. Acceptance of the report may result in the issuance of a no further action certificate or it may mark a transition to the long-term closure activities associated with the site, as proposed in the response action. A decision that the report is unacceptable may be based upon an insufficiency of the report or it may be based on a judgment that the terms of the response action have not been met.

In cases where a participant has elected to proceed through this program without department interaction and without submitting site assessment (pursuant to rule 137.8(455H)) or risk evaluation/response action documents (pursuant to rule 137.9(455H)), the final report shall contain

the substantive information related to those rules in addition to information required under this rule. The intent is to create a document for departmental review and approval which clearly sets forth, in substance, the same process which would have been developed had the participant engaged in a stepwise approach including interaction with the department during the process.

567—137.11(455H) No further action classification.

137.11(1) *Eligibility.* An enrolled site shall be eligible to obtain a no further action classification, when the department determines the participant has met all compliance standards of this chapter applicable to the affected area and the hazardous substances actually identified and evaluated such that no further response action is required other than maintenance of institutional or technological controls or certain specified continuing site activities. Upon request of a participant or a protected party and compliance with applicable standards, the department will issue a no further action letter to each protected party requesting it.

A no further action classification may be conditioned upon the continued maintenance and effectiveness of any applicable institutional or technological control in accordance with rule 137.7(455H).

137.11(2) *No further action certificate.* A no further action letter shall be in a form recordable in the county real estate records as provided in Iowa Code chapter 558 and consistent with the model forms developed by the department. The no further action letter may be recorded as provided by law.

137.11(3) *No further action certificates conditioned on institutional and technological controls.* A no further action certificate conditioned upon the continuing effectiveness and maintenance of institutional and technological controls or other continuing requirements must be recorded with the consent of the fee titleholder for each parcel of affected property subject to the controls and for parcels of property for which prevention of exposure is dependent upon the continuing effectiveness and maintenance of the controls. If a participant is not able to record the no further action letter on a parcel within the affected area due to objections of the fee titleholder or other legal restraints, this alone shall not be a basis for denying or rescinding the no further action classification or the certificate or the legal protections attendant to the no further action classification. Any modification or termination of institutional and technological controls shall be noted in an amended no further action certificate and shall be recorded as to any property subject to an earlier recorded certificate or institutional control. If a no further action certificate is required to be recorded, the no further action classification is not effective until the document is recorded with the county recorder.

137.11(4) *Scope of liability protection.* Upon issuance of the no further action letter by the department, the liability protection provisions contained in Iowa Code Supplement chapter 455H, subchapter 3, apply. The scope of the no further action classification and the scope of liability protection extend only to that area of affected property as defined by actual and modeled contaminant data and the specific environmental condition for which a regulatory standard has been met and approved by a no further action classification. The scope of protection corresponds to the scope of the site assessment conducted by the participant, the exposure pathways actually evaluated by the assessment report and reviewed by the department, and the hazardous substances identified in that assessment for which compliance with a department-approved standard has been achieved. Liability protection does not apply to releases, sources of contamination, hazardous substances or other environmental conditions not expressly addressed in the participant's site assessment, response action or specifically referenced in the no further action certificate.

The no further action classification and certificate shall be void if the department demonstrates by clear, satisfactory, and convincing evidence that any approval under this chapter was obtained by fraud or material misrepresentation, knowing failure to disclose material information, or false certification to the department.

137.11(5) *Reopener and reclassification conditions.*

a. The department shall have grounds to reopen and rescind a no further action classification and consider reclassification of the affected area if specified conditions of the no further action classification and certificate are not maintained, or if institutional or technological controls fail to meet their intended

purpose or are determined to be ineffective and unenforceable. If the conditions upon which the no further action classification was issued cannot be corrected or reinstated, the department may rescind the classification. The effect of termination is to put all parties in the same position as if the no further action letter had not been issued.

b. If a no further action certificate is issued without conditions or technological and institutional controls and conditions should arise which might require further corrective action, the department may require further response action by a participant or protected party only as provided in Iowa Code Supplement section 455H.301. The department may require further response action against a statutorily responsible party who is not a participant or a protected party. If the participant was a person having control over a hazardous substance, as defined in Iowa Code section 455B.381, at the time of the release, a no further action certificate may provide or the department may require further response action to protect against an imminent and substantial threat to public health, safety, and welfare. A protected party who was a person having control over a hazardous substance, as defined above, may be required by the department to conduct a further response action, where appropriate, to protect against an imminent and substantial threat to public health, safety, and welfare.

These rules are intended to implement Iowa Code Supplement chapter 455H.

[Filed emergency 10/27/98 after Notice 8/12/98—published 11/18/98, effective 10/27/98]
[Filed 7/1/04, Notice 4/14/04—published 7/21/04, effective 8/25/04]
[Filed 6/28/06, Notice 3/15/06—published 7/19/06, effective 8/23/06]

APPENDIX D

IDNR LAND RECYCLING PROGRAM & SUMMARY OF SIMPLIFIED RISK-BASED FORMULA FOR DETERMINING GROUNDWATER AND SOIL RESPONSE ACTION STANDARDS

Summary of Simplified Risk-Based Formulae for Determining Groundwater and Soil Response Action Standards

Standard	Cancer-Based	Non-Cancer Based
Statewide-Groundwater Protected Source	$\frac{1.75 \times 10^{-4}}{SF_o}$	$7 \times RfD_o$
Statewide-Groundwater Non-protected Source	$\frac{3.5 \times 10^{-3}}{SF_o}$	$35 \times RfD_o$
Statewide-Soil	$\frac{3.194}{(3.16 \times SF_d \times Abs) + SF_o}$	$\frac{78{,}214 \times RfD_o \times RfD_d}{(2.8 \times RfD_o \times Abs) + RfD_d}$
Site-Specific-Soil Deep Residential	$\frac{31.94}{(3.16 \times SF_d \times Abs) + SF_o}$	$\frac{782{,}140 \times RfD_o \times RfD_d}{(2.8 \times RfD_o \times Abs) + RfD_d}$
Site-Specific-Soil Nonresidential <2 ft. deep	$\frac{318}{(6.6 \times SF_d \times Abs) + SF_o}$	$\frac{387{,}121 \times RfD_o \times RfD_d}{(2 \times RfD_o \times Abs) + RfD_d}$
Site-Specific-Soil Nonresidential >2 ft. deep	$\frac{2710}{(3 \times SF_d \times Abs) + SF_o}$	$\frac{387{,}121 \times RfD_o \times RfD_d}{(3 \times RfD_o \times Abs) + RfD_d}$

NOTES: Cancer Slope Factor (SF); Reference Dose (RfD); Subscripts: "o" - oral, "d" - dermal

1. A standard for a protected groundwater source will be the drinking-water maximum contaminant level (MCL) if one exists, if not the lifetime health advisory level (HAL) will be the standard, and if neither a MCL nor HAL exist the standard will be risk-based as described herein.

2. Standards for Compounds classified as cancer group A or B will be cancer based.

3. Standards for Compounds classified as cancer group D or E will be non-cancer based.

4. Standards for Compounds classified as cancer group C will be determined as follows:

   a. Statewide Standard for Protected Groundwater Source: $0.7 \times RfD_o$

   b. Statewide Standard for Non-Protected Groundwater Source:
      If a SF_o exists, use the larger of: $(3.5 \times 10^{-3}) \div SF_o$ or $3.5 \times RfD_o$
      If no SF_o exists use: $35 \times RfD_o$

   c. All Soil Standards:
      If a SF exists, use the larger of: the cancer-based standard or
      0.1 times the non-cancer-based standard.
      In no SF exists use the non-cancer-based standard.

5. For the time being dermal Absorption factors (Abs) can be obtained from Chapter 3, Exhibit 3-4, page 16 at the following Internet address (other chemicals assumed Abs = 0): http://www.epa.gov/superfund/programs/risk/ragse/

6. Compliance with standards for individual chemicals does not guarantee compliance with cumulative risk standards, especially for site-specific soil standards.

APPENDIX E

LABORATORY QUALITY ASSURANCE / QUALITY CONTROL MANUALS

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Quality Assurance Manual Cover Page

Eurofins Cedar Falls

3019 Venture Way

Cedar Falls, IA 50613

Phone No. 319-277-2401

Fax No. 319-277-2425

https://www.eurofinsus.com/env

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1) INTRODUCTION, SCOPE AND APPLICABILITY

1.1) Introduction and Compliance References

Eurofins Cedar Falls' Quality Assurance (QA) Manual is a document prepared to define the overall policies, organization objectives and functional responsibilities for achieving the laboratory's QA Program. Governing SOPs are in place within the organization to ensure the proper execution of this QA Manual (refer to Appendix 1). This manual and referenced documents are required reading for all personnel.

The laboratory is a team of people who work together to serve the health and environmental needs of society through science and technology. We maintain a local perspective in our scope of services and client relations and maintain a national perspective in terms of quality.

As such, this QA Manual has been prepared to assure compliance with The NELAC Institute (TNI) Standard, dated 2009 and 2016; and ISO/IEC Guide 17025:2005 and 2017. Policies and procedures listed in Appendix 1 are compliant with the National Divisional Support Center (NDSC) Quality Management Plan (QMP) for Eurofins Environmental Testing America and the various accreditation and certification programs which are held by the laboratory to support environmental work (Appendix 2). The QMP provides a summary of Eurofins Environmental Testing America's quality and data integrity system. It contains requirements and general guidelines under which all Eurofins Environmental Testing America facilities shall conduct their operations.

Refer to Appendix 3 for a list of additional references for which this QA Manual is compliant; and Appendix 4 for the compliance crosswalk of this manual to the TNI & ISO/IEC Guide 17025 requirements.

1.2) Terms and Definitions

A QA Program is a system designed to ensure that data produced by the laboratory conforms to the standards set by state and/or federal regulations. The program functions at the local management level through company goals, from guidance at the executive management level, and at the analytical level through Standard Operating Procedures (SOPs) and quality control. Our program is designed to minimize systematic error, encourage constructive, documented problem solving, and provide a framework for continuous improvement within the organization to better serve our clients.

Refer to Appendix 5 for a list of Terms and Acronyms.

1.3) Scope / Fields of Testing

The laboratory analyzes a broad range of environmental and industrial samples. Sample matrices vary among air, drinking water, effluent water, groundwater, hazardous waste, sludge and soils. The QA Program contains specific procedures and methods to test samples of differing matrices for chemical, physical and biological parameters. The QA Program also contains guidelines on maintaining documentation of analytical processes, reviewing results, servicing clients and tracking samples through the laboratory. The technical and service requirements of all analytical requests are thoroughly evaluated before commitments are made to accept the work. Measurements are made using published reference methods or methods developed and validated by the laboratory.

The methods covered by this manual include the most frequently requested methodologies needed to provide analytical services in the United States and its territories. The specific list of test methods used by the laboratory can be found in the Laboratory Information Management System (LIMS). Our areas of expertise include:

Standard Services	Specialty Services
• Volatiles • Semivolatiles	• Agricultural Chemicals

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• Metals • Pesticides/PCBs • Petroleum Hydrocarbons • Waste Characterization • Non-potable Water Testing • Drinking Water Testing • Soil and Surface Water Testing	

Note: All current certificates and scopes of accreditation are available on the laboratory's website at https://www.eurofinsus.com/env.

The approach of this manual is to define the minimum level of quality assurance and quality control necessary to meet these requirements. All methods performed by the laboratory shall meet these criteria as appropriate. In some instances, quality assurance project plans (QAPPs), project specific data quality objectives (DQOs) or local regulations may require criteria other than those contained in this manual. In these cases, the laboratory will abide by the requested criteria following review and acceptance of the requirements by the Laboratory Director and the Quality Assurance (QA) Manager. In some cases, QAPPs and DQOs may specify less stringent requirements. The Laboratory Director and the QA Manager must determine if it is in the laboratory's best interest to follow the less stringent requirements.

1.4) Management of the Manual

1.4.1) Review Process

The template on which this manual is based is reviewed annually by Eurofins National Divisional Support Center (NDSC), which houses the Quality Assurance leadership team for Eurofins Environment Testing America. NDSC-QA will assure that the template remains in compliance with Section 1.1. This manual itself is reviewed at a minimum every two years by senior laboratory management to assure that it reflects current practices and meets the requirements of the laboratory's clients and regulators as well as the QMP, but more frequent review is also acceptable (e.g., annually to coincide with the release of the new template). Occasionally, the manual may need changes in order to meet new or changing regulations and operations. The QA Manager will review the changes in the normal course of business and incorporate changes into revised sections of the document. All updates will be reviewed by the senior laboratory management staff. The laboratory updates and approves such changes according to our Document Control & Updating procedures (refer to laboratory SOP No. *CED-Q-DC-SOP42896*).

2) MANAGEMENT REQUIREMENTS

2.1) Overview

The Eurofins Cedar Falls laboratory is a local operating unit of Eurofins Environment Testing North Central, LLC ("EETNC"). EETNC is a wholly owned subsidiary of Eurofins Environment Testing America, Inc., which is in turn a wholly owned subsidiary of Eurofins Scientific, S.E., a publicly traded company. The laboratory's operational and support staff have the day-to-day independent operational authority under the direction of the Laboratory Director and is supported by the NDSC-QA team. The laboratory management staff includes managers, supervisors, and group leaders. The organizational chart of the management staff is presented in Section 2.4. Individual departmental staff lists are maintained in the laboratory's internal intranet.

2.2) Roles and Responsibilities

In order for the QA Program to function properly, all members of the staff must clearly understand and meet their individual responsibilities as they relate to the quality program. The responsibility for quality resides with every employee of the laboratory. All employees have access to the QA Manual, are trained to this manual, and are responsible for upholding the standards therein. Each person carries out his/her daily tasks impartially and in a manner consistent with the goals and in accordance with the

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procedures in this manual and the laboratory's SOPs. The following descriptions briefly define each role in its relationship to the Quality Assurance Program.

2.2.1) Vice President of Quality and Environmental Health and Safety (VP-QA/EHS)

The Vice President (VP) of QA/EHS reports directly to Eurofins Environment Testing America Chief Operating Officer (COO). With the aid of the NDSC Quality Team Members, Business Unit Managers, and Laboratory Directors, the VP-QA/EHS has the responsibility for the establishment, general overview and maintenance of the Quality Assurance and EHS Programs within Eurofins Environment Testing America. Additional responsibilities include:

- Review of QA/QC and EHS aspects of NDSC Official Documents, national projects, and expansions or changes in services.
- Work with various organizations outside of the Company to further the development of quality standards and represent the Company at various trade meetings.
- Prepare monthly reports for QA and EHS metrics across the environmental testing laboratories and a summary of any QA- and EHS-related initiatives and issues.
- With the assistance of Executive Management and the EHS Managers, maintenance and implementation of Eurofins Environment Testing America's Environmental Health and Safety Program.

2.2.2) Quality Directors

There are four (4) Quality Directors within NDSC that report directly to the VP-QA/EHS. These Quality Directors have oversight of the general overview and maintenance of the QA Program within the Eurofins Environment Testing America laboratories. Supported tasks include:

- Monitor laboratory internal audit findings.
- Identify common laboratory weaknesses and monitor corrective action closures.
- Develop NDSC quality guidance documents and management tools for ensuring and improving compliance.
- Monitor and communicate regulatory and certification requirements.
- Training and OnBoarding
- Laboratory assessments, mentoring, and interventions.
- Track/drive root cause investigations and corrective action plans.
- Build knowledge base for preventive actions.

2.2.3) Quality Information Manager

The Quality Information Manager works directly with the NDSC Quality Directors and EHS Managers; and reports directly to the VP-QA/EHS. The Quality Information Manager is responsible for the management of:

- NDSC Official Documents.
- TALS/LIMS Certification Module Data.
- Company's Intranet Website.
- Company's Regulatory Limits Database.
- Subcontract laboratory and approved vendor information.
- Internal and External client support for various company groups (e.g., Client Services, EHS, Legal, IT, Sales) for both quality and operational functions.
- Communicate regulatory information and lists.

2.2.4) Environmental Health and Safety (EHS) Managers

There are three (3) EHS Managers within NDSC that report directly to the VP-QA/EHS. These EHS Managers have oversight of the general overview and maintenance of the EHS Program within the Eurofins Environment Testing America laboratories. Supported tasks include:

- Consolidation and tracking all safety and health-related information and reports for the company, and managing compliance activities for Eurofins Environment Testing America locations.

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- Coordination/preparation of the Environmental Health and Safety Manual Template that is used by each laboratory to prepare its own laboratory-specific Safety Manual/Chemical Hygiene Plan.
- Preparation of information and training materials for laboratory EHS Coordinators.
- Assistance in the coordination of employee exposure and medical monitoring programs to ensure compliance with applicable safety and health regulations.
- Serving as Department of Transportation (D.O.T.) focal point and providing technical assistance to location management.
- Serving as Hazardous Waste Management main contact and providing technical assistance to location management.

2.2.5) Ethics and Compliance Officer (ECO)

Both the NDSC VP-QA/EHS and Corporate Counsel are designated to fulfill the role of Ethics and Compliance Officer (ECO). Each ECO acts as a back-up to the other ECO and both are involved when data investigations occur. Each ECO has a direct line of communication to the entire executive management personnel and laboratory management staff.

The ECOs monitor and audit procedures to determine compliance with policies and to make recommendations for policy enhancements to the President, COO, Laboratory Director or other appropriate individuals within the Company. The ECOs will assist the laboratory QA Manager in the coordination of internal auditing of ethical policy related activities and processes within the laboratory, in conjunction with the laboratory's regular internal auditing function.

The ECOs will also participate in investigations of alleged violations of policies and work with the appropriate internal departments to investigate misconduct, remedy the situation, and prevent recurrence of any such activity.

2.2.6) Laboratory Director / Business Unit Manager

The Laboratory Director (also known as the Business Unit Manager) is responsible for the overall quality, safety, financial, technical, human resource and service performance of the whole laboratory and reports to his/her President. The Laboratory Director is also responsible for any service centers connected with the laboratory. The Laboratory Director provides the resources necessary to implement and maintain an effective and comprehensive Quality Assurance and Data Integrity Program. Specific responsibilities include, but are not limited to:

- Provide one or more technical managers for the appropriate fields of testing. If the Technical Manager is absent for a period of time exceeding 15 consecutive calendar days, the Laboratory Director must designate another full time staff member meeting the qualifications of the Technical Manager to temporarily perform this function. If the absence exceeds 35 consecutive calendar days, the primary accrediting authority must be notified in writing.
- Ensure that all analysts and supervisors have the appropriate education and training to properly carry out the duties assigned to them and ensure that this training has been documented. Work with Eurofins Environment Testing Human Resources for hiring of new personnel.
- Ensure that personnel are free from any commercial, financial and other undue pressures which might adversely affect the quality of their work.
- Ensure Company human resource policies are adhered to and maintained.
- Ensure that sufficient numbers of qualified personnel are employed to supervise and perform the work of the laboratory. Assess laboratory capacity and workload.
- Ensure that appropriate corrective actions are taken to address analyses identified as requiring such actions by internal and external performance or procedural audits. Procedures that do not meet the standards set forth in the QA Manual or laboratory SOPs may be temporarily suspended by the Laboratory Director.
- Review and approve all SOPs prior to their implementation and ensure all approved SOPs are implemented and adhered to.
- Pursue and maintain appropriate laboratory certification and contract approvals. Support ISO 17025 requirements.
- Ensure client specific reporting and quality control requirements are met.
- Contribute to the continuous improvement of the laboratory operations.
- Maintain an awareness of technical developments and regulatory requirements.

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- Captains the management team, consisting of the QA Manager, the Technical Manager(s), and the Client Service Manager as direct reports.

2.2.7) Quality Assurance Manager or Designee

The QA Manager has responsibility and authority to ensure the continuous implementation of the quality system at the laboratory where he/she works. The QA Manager is also responsible for any service centers connected with his/her laboratory that perform analytical tests, such as short holding time analyses for pH.

The QA Manager reports directly to the Laboratory Director and his/her NDSC Quality Director. This position is able to evaluate data objectively and perform assessments without outside (e.g., managerial) influence. The NDSC-QA Team may be used as a resource in dealing with regulatory requirements, certifications and other quality assurance related items. The QA Manager directs the activities of the QA staff to accomplish specific responsibilities which include, but are not limited to:

- Serve as the focal point for QA/QC in the laboratory.
- Have functions independent from laboratory operations for which he/she has quality assurance oversight.
- Have documented training and/or experience in QA/QC procedures and the laboratory's Quality System.
- Have a general knowledge of the analytical test methods for which data audit/review is performed (and/or having the means of getting this information when needed).
- Arrange for or conduct internal audits on quality systems and the technical operation.
- Notify laboratory management of deficiencies in the quality system and ensure corrective action is taken. Procedures that do not meet the standards set forth in the QA Manual or laboratory SOPs shall be investigated following procedures outlined in Section 12 and if deemed necessary may be temporarily suspended during the investigation.
- Maintain and update the QA Manual.
- Monitor and evaluate laboratory certifications; schedule proficiency testing samples.
- Monitor and communicate regulatory changes that may affect the laboratory to management.
- Training and advising the laboratory staff on quality assurance/quality control procedures that are pertinent to their daily activities.
- The laboratory QA Manager will maintain records of all ethics-related training, including the type and proof of attendance.
- Maintain, improve, and evaluate the corrective action database and the corrective and preventive action systems.
- Objectively monitor standards of performance in quality control and quality assurance without outside (e.g., managerial) influence.
- Coordinate document control of SOPs, MDLs, control limits, and miscellaneous forms and information.
- Perform technical data audits and method audits to ensure consistency and compliance with regulatory requirements.
- Review of external audit reports and data validation requests.
- Follow-up with audits to ensure client QAPP requirements are met.
- Establishment of reporting schedule and preparation of various quality reports for the Laboratory Director, clients, and/or the NDSC-QA Team.
- Development of suggestions and recommendations to improve quality systems.
- Research of current state and federal requirements and guidelines.
- Participate in the vendor and supplier approval process, including subcontractors.
- Captain the QA team to enable communication and to distribute duties and responsibilities.
- Communicate to the relevant regulatory authorities when there are management or facility changes that impact the laboratory.
- Ensure communication & monitoring standards of performance to ensure that systems are in place to produce the level of quality as defined in this document.
- Evaluate the thoroughness and effectiveness of training.
- Compliance with ISO 17025.

2.2.8) Technical Manager or Designee

The Technical Managers report directly to the Laboratory Director. They are accountable for all analyses

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and analysts under their experienced supervision and for compliance with the ISO 17025 Standard. The scope of responsibility ranges from the new-hire process and existing technology through the ongoing training and development programs for existing analysts and new instrumentation. Specific responsibilities include, but are not limited to:

- Exercise day-to-day supervision of laboratory operations for the appropriate field of accreditation and reporting of results. Coordinate, write, and review preparation of all test methods, i.e., SOPs, with regard to quality, integrity, regulatory and optimum and efficient production techniques, and subsequent analyst training and interpretation of the SOPs for implementation and unusual project samples. Ensure that the SOPs are properly managed and adhered to at the bench. Develop standard costing of SOPs to include supplies, labor, overhead, and capacity (design vs. demonstrated versus first-run yield) utilization.
- Review and approve, with input from the QA Manager, proposals from marketing, in accordance with an established procedure for the review of requests and contracts. This procedure addresses the adequate definition of methods to be used for analysis and any limitations, the laboratory's capability and resources, the client's expectations. Differences are resolved before the contract is signed and work begins. A system documenting any significant changes is maintained, as well as pertinent discussions with the client regarding their requirements or the results of the analyses during the performance of the contract. All work subcontracted by the laboratory must be approved by the client. Any deviations from the contract must be disclosed to the client. Once the work has begun, any amendments to the contract must be discussed with the client and so documented.
- Monitor the validity of the analyses performed and data generated in the laboratory. This activity begins with reviewing and supporting all new business contracts, ensuring data quality, analyzing internal and external non-conformances to identify root cause issues and implementing the resulting corrective and preventive actions, facilitating the data review process (training, development, and accountability at the bench), and providing technical and troubleshooting expertise on routine and unusual or complex problems.
- Provide training and development programs to applicable laboratory staff as new hires and, subsequently, on a scheduled basis. Training includes instruction on calculations, instrumentation management to include troubleshooting and preventive maintenance.
- Enhance efficiency and improve quality through technical advances and improved LIMS utilization. Capital forecasting and instrument life cycle planning for second generation methods and instruments as well as asset inventory management.
- Coordinate sample management from "cradle to grave," ensuring that no time is lost in locating samples.
- Schedule all QA/QC-related requirements for compliance, e.g., MDLs, etc.
- Captain department personnel to communicate quality, technical, personnel, and instrumental issues for a consistent team approach.
- Coordinate audit responses with the QA Manager.
- Compliance with ISO 17025.

2.2.9) Client Service Manager

The Client Service Manager reports to the Laboratory Director and serves as the interface between the laboratory's technical departments and the laboratory's clients. The staff consists of the Client Services/Project Management Group. With the overall goal of total client satisfaction, the functions of this position are outlined below:

- Technical training and growth of the Project Management team.
- Technical liaison for the Project Management team.
- Human resource management of the Project Management team.
- Has signature authority for laboratory reports.
- Assesses and assures customer satisfaction.
- Provides feedback to management on changing customer needs.
- Works with the Department Managers and/or Analysts/Technicians to ensure the requirements of projects are met in a timely manner.
- Organizes bid activities for prospective new projects and clients.

2.2.10) Project Manager (PM) / Project Management Assistant (PMA)

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Members of the laboratory Client Services/Project Management Group are responsible for organizing and managing client projects. Clients are assigned a project manager who serves as their primary contact at the laboratory. It is the PM's responsibility to act as the client advocate by communicating client requirements to laboratory personnel and ensuring that clients provide complete information needed by the laboratory to meet those requirements – including all verbal communications. There is an entire staff of Project Managers and Project Management Assistants that make up the Client Services/Project Management Group.

- Scheduling sample submissions, sample container orders and sample pick-up via the laboratory courier service.
- Confirming certification status
- Coordinating and communicating turnaround time (TAT) requirements for high priority samples/projects.
- Answering common technical questions, facilitating problem resolution and coordinating technical details with the laboratory staff.
- Ensuring that client specifications, when known, are met by communicating project and quality assurance requirements to the laboratory.
- Notifying the supervisors of incoming projects and sample delivery schedules.
- Accountable to clients for communicating sample status reports or results prior to receipt of the final report.
- Monitor the status of all data package projects in-house to ensure timely and accurate delivery of reports.
- Inform clients of data package-related problems and resolve service issues.
- Has signature authority for laboratory reports.

2.2.11) Department Supervisors / Managers

Department Supervisors and Managers report to the Technical Manager. Each one is responsible to:

- Ensure that analysts in their department adhere to applicable SOPs and the QA Manual. They perform frequent SOP and QA Manual review to determine if analysts are in compliance and if new, modified, and optimized measures are feasible and should be added to these documents.
- With regard to analysts, participates in the selection, training (as documented in Section 3.3), development of performance objectives and standards of performance, appraisal (measurement of objectives), scheduling, counseling, discipline, and motivation of analysts and documents these activities in accordance with systems developed by the QA and Personnel Departments. They evaluate staffing sufficiency and overtime needs. Training consists of familiarization with SOP, QC, Safety, and computer systems.
- Encourage the development of analysts to become cross-trained in various methods and/or operate multiple instruments efficiently while performing maintenance and documentation, self-supervise, and function as a department team.
- Provide guidance to analysts in resolving problems encountered daily during sample prep/analysis in conjunction with the Technical Manager and/or QA Manager. Each is responsible for 100% of the data review and documentation, non-conformance and corrective action issues, the timely and accurate completion of performance evaluation samples and MDLs, for his/her department.
- Ensure all logbooks are maintained, current, and properly labeled or archived.
- Report all non-conformance conditions to the QA Manager, Technical Manager, and/or Laboratory Director.
- Ensure that preventive maintenance is performed on instrumentation as detailed in the QA Manual or SOPs. He/she is responsible for developing and implementing a system for preventive maintenance, troubleshooting, and repairing or arranging for repair of instruments.
- Maintain adequate and valid inventory of reagents, standards, spare parts, and other relevant resources required to perform daily analysis.
- Achieve optimum turnaround time on analyses and compliance with holding times.
- Conduct efficiency and cost control evaluations on an ongoing basis to determine optimization of labor, supplies, overtime, first-run yield, capacity (designed vs. demonstrated), second- and third-generation production techniques/instruments, and long-term needs for budgetary planning.
- Develop, implement, and enhance calibration programs.
- Provide written responses to external and internal audit issues.

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2.2.12) Safety Officer

The Safety Officer—also known as the Environmental Health and Safety Coordinator (EHSC)—reports to the Laboratory Director and his/her EHS Manager and ensures that systems are maintained for the safe operation of the laboratory. The duties of the EHSC may be combined with another position in the laboratory. The EHSC is responsible for:

- Conduct ongoing, necessary safety training and conduct new employee safety orientation.
- Assist in developing and maintaining the Chemical Hygiene Plan/Safety Manual.
- Administer dispersal of all material Safety Data Sheet (SDS) information.
- Perform regular chemical hygiene and housekeeping instruction.
- Give instruction on proper labeling and practice.
- Serve as chairperson of the laboratory safety committee.
- Provide and train personnel on protective equipment.
- Oversee the inspection and maintenance of general safety equipment – fire extinguishers, safety showers, eyewash fountains, etc. and ensure prompt repairs as needed.
- Supervise and schedule fire drills and emergency evacuation drills.
- Measure and record ventilation hood velocities according to the laboratory's schedule and procedures. Follow-up and/or schedule repair if ventilation hoods do not meet laboratory criteria.
- Determine what initial and subsequent exposure monitoring, if necessary to determine potential employee exposure to chemicals used in the laboratory.
- When determined necessary, conduct exposure monitoring assessments.
- Determine when a complaint of possible over-exposure is "reasonable" and should be referred for medical consultation.
- Assist in the internal and external coordination of the medical consultation/monitoring program conducted by Eurofins medical consultants.

2.2.13) Hazardous Waste Coordinator

The Hazardous Waste Coordinator ensures that waste disposal systems and processes are maintained to ensure compliance with all local, state, and federal hazardous waste regulations. The duties of the Hazardous Waste Coordinator may be combined with another position in the laboratory. Specific responsibilities include, but are not limited to:

- Stay current in knowledge of hazardous waste regulations.
- Maintain continued training on hazardous waste issues.
- Review and update annually the Hazardous Waste Contingency Plan in the Environmental Health and Safety Manual (EHSM).
- Audit staff with regard to compliance with the Hazardous Waste Contingency Plan.
- Contact hazardous waste subcontractors for review of procedures and opportunities for minimization of waste.
- Manage waste generated by the facility and organize waste streams for pickup by a licensed hazardous waste management contractor.

2.2.14) Laboratory Analysts

Laboratory analysts are responsible for conducting analysis and performing all tasks assigned to them by the Operations Manager, group leader or supervisor. The responsibilities of the analysts are listed below:

- Perform analyses by adhering to analytical and quality control protocols prescribed by current SOPs, this QA Manual, and project-specific plans honestly, accurately, timely, safely, and in the most cost-effective manner.
- Document standard and sample preparation, instrument calibration and maintenance, data calculations, sample matrix effects, and any observed non-conformance on worklists, benchsheets, laboratory notebooks and/or the Non-Conformance Database.
- Report all non-conformance situations, instrument problems, matrix problems and QC failures, which might affect the reliability of the data, to their supervisor, the Technical Manager, and/or the QA Manager or member of QA staff.
- Perform 100% review of the data generated prior to entering and submitting for secondary level review.

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- Suggest method improvements to their supervisor, the Technical Manager, and the QA Manager. These improvements, if approved, will be incorporated. Ideas for the optimum performance of their assigned area, for example, through the proper cleaning and maintenance of the assigned instruments and equipment, are encouraged.
- Work cohesively as a team in their department to achieve the goals of accurate results, optimum turnaround time, cost effectiveness, cleanliness, complete documentation, and personal knowledge of environmental analysis.

2.2.15) Sample Receiving Staff

Sample Receiving staff report to the Sample Receiving Supervisor; the Sample Receiving Supervisor reports to the Metals Supervisor. The responsibilities are outlined below:

- Ensure implementation of proper sample receipt procedures, including maintenance of chain-of-custody.
- Report non-conformances associated with condition-upon-receipt of samples.
- Log incoming samples into the LIMS.
- Ensure that all samples are stored in the proper environment.
- Ensure the verification of data entry from login.
- Responsible for meeting quality requirements including documenting preservation.
- Responsible for ensuring the timely and correct shipment of sample containers, including proper preservatives and instructions, to clients.

2.3) Business Continuity and Contingency Plans

Various policies and practices are in place to address continuity of business and contingency plans to ensure continued operations or minimal disruption in operations should unplanned events (natural disasters, unexpected management changes, etc.) occur. Deputies are identified for all key management personnel. Deputies would temporarily fill a role if the primary is absent for more than 15 consecutive calendar days. The deputies must meet the same qualifications as the primary person should they be required to take on the responsibilities. The Laboratory Director and/or QA Manager communicates to the relevant regulatory authorities when there are management or facility changes that impact the laboratory. Changes in the technical director must be communicated within a period of time and in the manner dictated by each regulatory authority.

The following table defines who assumes the responsibilities of key personnel in their absence:

Key Personnel	Deputy
Laboratory Director	Business Controller
QA Manager	Laboratory Director
Technical Manager (Operations Manager)	Laboratory Director
Department Supervisor/Manager	Technical Manager (Operations Manager)
EHS Coordinator	Laboratory Director
Hazardous Waste Coordinator	Laboratory Director
Client Service Manager	Designated Project Manager

2.4) Organizational Charts

Organizational charts of the NDSC functional groups are maintained on the Company's Intranet Website.

The organizational chart of Eurofins Cedar Falls' laboratory management staff is presented below.

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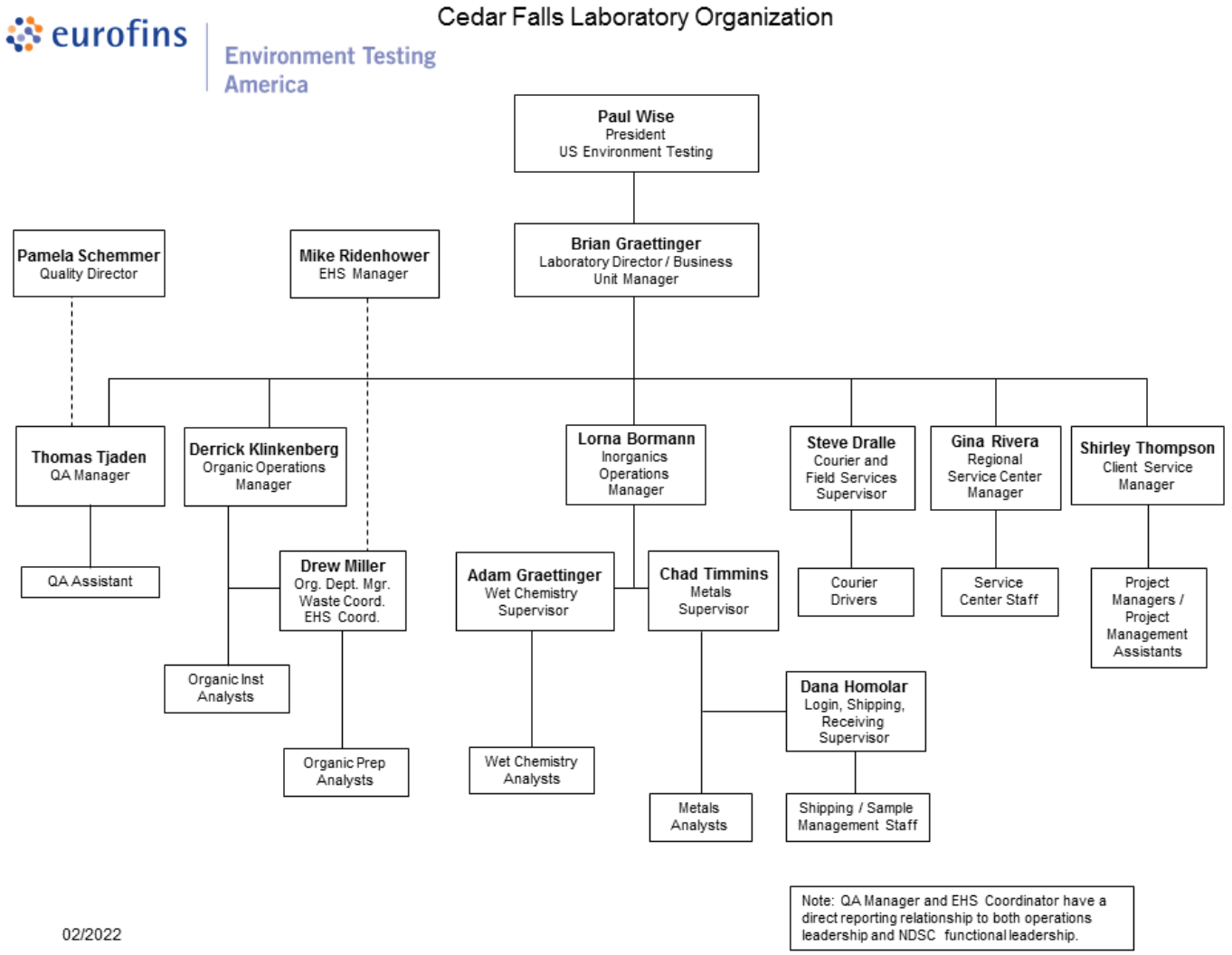

3) PERSONNEL

3.1) Overview

The laboratory's management believes that its highly qualified and professional staff is the single most important aspect in assuring a high level of data quality and service. The staff consists of professionals and support personnel.

All personnel must demonstrate competence in the areas where they have responsibility. Any staff that is undergoing training shall have appropriate supervision until they have demonstrated their ability to perform their job function on their own. Staff shall be qualified for their tasks based on appropriate education, training, experience and/or demonstrated skills as required.

The laboratory employs sufficient personnel with the necessary education, training, technical knowledge and experience for their assigned responsibilities.

All personnel are responsible for complying with all QA/QC requirements that pertain to the laboratory and their area of responsibility. Each staff member must have a combination of experience and education to adequately demonstrate a specific knowledge of their particular area of responsibility. Technical staff must also have a general knowledge of lab operations, test methods, QA/QC procedures and records management.

Laboratory management is responsible for formulating goals for lab staff with respect to education, training and skills and ensuring that the laboratory has a policy and procedures for identifying training

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needs and providing training of personnel. The training shall be relevant to the present and anticipated responsibilities of the lab staff.

The laboratory only uses personnel that are employed by or under contract to, the laboratory. Contracted personnel, when used, must meet competency standards of the laboratory and work in accordance to the laboratory's quality system.

3.2) Education and Experience Requirements for Technical Personnel

The laboratory makes every effort to hire analytical staff members that possess a college degree (AA, BA, BS) in an applied science with some chemistry in the curriculum. Exceptions can be made based upon the individual's experience and ability to learn. Selection of qualified candidates for laboratory employment begins with documentation of minimum education, training, and experience prerequisites needed to perform the prescribed task. Minimum education and training requirements for laboratory employees are outlined in job descriptions maintained by Eurofins Environment Testing America Human Resources.

Experience and specialized training are occasionally accepted in lieu of a college degree (basic lab skills such as using a balance, colony counting, aseptic or quantitation techniques, etc., are also considered).

As a general rule for analytical staff:

Specialty	Education	Experience
Extractions, Digestions, some electrode methods (pH, DO, Redox, etc.), or Titrimetric and Gravimetric Analyses	H.S. Diploma	On the job training (OJT)
CVAA, Single component or short list Chromatography (e.g., Fuels, GC-BTEX, IC)	A college degree in an applied science or 2 years of college and at least 1 year of college chemistry	Or 2 years prior analytical experience is required
ICP, ICPMS, Long List or complex chromatography (e.g., Pesticides, PCBs, etc.), GCMS	A college degree in an applied science or 2 years of college chemistry	Or 5 years of prior analytical experience
Spectra Interpretation	A college degree is an applied science or 2 years of college chemistry	And 2 years relevant experience, Or 5 years of prior analytical experience
Technical Managers – General	Bachelor's degree in an applied science or engineering with 24 semester hours in chemistry An advanced (MS, PhD.) degree may substitute for one year of experience	And 2 years experience in environmental analysis of representative analytes for which they will oversee
Technical Managers – Wet Chemistry only (no advanced instrumentation)	Associates degree in an applied science or engineering or 2 years of college with 16 semester hours in chemistry	And 2 years relevant experience
Technical Managers - Microbiology	Bachelor's degree in an applied science with 16 semester hours in general microbiology and biology An advanced (MS, PhD.) degree may substitute for one year of experience	And 2 years relevant experience

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When an analyst does not meet these requirements, they can perform a task under the direct supervision of a qualified analyst, peer reviewer or Technical Manager, and are considered an analyst-in-training. The person supervising an analyst-in-training is accountable for the quality of the analytical data and must review and approve data and associated corrective actions.

3.3) Training

The laboratory is committed to furthering the professional and technical development of employees at all levels.

Orientation to the laboratory's policies and procedures, in-house method training, and employee attendance at outside training courses and conferences all contribute toward employee proficiency. Below are examples of various areas of required employee training:

Required Training	Time Frame	Responsible Party	Employee Type
Environmental Health and Safety	Prior to lab work	Local EHSC	All
Ethics Statement	Upon hiring	Eurofins HR	All
	Annually	Local QA	All
Ethics Training	Upon hiring	Eurofins Global	All
	Annually	Eurofins Global	All
Data Integrity Training	60 days of hire	Local QA	Technical and PMs
	Annually	NDSC QA	Technical and PMs
Initial Demonstration of Capability (IDOC)	Prior to unsupervised method performance	Local QA and Ops	Technical
Continuing Demonstration of Capability (CDOC)	Annually	Local QA and Ops	Technical

The laboratory maintains records of relevant authorization/competence, education, professional qualifications, training, skills and experience of technical personnel (including contracted personnel) as well as the date that approval/authorization was given. These records are kept on file at the laboratory. Also refer to "Demonstration of Capability" in Section 17.

The training of technical staff is kept up to date by:

- Each employee must have documentation in their training file that they have read, understood and agreed to follow the most recent version of the laboratory QA Manual and SOPs in their area of responsibility. This documentation is updated as SOPs are updated.
- Documentation from any training courses or workshops on specific equipment, analytical techniques or other relevant topics.
- Documentation of proficiency (refer to Section 17).
- An Ethics Agreement signed by each staff member (renewed each year) and evidence of annual ethics training.
- A Confidentiality Agreement signed by each staff member signed at the time of employment.
- Human Resources maintains documentation and attestation forms on employment status and records; benefit programs; timekeeping/payroll; and employee conduct (e.g., ethics violations). This information is maintained in the employee's secured personnel file.

Evidence of successful training could include such items as:

- Adequate documentation of training within operational areas, including one-on-one technical training for individual technologies, and particularly for people cross-trained.
- Analysts knowledge to refer to QA Manual for quality issues.
- Analysts following SOPs, i.e., practice matches SOPs.

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- Analysts regularly communicate to supervisors and QA if SOPs need revision, rather than waiting for auditors to find problems.

Further details of the laboratory's training program are described in the Laboratory Training SOP (Doc. No. *CED-R-PE-SOP42903*).

3.4) Data Integrity and Ethics Training Program

The laboratory's Ethics and Data Integrity Program is discussed in Section 5.2. Employees are trained as to the legal and environmental repercussions that result from data misrepresentation. Key topics covered in the presentation include:

- Organizational mission and its relationship to the critical need for honesty and full disclosure in all analytical reporting.
- Ethics Policy
- How and when to report ethical/data integrity issues. Confidential reporting.
- Record keeping.
- Discussion regarding data integrity procedures.
- Specific examples of breaches of ethical behavior (e.g. peak shaving, altering data or computer clocks, improper macros, etc., accepting/offering kickbacks, illegal accounting practices, unfair competition/collusion)
- Internal monitoring. Investigations and data recalls.
- Consequences for infractions including potential for immediate termination, debarment, or criminal prosecution.
- Importance of proper written narration / data qualification by the analyst and project manager with respect to those cases where the data may still be usable but are in one sense or another partially deficient.

Additionally, a data integrity hotline (1-800-736-9407) is maintained by the NDSC.

4) ACCOMMODATIONS AND ENVIRONMENTAL CONDITIONS

4.1) Overview

The laboratory is a 20,600 ft² secure laboratory facility with controlled access and designed to accommodate an efficient workflow and to provide a safe and comfortable work environment for employees. All visitors sign in and are escorted by laboratory personnel. Access is controlled by various measures.

The laboratory is equipped with structural safety features. Each employee is familiar with the location, use, and capabilities of general and specialized safety features associated with their workplace. The laboratory provides and requires the use of protective equipment including safety glasses, protective clothing, gloves, etc. OSHA and other regulatory agency guidelines regarding required amounts of bench and fume hood space, lighting, ventilation (temperature and humidity controlled), access, and safety equipment are met or exceeded.

Traffic flow through sample preparation and analysis areas is minimized to reduce the likelihood of contamination. Adequate floor space and bench top area is provided to allow unencumbered sample preparation and analysis space. Sufficient space is also provided for storage of reagents and media, glassware, and portable equipment. Ample space is also provided for refrigerated sample storage before analysis and archival storage of samples after analysis. Laboratory HVAC and deionized water systems are designed to minimize potential trace contaminants.

The laboratory is separated into specific areas for sample receiving, sample preparation, volatile organic sample analysis, non-volatile organic sample analysis, inorganic sample analysis, metals sample analysis, microbiological sample analysis, and administrative functions.

4.2) Environment

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Laboratory accommodation, test areas, energy sources, and lighting are adequate to facilitate proper performance of tests. The facility is equipped with heating, ventilation, and air conditioning (HVAC) systems appropriate to the needs of environmental testing performed at this laboratory.

The environment in which these activities are undertaken does not invalidate the results or adversely affect the required accuracy of any measurements.

The laboratory provides for the effective monitoring, control and recording of environmental conditions that may affect the results of environmental tests as required by the relevant specifications, methods, and procedures. Such environmental conditions include humidity, voltage, temperature, and vibration levels in the laboratory.

When any of the method or regulatory required environmental conditions change to a point where they may adversely affect test results, analytical testing will be discontinued until the environmental conditions are returned to the required levels.

Environmental conditions of the facility housing the computer network and LIMS are regulated to protect against raw data loss.

When the laboratory performs laboratory activities at sites or facilities outside its permanent control, it shall ensure that the requirements related to facilities and environmental conditions of this document are met.

Specific requirements for facility and environmental conditions, as well as periodic monitoring of conditions, are given in the Environmental Health & Safety Manual plus each laboratory's Facility Addendum.

4.3) Work Areas

There is effective separation between neighboring areas when the activities therein are incompatible with each other. Examples include:

- Microbiological culture handling and sample incubation areas.
- Volatile organic chemical handling areas, including sample preparation and waste disposal, and volatile organic chemical analysis areas.
- Closed areas for GC/MS analytical work.
- Designated areas for waste disposal and chemical storage.

Access to and use of all areas affecting the quality of analytical testing is defined and controlled by secure access to the laboratory building as described below in the Building Security section.

Adequate measures are taken to ensure good housekeeping in the laboratory and to ensure that any contamination does not adversely affect data quality. These measures include regular cleaning to control dirt and dust within the laboratory. Work areas are available to ensure an unencumbered work area. Work areas include:

- Access and entryways to the laboratory.
- Sample receipt areas.
- Sample storage areas.
- Chemical and waste storage areas.
- Data handling and storage areas.
- Sample processing areas.
- Sample analysis areas.

Refer to the following documents and procedures for specific requirements for microbiological laboratory facility requirements:

- Standard Methods, 23rd Ed., 9020B, Sec. 2.

4.4) Responding to Emergencies

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Employees must be aware of procedures to respond to all emergencies that might occur in the workplace. Employees must be familiar with the location and proper operation of all emergency equipment, evacuation routes and designated assembly areas for all areas where they work. Refer to the NDSC EHS Manual (Doc. No. *CED-S-EHS-QP43267*, Section 7) and the laboratory's local addendum for complete details. These documents provide direction for situations where normal operations of the laboratory are not possible (e.g., electrical failures, heating/air conditioning failures, fire/building evacuation, computer failures, hazardous material spills, injury to employees, pandemic flu, disruption of phone service, etc.).

In the event that the building or information technology (IT) systems would be severely challenged, a designated disaster recovery team, which includes Facility Management, Maintenance, Safety, Laboratory/Executive Management, Public Relations, IT, QA and other applicable personnel depending on the scope of the disaster, would assemble at a designated area to assess the situation and formulate a plan.

4.5) Building Security

The laboratory is considered a secure facility. All employees are issued a key fob that allows access to the facility's secure employee entrance. All outside doors (except the main lobby entrance) are locked during normal business hours to prevent unauthorized entry (an attendant monitors this entrance at all times). Building keys and alarm codes are distributed to employees as necessary.

All visitors to the laboratory must sign in and out in a visitor's logbook that is located in the lobby. A visitor is defined as any person who visits the laboratory who is not an employee of the laboratory. Both visitors and vendors must review and sign specific EHS forms; and are escorted by laboratory personnel at all times, or the location of the visitor is noted in the visitor's logbook.

Signs are posted in the laboratory designating employee-only areas: "Notice - Authorized Personnel Only".

5) QUALITY SYSTEM

5.1) Quality Policy Statement

The Quality Policy Statement gives employees clear requirements for the production of analytical data. As an organization, all personnel are committed to high quality professional practice, testing and data, and service to our clients.

We strive to provide the highest quality data achievable by:

- Reading and understanding all of the quality documents applicable to each position and implementing the process in our work.
- Following all recordkeeping requirements; describing clearly and accurately all activities performed; recording "real time" as the task is carried out; understanding that it is never acceptable to "back date" entries and should additional information be required at a later date, the actual date and by whom the notation is made must be documented.
- Ensuring data integrity through the completeness, consistency, impartiality and accuracy of the data generated. Data is attributable, legible, contemporaneously recorded, original or a true copy, and accurate (ALCOA). This applies to manual paper documentation and electronic records.
- Providing accountability and traceability for each sample analyzed through proper sample handling, labeling, preparation, instrument calibration/qualification/validation, analysis, and reporting; establishing an audit trail (the who, what, when, and why) that identifies date, time, analyst, instrument used, instrument conditions, quality control samples (where appropriate and/or required by the method), and associated standard material.
- Emphasizing a total quality management process which provides impartiality, accuracy, and strict compliance with agency regulations and client requirements, giving the highest degree of confidence; understanding that meeting the requirements of the next employee in the work flow process is just as important as meeting the needs of the external client.
- Providing thorough documentation and explanation to qualify reported data that may not meet all requirements and specifications, but is still of use to the client; understanding this occurs only

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after discussion with the client on the data limitations and acceptability of this approach.
- Responding immediately to indications of questionable data, out-of-specification occurrences, equipment malfunctions, and other types of laboratory problems, with investigation and applicable corrective action; documenting these activities completely, including the reasons for the decisions made.
- Providing a work environment that ensures accessibility to all levels of management and encourages questions and expression of concerns on quality issues to management. Eurofins recognizes that the implementation of a quality assurance program requires management's commitment and support as well as the involvement of the entire staff.
- Continually improve systems and manage risk to support quality improvement efforts in laboratory, administrative and managerial activities.
- Complying with the ISO/IEC 17025:2005 and 2017 International Standard, the 2009 and 2016 TNI Standard, and to continually improve the effectiveness of the management system.

5.2) Ethics and Data Integrity

Eurofins Environment Testing America is committed to ensuring the integrity of its data and meeting the quality needs of its clients. The laboratory operates our Ethics and Data Integrity program under the guidance of Eurofins Key Guidance Document (KGD). The elements of the our program include:

- An Ethics Policy (NDSC Document No. CW-L-P-004) and Employee Ethics Statements.
- Ethics and Compliance Officer/s (ECOs).
- A Training Program.
- Self-governance through disciplinary action for violations.
- A confidential mechanism for anonymously reporting alleged misconduct and a means for conducting internal investigations of all alleged misconduct (NDSC Document No. CW-L-S-002).
- Procedures and guidance for recalling data if necessary (NDSC Document No. CW-Q-S-005).
- Effective external and internal monitoring system that includes procedures for internal audits (Section 15).
- Produce results, which are accurate and include QA/QC information that meets client pre-defined Data Quality Objectives (DQOs).
- Present services in a confidential, honest and forthright manner.
- Provide employees with guidelines and an understanding of the Ethical and Quality Standards of our industry.
- Provide procedures and guidance to ensure the impartiality and confidentiality of all data and customer information.
- Operate our facilities in a manner that protects the environment and the health and safety of employees and the public.
- Obey all pertinent federal, state and local laws and regulations and encourage other members of our industry to do the same.
- Educate clients as to the extent and kinds of services available.
- Assert competency only for work for which adequate personnel and equipment are available and for which adequate preparation has been made.
- Promote the status of environmental laboratories, their employees, and the value of services rendered by them.

5.3) Quality System Documentation

The laboratory's Quality System is communicated through a variety of documents.

- Quality Assurance (QA) Manual – Each laboratory has a lab-specific QA manual.
- NDSC Official Documents – Each laboratory may use the Guidance (instructional use) documents at their discretion. Template documents are process documents that the laboratory needs to implement locally by using the document as is or as an outline to define their internal practices that meet the minimum requirements of the template. Required documents need to be implemented as is and listed in the laboratory's document control list.
- Key Guidance Documents (KGDs) - Documents compiled at the Group Service Centre (GSC) level by Functional Leaders (document owners) aimed at providing specific Eurofins groups of employees with guidelines necessary for the good conduct of their respective work.
- Laboratory SOPs and Policies – General and Technical

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- Work Instructions – A subset of procedural steps, tasks or forms associated with an operation of a management system (e.g., checklists, preformatted bench sheets, forms).

5.3.1) Order of Precedence

In the event of a conflict of discrepancy between polices, the order of precedence is as follows:

1. Quality Management Plan (QMP)
2. NDSC Guidance Documents
3. KGDs
4. Laboratory Quality Assurance Manual
5. Laboratory SOPs and Policies
6. Other (Work Instructions, Memos, Flow Charts, etc.)

Note: The laboratory has the responsibility and authority to operate in compliance with regulatory requirements of the jurisdiction in which the work is performed. Where the QMP conflicts with those regulatory requirements, the regulatory requirements of the jurisdiction shall hold primacy. The laboratory's QA Manual shall take precedence over the QMP in those cases.

5.4) QA/QC Objectives for the Measurement of Data

Quality Assurance (QA) is responsible for developing planned activities whose purpose is to provide assurance to all levels of management that a quality program is in place within the laboratory, and that it is functioning in an effective manner that is consistent with the requirements of TNI/NELAP, ISO 17025, and any other regulatory agencies (i.e., states) in which the laboratory maintains accreditation.

Quality Control (QC) is generally understood to be limited to the analyses of samples and to be synonymous with the term *"analytical quality control"*. QC refers to the routine application of statistically based procedures to evaluate and control the accuracy of results from analytical measurements. The QC program includes procedures for estimating and controlling precision and bias and for determining reporting limits.

Request for Proposals (RFPs) and Quality Assurance Project Plans (QAPPs) provide a mechanism for the client and the laboratory to discuss the data quality objectives in order to ensure that analytical services closely correspond to client needs. In order to ensure the ability of the laboratory to meet the Data Quality Objectives (DQOs) specified in the QAPP, clients are advised to allow time for the laboratory to review the QAPP before being finalized. The client is responsible for developing the QAPP; however, the laboratory will provide support to the client for developing the sections of the QAPP that concern laboratory activities.

Historically, laboratories have described their QC objectives in terms of precision, accuracy, representativeness, comparability, completeness, selectivity and sensitivity (PARCCSS). Each laboratory SOP defines the required QC indicators.

5.4.1) Precision

The objective is to meet the performance for precision demonstrated for the methods on similar samples and to meet DQOs of the EPA and/or other regulatory programs. Precision is defined as the degree of reproducibility of measurements under a given set of analytical conditions (exclusive of field sampling variability). Precision is documented on the basis of replicate analysis, usually sample duplicate (DU) or matrix spike duplicate (MSD) samples.

5.4.2) Accuracy

The objective is to meet the performance for accuracy demonstrated for the methods on similar samples and to meet DQOs of the EPA and/or other regulatory programs. Accuracy is defined as the degree of bias in a measurement system. Accuracy may be documented through the use of the laboratory control sample (LCS) and/or matrix spike (MS). A statement of accuracy is expressed as an interval of acceptance recovery about the mean recovery.

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5.4.3) Representativeness

The objective is to provide data which is representative of the sampled medium. Representativeness is defined as the degree to which data represent a characteristic of a population or set of samples and is a measurement of both analytical and field sampling precision. The representativeness of the analytical data is a function of the procedures used in procuring and processing the samples. The representativeness can be documented by the relative percent difference between separately procured, but otherwise identical samples or sample aliquots.

The representativeness of the data from the sampling site depends on both the sampling procedures and the analytical procedures. Refer to laboratory SOPs for subsampling and homogenization techniques appropriate to the analytical method.

5.4.4) Comparability

The objective is to provide analytical data for which the accuracy, precision, representativeness, and reporting limit statistics are similar to these quality indicators generated by other laboratories for similar samples, and data generated by the laboratory over time.

Comparability is documented by inter-laboratory studies carried out by regulatory agencies or carried out for specific projects or contracts, by comparison of periodically generated statements of accuracy, precision, and reporting limits with those of other laboratories.

5.4.5) Completeness

The completeness objective for data is 90% (or as specified by a particular project), expressed as the ratio of the valid data to the total data over the course of the project. Data will be considered valid if they are adequate for their intended use. Data usability will be defined in a QAPP, project scope, or regulatory requirement. Data validation is the process for reviewing data to determine its usability and completeness. If the completeness objective is not met, actions will be taken internally and with the data user to improve performance. This may take the form of an audit to evaluate the methodology and procedures as possible sources for the difficulty or may result in a recommendation to use a different method.

5.4.6) Selectivity

Selectivity is defined as the capability of a test method or instrument to respond to a target substance or constituent in the presence of non-target substances. Target analytes are separated from non-target constituents and subsequently identified/detected through one or more of the following, depending on the analytical method: extractions (separation), extract clean-ups (separation), digestions (separation), interelement corrections (separation), specific retention times (separation and identification), confirmations with different columns or detectors (separation and identification), specific wavelengths (identification), specific mass spectra (identification), and specific electrodes (separation and identification).

5.4.7) Sensitivity

Sensitivity refers to the amount of analyte necessary to produce an instrument response that can be reliably detected (above the Method Detection Limit) or quantified (above the Method Reporting Limit).

5.5) Criteria for Quality Indicators

The laboratory maintains tables, housed in LIMS, that summarize the precision and accuracy acceptability limits for performed analyses. This summary includes an effective date, is updated each time new limits are generated, and are managed by the laboratory's QA department. Unless otherwise noted, limits within these tables are laboratory generated. Some acceptability limits are derived from US EPA methods when they are required. Where US EPA method limits are not required, the laboratory has developed limits from evaluation of data from similar matrices. Criteria for development of control limits is contained in the laboratory's Control Limits SOP (Doc. No. *CED-Q-QC-SOP42899*).

5.6) Statistical Quality Control

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Statistically-derived precision and accuracy limits are required by selected methods (such as SW-846) and programs. The laboratory routinely utilizes statistically-derived limits to evaluate method performance and determine when corrective action is appropriate. The analysts use the current limits entered into LIMS. The QA department maintains an archive of all limits used within the laboratory. If a method defines the QC limits, the method limits are used.

If a method requires the generation of historical limits, the lab develops such limits from recent data in the QC database of the LIMS following the guidelines described in Section 22. All calculations and limits are documented and dated when approved and effective. On occasion, a client requests contract-specified limits for a specific project.

Current QC limits are entered and maintained in the LIMS analyte database. As sample results and the related QC are entered into LIMS, the sample QC values are compared with the limits in LIMS to determine if they are within the acceptable range. The analyst then evaluates if the sample needs to be rerun or re-extracted/rerun or if a comment should be added to the report explaining the reason for the QC outlier.

5.6.1) QC Charts

The QA Manager evaluates these to determine if adjustments need to be made or for corrective actions to methods. All findings are documented and kept on file. Further details of the laboratory's control charting program are described in the laboratory's Control Limits SOP (Doc. No. *CED-Q-QC-SOP42899*).

5.7) Quality System Metrics

In addition to the QC parameters discussed above, the entire Quality System is evaluated on a monthly basis through the use of specific metrics (refer to Section 16). These metrics are used to evaluate and manage risk, and to drive continuous improvement in the laboratory's Quality System.

6) DOCUMENT CONTROL

6.1) Overview

The QA Department is responsible for the control of documents used in the laboratory to ensure that approved, up-to-date documents are in circulation and out-of-date (obsolete) documents are archived or destroyed. The following documents, at a minimum, must be controlled:

- Laboratory Quality Assurance (QA) Manual
- Laboratory Standard Operating Procedures (SOPs)
- Laboratory Policies
- Work Instructions and Forms
- NDSC Documents[1]
- KGDs[1]

[1]Includes locally implemented documents that are document controlled within the laboratory's document control system. The NDSC documents are only considered controlled when they are read on the intranet site. Printed copies are considered uncontrolled unless the laboratory physically distributes them as controlled documents. A detailed description of the procedure for issuing, authorizing, controlling, distributing, and archiving NDSC Official Documents is found in Document No. CW-Q-S-001, *NDSC Document Control and Archiving*. The laboratory's internal document control procedure is defined in laboratory SOP No. *CED-Q-DC-SOP42896*.

The laboratory QA Department also maintains access to various references and document sources integral to the operation of the laboratory. This includes reference methods and regulations. Instrument manuals (hard or electronic copies) are also maintained by the laboratory.

The laboratory maintains control of records for raw analytical data and supporting records such as audit reports and responses, logbooks, standard logs, training files, MDL studies, Proficiency Testing (PT) studies, certifications and related correspondence, and corrective action reports. Raw analytical data consists of bound logbooks, instrument printouts, any other notes, magnetic media, electronic data, and final reports.

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6.2) Document Approval and Issue

The pertinent elements of the document control system includes a unique document title and number, pagination, the total number of pages of the item or an "end of document" page, the effective date, revision number, and the laboratory's name. The QA personnel are responsible for the maintenance of this system.

Controlled documents are authorized by the QA Department. In order to develop a new document, a responsible manager submits an electronic draft to the QA Department for suggestions and approval before use. Upon approval, QA personnel add the identifying version information to the document and retains that document as the official document on file. That document is then provided to all applicable operational units. Controlled documents are identified as such and records of their distribution are kept by the QA Department. Document control may be achieved by either electronic or hardcopy distribution.

The QA Department maintains a list of the official versions of controlled documents.

Quality System Policies and Procedures will be reviewed at a minimum of every two years (except Safe Drinking Water Act documents, which are reviewed annually) and revised as appropriate. Changes to documents occur when a procedural change warrants.

6.3) Procedures for Document Control Policy

Changes to the QA Manual are tracked by revision number. Whenever practical, altered or new text should be highlighted in the document. Uncontrolled copies must not be used within the laboratory. Previous revisions and back-up data are stored by the QA Department. Electronic copies are stored in the Document Database (D4) for the applicable revision.

For changes to SOPs, refer to laboratory SOP No. *CED-Q-DC-SOP42896*. The SOP identified above also defines the process of changes to the QA Manual.

Forms, worksheets, work instructions and information are organized by department in the QA office. Electronic versions are kept on a hard drive in the QA department; hard copies are kept in QA files.

6.4) Obsolete Documents

All invalid or obsolete documents are removed, or otherwise prevented from unintended use. The laboratory has specific procedures as described above to accomplish this. In general, obsolete documents are collected from employees according to distribution lists and are marked obsolete on the cover or destroyed. At least one copy of the obsolete document is archived according to laboratory SOP No. *CED-Q-DC-SOP42896*.

7) SERVICE TO THE CLIENT

7.1) Overview

The laboratory has established procedures for the review of work requests and contracts, oral or written. The procedures include evaluation of the laboratory's capability and resources to meet the contract's requirements within the requested time period. All requirements, including the methods to be used, must be adequately defined, documented and understood. For many environmental sampling and analysis programs, testing design is site or program specific and does not necessarily fit into a standard laboratory service or product. It is the laboratory's intent to provide both standard and customized environmental laboratory services to our clients.

A thorough review of technical and QC requirements contained in contracts is performed to ensure project success. The appropriateness of requested methods, and the lab's capability to perform them must be established. Projects, proposals, and contracts are reviewed for adequately defined requirements and the laboratory's capability to meet those requirements. Alternate test methods that are capable of meeting the clients' requirements may be proposed by the laboratory. A review of the laboratory's capability to analyze non-routine analytes is also part of this review process.

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All projects, proposals and contracts are reviewed for the client's requirements in terms of compound lists, test methodology requested, sensitivity (detection and reporting levels), accuracy, and precision requirements (%Recovery and RPD). The reviewer ensures that the laboratory's test methods are suitable to achieve these requirements and that the laboratory holds the appropriate certifications and approvals to perform the work. The laboratory and any potential subcontract laboratories must be certified, as required, for all proposed tests.

Electronic or hard copy deliverable requirements are evaluated against the laboratory's capacity for production of the documentation.

If the laboratory cannot provide all services but intends to subcontract such services, whether to another Eurofins facility on the same LIMS or to an outside firm, this will be documented and discussed with the client prior to contract approval. (Refer to Section 8 for Subcontracting Procedures.)

The laboratory informs the client of the results of the review if it indicates any potential conflict, deficiency, lack of accreditation, or inability of the lab to complete the work satisfactorily. Any discrepancy between the client's requirements and the laboratory's capability to meet those requirements is resolved in writing before acceptance of the contract. It is necessary that the contract be acceptable to both the laboratory and the client. Amendments initiated by the client and/or Eurofins Cedar Falls are documented in writing.

All contracts, QAPPs, Sampling and Analysis Plans (SAPs), contract amendments, and documented communications become part of the project record.

The same contract review process used for the initial review is repeated when there are amendments to the original contract by the client, and the participating personnel are informed of the changes.

7.2) Review Sequence and Key Personnel

Appropriate personnel will review the work request at each stage of evaluation.

For routine projects and other simple tasks, a review by the Project Manager (PM) or Project Management Assistant (PMA) is considered adequate. The PM or PMA confirms that the laboratory has any required certifications, that it can meet the clients' data quality and reporting requirements and that the lab has the capacity to meet the clients turn around needs. Laboratory SOP No. *CED-P-PROJ-SOP42905* provides additional details for project and contract review procedures for meeting regulatory, accreditation, and client requirements. It is recommended that, where there is a Sales person assigned to the account, an attempt should be made to contact that Sales person to inform them of the incoming samples.

For new, complex or large projects, the proposed contract is given to the Client Relationship Manager (CRM) or Proposal Team, who will decide which laboratory will receive the work based on the scope of work and other requirements, including certification, testing methodology, and available capacity to perform the work. The contract review process is outlined in NDSC Document No. CA-L-P-002, Contract Compliance Policy.

This review encompasses all facets of the operation. The scope of work is distributed to the appropriate personnel, as needed based on scope of contract, to evaluate all of the requirements shown above (not necessarily in the order below):

- Contract Administrator
- Laboratory Project Manager
- Laboratory Directors and/or Technical Managers
- Account Executives
- Quality Managers
- Laboratory Environmental Health and Safety Managers/Directors

The Laboratory Director reviews the formal laboratory quote and makes final acceptance for his/her facility.

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The Sales Director, Contract Administrator, Account Executive or Proposal Coordinator then submits the final proposal to the client.

In the event that one of the above personnel is not available to review the contract, his or her back-up will fulfill the review requirements.

7.3) Balancing Laboratory Capacity and Workload

Evaluating laboratory capacity to perform specific projects is the responsibility of the Laboratory Director, Technical Managers, and Client Service Manager. Many analysts are cross-trained to perform a variety of tests, and there is redundant equipment available in case of malfunctions. This minimizes the need to evaluate small and medium size projects against capacity available to complete them. Large and complex projects are reviewed against capacity estimates before bids are submitted to ensure that the client's analysis schedule is met. Regularly scheduled meetings are held between laboratory management, PMs and QA personnel to review progress with current projects, as well as special requirements of new work scheduled for the laboratory. Laboratory capacity and backlog is tracked on a continuous basis using information from the Laboratory Sample Information System (LIMS) including turnaround time, and work in-house.

7.4) Documentation

The Contracts Department and the Laboratory Director (or his/her Designee) maintain copies of all signed contracts.

Appropriate records are maintained for every contract or work request. All stages of the contract review process are documented and include records of any significant changes. This information is available on the Company Intranet Website (TANet Oasis). Comments and notes are also maintained in LIMS for client and individual bids and contracts.

The contract will be distributed to and maintained by the appropriate Sales/Marketing personnel and the Account Executive. A copy of the contract and formal quote will be filed with the laboratory PM and the Laboratory Director.

Records are maintained of pertinent discussions with a client relating to the client's requirements or the results of the work during the period of execution of the contract. Each PM and PMA keeps a phone log of conversations with the client. A quote log is maintained by the Proposal Group and distributed to Sales, Project Managers, and the Laboratory Director on a regular basis. Communications between Sales and Marketing should be captured in Salesforce and pertinent information should be copied to all appropriate PM and technical staff. Information regarding specific projects or clients is entered into LIMS for reference by all laboratory staff. National client contract information is available on the TANet Oasis intranet website.

7.4.1) Project-Specific Quality Planning

Communication of contract specific technical and QC criteria is an essential activity in ensuring the success of site specific testing programs. To achieve this goal, a PM and/or PMA is assigned to each client. It is the PM/PMA's responsibility to ensure that project-specific technical and QC requirements are effectively evaluated and communicated to the laboratory personnel before and during the project. QA department involvement may be needed to assist in the evaluation of custom QC requirements.

PM's are the primary client contact and they ensure resources are available to meet project requirements; they coordinate opportunities and work with laboratory management and supervisory staff to ensure available resources are sufficient to perform work for the client's project.

Prior to work on a new project, the dissemination of project information and/or project opening meetings may occur to discuss schedules and unique aspects of the project. Items to be discussed may include the project technical profile, turnaround times, holding times, methods, analyte lists, reporting limits, deliverables, sample hazards, or other special requirements. The PM introduces new project information to maximize production and client satisfaction, while maintaining quality.

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Any change that may occur within an active project is agreed upon between the client/regulatory agency and the PM/laboratory. These changes (e.g., use of a non-standard method or modification of a method) and approvals must be documented prior to implementation. Documentation pertains to any document (e.g., letter, e-mail, variance, contract addendum), which has been acknowledged by both parties.

Such changes may be communicated to the laboratory during producton meetings. The laboratory staff is then introduced to the modified requirements via the PM or the individual laboratory Technical Manager. After the modification is implemented into the laboratory process, documentation of the modification is made in the case narrative of the data report(s).

The laboratory strongly encourages client visits to the laboratory and for formal/informal information sharing session with employees in order to effectively communicate ongoing client needs as well as project specific details for customized testing programs.

7.5) Special Services

The laboratory cooperates with clients and their representatives to monitor the laboratory's performance in relation to work performed for the client. It is the laboratory's goal to meet all client requirements in addition to statutory and regulatory requirements. The laboratory has procedures to ensure confidentiality to clients (Sections 15 and 23).

The laboratory's standard procedures for reporting data are described in Section 23. Special services are also available and provided upon request. These services include:

- Reasonable access for our clients or their representatives to the relevant areas of the laboratory for the witnessing of tests performed for the client.
- Assisting client-specified third party data validators as specified in the client's contract.
- Supplemental information pertaining to the analysis of their samples. Note: An additional charge may apply for additional data/information that was not requested prior to the time of sample analysis or previously agreed upon.

When the client requests a statement of conformity to a specification or standard based on the analysis performed by the laboratory (e.g., pass/fail, in-tolerance/out-of-tolerance), the decision rule shall be clearly defined. Unless inherent in the requested specification or standard, the decision rule selected shall be communicated to the client. Associated reporting requirements are addressed in Section 23.2.18.

7.6) Client Communication

PMs are the primary communication link to the clients. They shall inform their clients of any delays in project completion as well as any non-conformances in either sample receipt or sample analysis. Project management will maintain ongoing client communication throughout the entire client project.

Technical Managers are available to discuss any technical questions or concerns that the client may have.

7.7) Reporting

The laboratory works with our clients to produce any special communication reports required by the contract.

7.8) Client Feedback and Surveys

The laboratory assesses both positive and negative client feedback. The results are used to improve overall laboratory quality and client service. Eurofins Sales and Marketing teams periodically develop lab and client specific surveys to assess client satisfaction. A link for clients to rate the service they receive on a particular job or project is also provided with each deliverable generated by LIMS and e-mailed to the client.

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When a complaint is received, we determine, to the best of our ability, the extent of the issue and what data is in question. The person receiving the complaint documents this information and promptly forwards it to the appropriate management personnel where the work in question was performed. If a data reporting error is discovered, the final report and/or data must be regenerated with the correct value(s).

The Laboratory Director and Quality department is responsible for entering client concerns into ICAT (Incident and Corrective Action Tracker). In some cases, an Investigation and Corrective Action Report is initiated to address and document the situation. While an individual issue may not warrant a formal investigation, QA monitors these issues for potential trends and will issue an Investigation and Corrective Action Report if a trend is evident.

8) SUBCONTRACTING OF TESTS

8.1) Overview

For the purpose of this quality manual, the phrase subcontract laboratory refers to a laboratory external to the Eurofins Environment Testing America laboratories. The phrase "work sharing" refers to internal transfers of samples between the Eurofins Environment Testing America laboratories. The term outsourcing refers to the act of subcontracting tests.

When contracting with our clients, the laboratory makes commitments regarding the services to be performed and the data quality for the results to be generated. When the need arises to outsource testing for our clients because project scope, changes in laboratory capabilities, capacity, or unforeseen circumstances, we must be assured that the subcontractors or work sharing laboratories understand the requirements and will meet the same commitments we have made to the client. Refer to the NDSC documents on Subcontracting Procedures (CW-L-S-004) and the Work Sharing Process (CA-C-S-001).

When outsourcing analytical services, the laboratory will assure, to the extent necessary, that the subcontract or work sharing laboratory maintains a program consistent with the requirements of this document, the requirements specified in TNI/ISO 17025 and/or the client's Quality Assurance Project Plan (QAPP). All QC guidelines specific to the client's analytical program are transmitted to the subcontractor and agreed upon before sending the samples to the subcontract facility. Additionally, work requiring accreditation will be placed with an appropriately accredited laboratory. The laboratory performing the subcontracted work will be identified in the final report, as will non-TNI accredited work where required.

PMs or other responsible Client Service members for the Export Lab (i.e., the Eurofins Environment Testing America laboratory that transfers samples to another laboratory) are responsible for obtaining client approval prior to subcontracting any samples. The laboratory will advise the client of a subcontract arrangement in writing and when possible approval from the client shall be obtained and retained in the project folder. Standard Terms & Conditions (T&C) include the flexibility to subcontract samples within the Eurofins Environment Testing America laboratories. Therefore, additional advance notification to clients for intra-laboratory subcontracting is not necessary unless specifically required by a client contract.

Note: In addition to the client, some regulating agencies (e.g., USDA) or contracts (e.g., certain USACE projects) require notification prior to placing such work.

8.2) Qualifying and Monitoring of Subcontractors

Whenever a PM [or Account Executive (AE), Client Relationship Manager (CRM), etc.] becomes aware of a client requirement or laboratory need where samples must be outsourced to another laboratory, the other laboratory(s) shall be selected based on the following:

- Subcontractors specified by the client - In these circumstances, the client assumes responsibility for the quality of the data generated from the use of a subcontractor.

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- Subcontractors reviewed by Eurofins Environment Testing America – Firms which have been reviewed by the Company and are known to meet standards for accreditations (e.g., State and TNI); technical specifications; legal and financial information.

A listing of current vendors is available on the Company's Intranet Website, TANet Oasis.

All Eurofins Environment Testing America laboratories are pre-qualified for work sharing provided they hold the appropriate accreditations and can adhere to the project/program requirements. Client approval is not necessary unless specifically required by the contract. In these cases, the client must provide acknowledgement that the samples can be sent to that facility (an e-mail is sufficient documentation or if acknowledgement is verbal, the date, time, and name of person providing acknowledgement must be documented). The originating laboratory is responsible for communicating all technical, quality, and deliverable requirements as well as other contract needs. (Refer to NDSC Document No. CA-C-S-001, Work Sharing Process.)

8.2.1) New Subcontractors

When the potential subcontract laboratory has not been previously approved, Account Executives or PMs may nominate a laboratory as a subcontractor based on need. The decision to nominate a laboratory must be approved by the Client Relations Manager (CRM) or Laboratory Director. The CRM or Laboratory Director requests that the QA Manager or PM begin the process of approving the subcontract laboratory. Refer to NDSC Document No. CW-L-S-004, Subcontracting Procedures.

Once the appropriate accreditation and legal information is received by the laboratory, it is evaluated for acceptability and forwarded to the NDSC Quality Information Manager (QIM) for review. After the NDSC QIM reviews the documents for completeness, the information is forwarded to the Finance Department for formal signature and contracting with the laboratory. The approved vendor will be added to the approved subcontractor list on the Intranet site, and the finance group is concurrently notified.

The client will assume responsibility for the quality of the data generated from the use of a subcontractor which they have requested the laboratory to use. The qualified subcontractors on the Intranet site are known to meet minimal standards. Eurofins Environment Testing America does not certify laboratories. The subcontractors on our approved list can only be recommended to the extent that we would use them.

8.3) Oversight and Reporting

The status and performance of qualified subcontractors will be monitored by NDSC-QA, and includes an annual review process (refer to NDSC SOP No. CW-L-S-004). Any problems identified will be brought to the attention of NDSC, Finance, Legal, and Quality personnel.

- Complaints shall be investigated. Documentation of the complaint, investigation, and corrective action will be maintained in the subcontractor's file on the Intranet site. Complaints are posted using the Vendor Performance Report.
- Information shall be updated on the Intranet site when new information is received from the subcontracted laboratories.
- Subcontractors in good standing will be retained on the approved subcontractor listing. Client Service personnel will notify all Eurofins Environment Testing America laboratories, NDSC, and Corporate Contracts if any laboratory requires removal from the approved subcontractor list. This notification will be posted on the Intranet site and e-mailed to all Client Service personnel, Laboratory Directors, QA Managers, and Sales personnel.

Prior to initially sending samples to the subcontracted laboratory, the PM confirms their certification status to determine if it's current and scope-inclusive. The information is documented within the project records.

The laboratory's certifications can be viewed on the company's website at https://www.eurofinsus.com/env.

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8.4) Subcontracting Procedures

All subcontracted samples must be accompanied by a Eurofins Environment Testing America (EETA) Chain of Custody (COC). A copy of the original COC sent by the client must be available in LIMS for all samples workshared within EETA. Client COCs are only forwarded to external subcontractors when samples are shipped directly from the project site to the subcontractor laboratory. Under routine circumstances, client COCs are not provided to external subcontractors.

Through communication with the subcontractor laboratory, the PM monitors the status of the subcontracted analyses, facilitates successful execution of the work, and ensures the timeliness and completeness of the analytical report.

Non-TNI accredited work must be identified in the subcontractor's report as appropriate. If TNI accreditation is not required, the report does not need to include this information.

Reports submitted from external subcontractor laboratories are not altered and are included in their original form in the final project report. This clearly identifies the data as being produced by a subcontractor facility. If subcontract laboratory data is incorporated into the laboratory's EDD (i.e., imported), the report must explicitly indicate which laboratory produced the data for which methods and samples.

Note: The results submitted by a EETA worksharing laboratory may be transferred electronically, and the results reported by the EETA worksharing laboratory are identified on the final report. The report must explicitly indicate which laboratory produced the data for which methods and samples. The final report must include a copy of the completed COC for all worksharing reports.

8.5) Contingency Planning

The full qualification of a subcontractor may be waived to meet emergency needs. This decision and justification must be documented in the project files, and the "Purchase Order Terms And Conditions For Subcontracted Laboratory Services" must be sent with the samples and COC.

In the event this provision is utilized, the laboratory (e.g., PM) will be required to verify and document the applicable accreditations of the subcontractor. All other quality and accreditation requirements will still be applicable, but the subcontractor need not have signed a subcontract agreement with Eurofins Environment Testing America at this time.

The use of any emergency subcontractor will require the PM to complete a New Vendor Add Form in order to process payment to the vendor and add them to LIMS. This form requires the user to define the subcontractor's category(ies) of testing and the reason for testing (also refer to Section 8.2.1).

8.6) Use of TNI/NELAP and A2LA Logo

It is not the laboratory's policy to use these logos on any company letterhead, including analytical reports.

9) PURCHASING SERVICES AND SUPPLIES

9.1) Overview

Evaluation and selection of suppliers and vendors is performed, in part, on the basis of the quality of their products, their ability to meet the demand for their products on a continuous and short term basis, the overall quality of their services, their past history, and competitive pricing. This is achieved through evaluation of objective evidence of quality furnished by the supplier, which can include certificates of analysis, recommendations, and proof of historical compliance with similar programs for other clients. To ensure that critical consumables and equipment conform to specified requirements, which may affect quality, all purchases from specific vendors are approved by a member of the supervisory or management staff. Capital expenditures are made in accordance with NDSC Document No. CW-F-S-007, Fixed Asset Acquisition, Retention, and Safeguarding.

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Contracts will be signed in accordance with Eurofins Spending and Contracting Authorization Matrix. Request for Proposals (RFP's) will be issued where more information is required from the potential vendors than just price. Process details are available in the NDSC Document No. CW-F-P-004, Guidance on Procurement and Contracts Policy. RFP's allow the laboratory to determine if a vendor is capable of meeting requirements such as supplying all of the laboratory facilities, meeting required quality standards and adhering to necessary ethical and environmental standards. The RFP process also allows potential vendors to outline any additional capabilities they may offer.

9.2) Glassware

Glassware used for volumetric measurements must be Class A or verified for accuracy according to laboratory procedure. Pyrex (or equivalent) glass should be used where possible. For safety purposes, thick-wall glassware should be used where available.

9.3) Reagents, Standards, and Supplies

Purchasing guidelines for equipment, consumables, and reagents must meet the requirements of the specific method and testing procedures for which they are being purchased. Solvents and acids are pre-tested in accordance with NDSC Document No. CA-Q-S-001, Solvent & Acid Lot Testing & Approval Program. Approval information for the solvents and acids tested under that Program is stored on the Company's SharePoint site, under Solvent Approvals. A master list of all tested materials, as well as the certificates of analysis for the materials, is stored in the same location.

9.3.1) Purchasing

Chemical reagents, solvents, glassware, and general supplies are ordered as needed to maintain sufficient quantities on hand. Materials used in the analytical process must be of a known quality. The wide variety of materials and reagents available makes it advisable to specify recommendations for the name, brand, and grade of materials to be used in any determination. This information is contained in the method SOP. The analyst may take the item from the general supplies area which contains items approved for laboratory use; or, if the item is not in the general supplies area, the analyst orders the item through the finance/procurement system which is set up for the laboratory with pre-approved items.

The analyst must provide the master item number, item description, package size, catalogue page number, and the quantity needed. If an item being ordered is not the exact item requested, approval must be obtained from the Technical Manager or Department Manager prior to placing the order. The Purchasing Coordinator or Department Manager places the order.

9.3.2) Receiving

It is the responsibility of the Receiving department to receive the shipment. It is the responsibility of the person who ordered the materials to document the date materials were received. Once the ordered reagents or materials are received, the person compares the information on the label or packaging to the original order to ensure that the purchase meets the quality level specified. This is documented through the addition of the received date and the person's initials to the information present on the packing slip.

The person receiving the shipment verifies the lot numbers of received solvents and acids against the pre-approval lists. If a received material is listed as unapproved, or is not listed, it is sequestered and returned to the vendor. Alternatively, the laboratory may test the material for the intended use, and if it is acceptable, document the approval on the approval list. Records of any testing performed locally are maintained on the shared "public" folder on the computer network.

Materials may not be released for use in the laboratory until they have been inspected, verified as suitable for use, and the inspection/verification has been documented.

Safety Data Sheets (SDSs) are available online through the Company's Intranet website. Anyone may review these for relevant information on the safe handling and emergency precautions of on-site chemicals.

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9.3.3) Specifications

Methods used in the laboratory specify the grade of reagent that must be used in the procedure. If the quality of the reagent is not specified, analytical reagent grade will be used. It is the responsibility of the analyst to check the procedure carefully for the suitability of grade of reagent.

Chemicals must not be used past the manufacturer's expiration date and must not be used past the expiration time noted in a method SOP. If expiration dates are not provided, the laboratory may contact the manufacturer to determine an expiration date or seek guidance from laboratory SOP No. *CED-P-STD-SOP42952* (Standards and Reagents - Documentation and Tracking).

The laboratory assumes a five year expiration date on inorganic dry chemicals and solvents unless noted otherwise by the manufacturer or by the reference source method. Chemicals/solvents should not be used past the manufacturer's or SOP expiration date unless verified as outlined below.

- An expiration date cannot be extended if the dry chemical/solvent is discolored or appears otherwise physically degraded. In this case, the dry chemical/solvent must be discarded.
- Expiration dates can be extended if the dry chemical/solvent is found to be satisfactory based on acceptable performance of quality control samples (Continuing Calibration Verification (CCV), Blanks, Laboratory Control Sample (LCS), etc.).
- If the dry chemical/solvent is used for the preparation of standards, the expiration dates can be extended 6 months if the dry chemical/solvent is compared to an unexpired independent source in performing the method and the performance of the dry chemical/solvent is found to be satisfactory. The comparison must show that the dry chemical/solvent meets CCV limits. The comparison studies are maintained on-file and available for review in the reagent module of the LIMS.

Wherever possible, standards must be traceable to national or international standards of measurement or to national or international reference materials. Records to that effect are available to the user.

Compressed gases in use are checked for pressure and secure positioning daily. To prevent a tank from going to dryness, or introducing potential impurities, the pressure should be closely watched as it decreases to approximately 15% of the original reading, at which point it should be replaced. For example, a standard sized laboratory gas cylinder containing 3,000 psig of gas should be replaced when it drops to approximately 450 psig. The quality of the gases must meet method or manufacturer specification or be of a grade that does not cause any analytical interference.

Water used in the preparation of samples, standards or reagents must have a conductivity of less than 1-µmho/cm (or resistivity of greater than 1.0 megohm-cm) at 25°C. The conductivity is monitored daily. If the water's specific conductivity is greater than the specified limit, the Facility Manager and appropriate Technical Managers must be notified immediately in order to notify all departments, decide on cessation (based on intended use) of activities, and make arrangements for correction.

The laboratory may purchase reagent grade (or other similar quality) water for use in the laboratory. This water must be certified clean by the supplier for all target analytes or otherwise verified by the laboratory prior to use. This verification is documented.

Standard lots are verified before first time use if the laboratory switches manufacturers or has historically had a problem with the type of standard.

Purchased bottleware used for sampling must be certified clean and the certificates must be maintained. If uncertified sampling bottleware is purchased, all lots must be verified clean prior to use. This verification must be maintained.

Records of manufacturer's certification and traceability statements are maintained as electronic copies in LIMS. These records include date of receipt, lot number (when applicable), and expiration date (when applicable). Incorporation of the item into the record indicates that the analyst has compared the new certificate with the previous one for the same purpose and that no difference is noted, unless approved and so documented by the Technical Manager or QA Manager.

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9.3.4) Storage
Reagent and chemical storage is important from the aspects of both integrity and safety. Light-sensitive reagents may be stored in brown-glass containers. Storage conditions are per the NDSC Environmental Health and Safety (EHS) Manual (Document No. *CED-S-EHS-QP43267*), the local laboratory addendum to the EHS Manual, and method SOPs or manufacturer instructions.

9.4) Equipment, Instruments, and Software
When a new piece of equipment is needed, either for additional capacity or for replacing inoperable equipment, the analyst or supervisor makes a supply request to the Technical Manager and/or the Laboratory Director. If they agree with the request, the procedures outlined in NDSC Document No. CA-T-P-001, Qualified Products List, are followed. A decision is made as to which piece of equipment can best satisfy the requirements. The appropriate written requests are completed and Purchasing places the order.

Upon receipt of a new or used piece of equipment, an identification name is assigned to it and is added to the laboratory's equipment list. Its capability is assessed to determine if it is adequate or not for the specific application. For instruments, a calibration curve is generated, followed by MDLs, Demonstration of Capabilities (DOCs), and other relevant criteria (refer to Section 18). IT must also be notified so that they can synchronize the instrument for back-ups. For software, its operation must be deemed reliable and evidence of instrument verification must be retained by the IT Department or QA Department. Software certificates supplied by the vendors are filed with the LIMS Administrator. The manufacturer's operation manual is retained by the department which operates the item.

9.5) Services
Service to analytical instruments (except analytical balances) is performed on an as needed basis. Routine preventative maintenance is discussed in Section 18. The need for service is determined by analysts and/or department managers. The service providers that perform the services are approved by the Technical Manager.

Analytical balances are serviced and calibrated annually by a vendor with current and valid ISO/IEC 17025 accreditation for calibration of analytical balances. The calibration and maintenance services are performed on-site, and the balances are returned to use immediately following successful calibration. Calibration certificates are filed for reference. If the calibration was unsuccessful, the balance is immediately removed from service and segregated pending either further maintenance or disposal.

Calibration services for support equipment such as reference thermometers and weight sets are obtained from vendors with current and valid ISO/IEC 17025 accreditation for calibration of the specific piece of equipment. Prior to utilizing the vendor's services, the vendor's accreditation status is verified. Once the equipment has been calibrated, the calibration certificates are reviewed by the QA department and documentation of the review is filed with the calibration certificates. The equipment is then returned to service within the laboratory.

9.6) Suppliers
The laboratory selects vendors through a competitive proposal / bid process, strategic business alliances or negotiated vendor partnerships (contracts).

This process is defined in the NDSC Document No. CW-F-P-004, Procurement & Contracts Policy. The level of control used in the selection process is dependent on the anticipated spending amount and the potential impact on the laboratory's business. Vendors that provide test and measuring equipment, solvents, standards, certified containers, instrument related service contracts or subcontract laboratory services shall be subject to more rigorous controls than vendors that provide off-the-shelf items of defined quality that meet the end use requirements. The purchasing system includes all suppliers/vendors that have been approved for use.

Evaluation of suppliers is accomplished by ensuring the supplier ships the product or material ordered and that the material is of the appropriate quality. This is documented by signing off on packing slips or

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other supply receipt documents. The purchasing documents contain the data that adequately describe the services and supplies ordered.

Any issues of vendor performance are to be reported immediately by the laboratory staff to the Purchasing Group by completing a Vendor Performance Report.

The Purchasing Group will work through the appropriate channels to gather the information required to clearly identify the problem and will contact the vendor to report the problem and to make any necessary arrangements for exchange, return authorization, credit, etc.

Suppliers are subject to re-evaluation, as deemed appropriate, through the use of Vendor Performance Reports used to summarize and review to determine corrective action necessary, or service improvements required by vendors.

The laboratory has access to a listing of all approved suppliers of critical consumables, supplies and services. This information is provided through the purchasing system.

9.6.1) New Vendor Procedure

Laboratory employees who wish to request the addition of a new vendor must complete a Vendor Add Request Form.

New vendors are evaluated based upon criteria appropriate to the products or services provided as well as their ability to provide those products and services at a competitive cost. Vendors are also evaluated to determine if there are ethical reasons or potential conflicts of interest with laboratory employees that would make it prohibitive to do business with them as well as their financial stability. The QA Department and/or the Technical Services Director are consulted with vendor and product selection that have an impact on quality.

10) COMPLAINTS

10.1) Overview

The laboratory considers an effective client complaint handling processes to be of significant business and strategic value. Listening to and documenting client concerns captures client knowledge that enables our operations to continually improve processes and client satisfaction. An effective client complaint handling process also provides assurance to the data user that the laboratory will stand behind its data, service obligations and products.

A client complaint is any expression of dissatisfaction with any aspect of our business services (e.g., communications, responsiveness, data, reports, invoicing and other functions) expressed by any party, whether received verbally or in written form. Client inquiries, complaints or noted discrepancies are documented, communicated to management, and addressed promptly and thoroughly.

The laboratory has procedures for addressing both external and internal complaints with the goal of providing satisfactory resolution to complaints in a timely and professional manner.

The nature of the complaint is identified, documented and investigated, and an appropriate action is determined and taken. In cases where a client complaint indicates that an established policy or procedure was not followed, the QA Department must evaluate whether a special audit must be conducted to assist in resolving the issue. A written confirmation or letter to the client, outlining the issue and response taken, is recommended as part of the overall action taken.

The process of complaint resolution and documentation utilizes the procedures outlined in Section 12 (Corrective Actions). The QA Manager summarizes complaints in the monthly QA Report to management, along with a summary of any investigations performed and actions taken.

10.2) External Complaints

An employee that receives a complaint initiates the complaint resolution process by first submitting the

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complaint to the Complaint Handling Team (consisting of the Laboratory Director, Client Service Manager, and QA staff).

Complaints fall into two categories: correctable and non-correctable. An example of a correctable complaint would be one where a report re-issue would resolve the complaint. An example of a non-correctable complaint would be one where a client complains that their data was repeatedly late. Non-correctable complaints should be reviewed for preventive action measures to reduce the likelihood of future occurrence and mitigation of client impact.

The general steps in the complaint handling process are:

- Receiving and documenting complaints
- Acknowledging receipt of complaint, whenever possible
- Complaint investigation and service recovery
- Process improvement

The laboratory shall inform the initiator of the complaint of the results of the investigation and the corrective action taken, if any.

10.3) Internal Complaints

Internal complaints include, but are not limited to: errors and non-conformances, training issues, internal audit findings, and deviations from methods. Corrective actions may be initiated by any staff member who observes a nonconformance and shall follow the procedures outlined in Section 12. In addition, Executive Management, Sales/Marketing, and IT may initiate a complaint by contacting the laboratory or through the corrective action system described in Section 12.

10.4) Review of Complaints

The number and nature of client complaints is reported by the QA Manager to the Laboratory Director and Quality Director in the QA Monthly report. Monitoring and addressing the overall level and nature of client complaints and the effectiveness of the solutions is part of the annual Management Systems Review (described in Section 16).

11) CONTROL OF NON-CONFORMING WORK

11.1) Overview

When data discrepancies are discovered or deviations and departures from laboratory SOPs, policies and/or client requests have occurred, corrective action is taken immediately. First, the laboratory evaluates the significance of the nonconforming work. Then, a corrective action plan is initiated based on the outcome of the evaluation. If it is determined that the nonconforming work is an isolated incident, the plan could be as simple as adding a qualifier to the final results and/or making a notation in the case narrative. If it is determined that the nonconforming work is a systematic or improper practices issue, the corrective action plan could include a more in depth investigation and a possible suspension of an analytical method. In all cases, the actions taken are documented using the laboratory’s corrective action system (refer to Section 12).

Due to the frequently unique nature of environmental samples, sometimes departures from documented policies and procedures are needed. When an analyst encounters such a situation, the problem is presented to the supervisor for resolution. The supervisor may elect to discuss it with the Technical Manager or have a representative contact the client to decide on a logical course of action. Once an approach is agreed upon, the analyst documents it using the laboratory's corrective action system described in Section 12. This information can then be supplied to the client in the form of a footnote or a case narrative with the report.

Project Management may encounter situations where a client may request that a special procedure be applied to a sample that is not standard lab practice. Based on a technical evaluation, the laboratory may accept or opt to reject the request based on technical or ethical merit. An example might be the need to report a compound that the lab does not normally report. The lab would not have validated the

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method for this compound following the procedures in Section 17. The client may request that the compound be reported based only on the calibration. Such a request would need to be approved by the Technical Manager and QA Manager, documented and included in the project folder. Deviations must also be noted on the final report with a statement that the compound is not reported in compliance with TNI (or the analytical method) requirements and the reason. Data being reported to a non-TNI state would need to note the change made to how the method is normally run.

11.2) Responsibilities and Authorities

Under certain circumstances, the Laboratory Director, a Technical Manager, or a member of the QA team may authorize departures from documented procedures or policies. The departures may be a result of procedural changes due to the nature of the sample; a one-time procedure for a client; QC failures with insufficient sample to reanalyze, etc. In most cases, the client will be informed of the departure prior to the reporting of the data. Any departures must be well documented using the laboratory's corrective action procedures. This information may also be documented in logbooks and/or data review checklists as appropriate. Any impacted data must be referenced in a case narrative and/or flagged with an appropriate data qualifier.

Any misrepresentation or possible misrepresentation of analytical data discovered by any laboratory staff member must be reported to facility Senior Management within 24 hours. The Senior Management staff is comprised of the Laboratory Director, the QA Manager, and the Technical Managers. The reporting of issues involving alleged violations of the company's Data Integrity or Manual Integration procedures must be conveyed to an ECO (e.g., the VP-QA/EHS) and the laboratory's Quality Director within 24 hours of discovery.

Whether an inaccurate result was reported due to calculation or quantitation errors, data entry errors, improper practices, or failure to follow SOPs, the data must be evaluated to determine the possible effect.

The Laboratory Director, QA Manager, ECOs, VP of Operations and the Quality Directors have the authority and responsibility to halt work, withhold final reports, or suspend an analysis for due cause as well as authorize the resumption of work.

11.3) Evaluation of Significance and Actions Taken

For each nonconforming issue reported, an evaluation of its significance and the level of management involvement needed is made. This includes reviewing its impact on the final data, whether or not it is an isolated or systematic issue, and how it relates to any special client requirements.

NDSC Document No. CW-Q-S-005 (Management of Nonconforming Work Affecting Data Quality) is the procedure to be followed when it is discovered that erroneous or biased data may have been reported to clients or regulatory agencies.

NDSC Document No. CW-L-S-002 (Internal Investigations) is the procedure to be followed for investigation and correction of situations involving alleged incidents of misconduct or violations of the Company's Ethics Policy.

Laboratory-level decisions are documented and approved using the laboratory's standard nonconformance/corrective action reporting in lieu of the data recall determination form contained in NDSC Document No. CW-Q-S-005.

11.4) Prevention of Nonconforming Work

If it is determined that the nonconforming work could recur, further corrective actions must be made following the laboratory's corrective action system. Periodically, as defined by the laboratory's preventive action schedule, the QA Department evaluates non-conformances to determine if any nonconforming work has been repeated multiple times. If so, the laboratory's corrective action process may be followed.

11.5) Method Suspension or Restriction (Stop Work Procedures)

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In some cases, it may be necessary to suspend/restrict the use of a method or target analyte which constitutes significant risk and/or liability to the laboratory. Suspension/restriction procedures can be initiated by any of the persons noted in Section 11.2, Paragraph 4.

Prior to suspension/restriction, confidentiality will be respected, and the problem with the required corrective and preventive action will be stated in writing and presented to the Laboratory Director.

The Laboratory Director shall arrange for the appropriate personnel to meet with the QA Manager as needed. This meeting shall be held to confirm that there is a problem, that suspension/restriction of the method is required and will be concluded with a discussion of the steps necessary to bring the method/target or test fully back on line. In some cases, that may not be necessary if all appropriate personnel have already agreed there is a problem and there is agreement on the steps needed to bring the method, target or test fully back on line. The QA Manager will also initiate a corrective action report as described in Section 12 if one has not already been started. A copy of any meeting notes and agreed upon steps should be e-mailed by the laboratory to their Business Unit President and VP-QA/EHS. This e-mail acts as notification of the incident.

After suspension/restriction, the laboratory will hold all reports to clients pending review. No faxing, mailing or distributing through electronic means may occur. The report must not be posted for viewing on the internet. It is the responsibility of the Laboratory Director to hold all reporting and to notify all relevant laboratory personnel regarding the suspension/restriction (e.g., Project Management, Log-in, etc.). Clients will NOT generally be notified at this time. Analysis may proceed in some instances depending on the non-conformance issue.

Within 72 hours, the QA Manager will determine if compliance is now met and reports can be released, or determine the plan of action to bring work into compliance, and release work. A team, with all principals involved (e.g., Laboratory Director, Technical Manager, QA Manager) can devise a start-up plan to cover all steps from client notification through compliance and release of reports. Project Management and the Directors of Client Services and Sales and Marketing must be notified if clients must be notified or if the suspension/restriction affects the laboratory's ability to accept work. The QA Manager must approve start-up or elimination of any restrictions after all corrective action is complete.

12) CORRECTIVE ACTION

12.1) Overview

A major component of the laboratory's QA Program is the problem investigation and feedback mechanism designed to keep the laboratory staff informed on quality related issues and to provide insight to problem resolution. When nonconforming work or departures from policies and procedures in the quality system or technical operations are identified, the corrective action procedure provides a systematic approach to assess the issues, restore the laboratory's system integrity, and prevent reoccurrence. The laboratory employs two systems to manage non-conformances. Issues suspected of being systematic in nature and for which root cause analysis and a formal Corrective Action Report (CAR) are needed are documented in the Incident and Corrective Action Tracking (ICAT) database. Routine batch non-conformances, events that are understood to be isolated in nature, are documented in the LIMS non-conformance memo (NCM) system.

12.2) General

Problems within the quality system or within analytical operations may be discovered in a variety of ways, such as QC sample failures, internal or external audits, proficiency testing (PT) performance, client complaints, staff observation, etc.

The purpose of a corrective action system is to:

- Identify non-conformance events and assign responsibility for investigating.
- Resolve non-conformance events and assign responsibility for any required corrective action.
- Identify systematic problems before they become serious.
- Identify and track client complaints and provide resolution.

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12.2.1) Non-Conformance Memo (NCM)
NCMs are used to document the following types of corrective actions:

- One-time deviations from an established procedure or SOP
- QC outside of limits
- Isolated reporting / calculation errors
- Client complaints (minor)
- Discrepancies in materials/goods received vs. manufacturer packing slips (forms of documentation other than an NCM in LIMS is also acceptable)

12.2.2) Corrective Actions Documented in the ICAT Database
The ICAT database is used to document background information, track the results of corrective action investigations/root cause analysis, and to provide reports of corrective action plans for the following types of corrective actions:

- Internal and external audit findings
- Failed or unacceptable PT results
- Identified poor process or method performance trends
- Systematic reporting / calculation errors
- Data recall investigations
- Questionable trends that are found in the review of NCMs.
- Client complaints (major)
- Excessive revised reports

12.3) Closed Loop Corrective Action Process
Any employee in the company can initiate a corrective action. There are four main components to a closed-loop corrective action process once an issue has been identified: Cause Analysis, Selection and Implementation of Corrective Actions (both short and long term), Monitoring of Corrective Actions, and Follow-up.

12.3.1) Cause Analysis
Upon discovery of a non-conformance event, the event must be defined and documented. An entry into the ICAT system must be initiated, someone is assigned to investigate the issue and the event it investigated for cause. Section 12.6 provides some general guidelines on determining responsibility for assessment.

The cause analysis step is the key to the process as a long term corrective action plan cannot be determined until the cause is determined.

If the cause is not readily obvious, the Technical Manager, Laboratory Director, or QA Manager (or designee) is consulted.

12.3.1.1) Root Cause Analysis
Root Cause Analysis is a class of problem solving (investigative) methods aimed at identifying the basic or causal factor(s) that underlie variation in performance or the occurrence of a significant failure. The root cause may be buried under seemingly innocuous events, many steps preceding the perceived failure. At first glance, the immediate response is typically directed at a symptom and not the cause. Typically, root cause analysis would be best with three or more incidents to triangulate a weakness. NDSC Document No. CA-Q-S-009 (Root Cause Analysis) provides guidance on this procedure.

Systematically analyze and document the root causes of the more significant problems that are reported. Identify, track, and implement the corrective actions required to reduce the likelihood of recurrence of significant incidents. Trend the root cause data from these incidents to identify root causes that, when corrected, can lead to dramatic improvements in performance by eliminating entire classes of problems.

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Identify the one event associated with problem and ask why this event occurred. Brainstorm the root causes of failures; for example, by asking why events occurred or conditions existed; and then why the cause occurred consecutive times until you get to the root cause. For each of these sub events or causes, ask why it occurred. Repeat the process for the other events associated with the incident.

Root cause analysis does not mean the investigation is over. Look at technique or other systems outside the normal indicators. Often creative thinking will find root causes that ordinarily would be missed and continue to plague the laboratory or operation.

12.3.2) Selection and Implementation of Corrective Actions

Where corrective action is needed, the laboratory shall identify potential corrective actions. The action(s) most likely to eliminate the problem and prevent recurrence are selected and implemented. Responsibility for implementation is assigned.

Corrective actions shall be to a degree appropriate to the magnitude of the problem identified through the root cause analysis.

Whatever corrective action is determined to be appropriate, the laboratory shall document and implement the changes. The ICAT record is used for this documentation.

12.3.3) Monitoring of Corrective Actions

The Technical Manager and QA Manager are responsible to ensure that the corrective action taken was effective.

Ineffective actions are documented and re-evaluated until acceptable resolution is achieved. Technical Managers are accountable to the Laboratory Director to ensure final acceptable resolution is achieved and documented appropriately.

The QA Manager reviews monthly NCM and ICAT records for trends. Highlights are included in the QA Monthly Report (refer to Section 16.1). If a significant trend develops that adversely affects quality, an audit of the area is performed, and corrective action implemented.

Any out-of-control situations that are not addressed acceptably at the laboratory level may be reported to the NDSC Quality Director by the QA Manager, indicating the nature of the out-of-control situation and problems encountered in solving the situation.

12.3.4) Follow-Up

Follow up audits may be initiated by the QA Manager or other management staff and shall be performed as soon as possible when the identification of a nonconformance casts doubt on the laboratory's compliance with its own policies and procedures, or on its compliance with state or federal requirements.

These audits often follow the implementation of the corrective actions to verify effectiveness. An additional audit would only be necessary when a critical issue or risk to business is discovered.

Also refer to Section 15.1.4 (Special Audits).

12.4) Basic Corrections

When mistakes occur in records, each mistake shall be crossed-out [not obliterated (e.g. no white-out)], and the correct value entered alongside. All such corrections shall be initialed (or signed) and dated by the person making the correction. In the case of records stored electronically, the original uncorrected file must be maintained intact and a second corrected file is created. This same process applies to adding additional information to a record. All additions made later than the initial must also be initialed (or signed) and dated. When corrections are due to reasons other than obvious transcription errors, the reason for the corrections (or additions) shall also be documented.

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12.5) Technical Corrective Actions

In addition to providing acceptance criteria and specific protocols for technical corrective actions in the method SOPs, the laboratory has general procedures to be followed to determine when departures from the documented policies and procedures and quality control have occurred (refer to Section 11). The documentation of these procedures is through the use of an NCM or record in the ICAT system.

The table in Section 12.6 includes examples of general technical corrective actions. For specific criteria and corrective actions, refer to the analytical methods or specific method SOPs.

Section 12.6 provides some general guidelines for identifying the individual(s) responsible for assessing each QC type and initiating corrective action. The table also provides general guidance on how a data set should be treated if associated QC measurements are unacceptable. Specific procedures are included in Method SOPs, Work Instructions, and QA Manual Sections 17 and 18. All corrective actions are reviewed monthly, at a minimum, by the QA Manager and highlights are included in the QA monthly report.

To the extent possible, samples shall be reported only if all quality control measures are acceptable. If the deficiency does not impair the usability of the results, data will be reported with an appropriate data qualifier and/or the deficiency will be noted in the case narrative. Where sample results may be impaired, the PM is notified by an NCM and appropriate corrective action (e.g., reanalysis) is taken and documented.

12.6) Example - General Corrective Action Procedures

QC Activity *(Individual responsible for initiation/assessment)*	**Acceptance Criteria**	**Recommended Corrective Action**
Initial Instrument Blank *(Analyst)*	• Instrument response < MDL.	• Prepare another blank. • If same response, determine cause of contamination: reagents, environment, instrument failure, etc.
Initial Calibration Standards *(Analyst, Technical Manager)*	• COD ≥ 0.990 or standard concentration value. • % Error within acceptance range. • See details in Method SOPs.	• Reanalyze standard. • If still unacceptable, remake standards and recalibrate instrument.
Independent (Second Source) Calibration Verification *(Analyst, Technical Manager)*	• % Recovery within control limits documented in LIMS.	• Remake and reanalyze standard. • If still unacceptable, then remake calibration standards or use new primary standards and recalibrate instrument.
Continuing Calibration Verification *(Analyst, Data Reviewer)*	• % Recovery within control limits documented in LIMS.	• Reanalyze standard. • If still unacceptable, then recalibrate and rerun affected samples. • In some cases, sample data associated with unacceptable CCV may still be reported with appropriate qualifier/flag (see details in Method SOPs).
Matrix Spike (MS) / Matrix Spike Duplicate (MSD) *(Analyst, Data Reviewer)*	• % Recovery within control limits documented in LIMS.	• If the acceptance criteria for duplicates or matrix spikes are not met because of matrix interferences, the

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		acceptance of the analysis batch is determined by the validity of the LCS. • If the LCS is within acceptance criteria the batch is acceptable. • The results of the duplicates, matrix spikes and the LCS are reported with the data set. • For matrix spike or duplicate results outside criteria, the data for that sample shall be reported with qualifiers.
Laboratory Control Sample (LCS) *(Analyst, Data Reviewer)*	• % Recovery within control limits documented in LIMS	• Batch must be re-prepared and re-analyzed. This includes any allowable marginal exceedance. • When not using marginal exceedances, the following exceptions apply: 1. When the acceptance criteria for the positive control are exceeded high and there are associated samples that are non-detects, then those non-detects may be reported with data qualifying codes. 2. When the acceptance criteria for the positive control are exceeded low, those sample results may be reported if they exceed a maximum regulatory limit/decision level with data qualifying codes. • If there is insufficient sample or the holding time cannot be met, contact the client and report with flags.
Surrogates *(Analyst, Data Reviewer)*	• % Recovery within control limits documented in LIMS.	• Individual sample should be repeated. Place comment in LIMS. • Surrogate results outside criteria shall be reported with qualifiers.
Method Blank (MB) *(Analyst, Data Reviewer)*	• < Reporting Limit[1]	• Reanalyze blank. • If still positive, determine source of contamination. If necessary, reprocess (i.e., digest or extract) entire sample batch. Report blank results. • Qualify the result(s) if the concentration of a targeted analyte in the MB is at or above the reporting limit AND is >1/10 of the amount measured in the sample.
Proficiency Testing (PT) Samples	• Criteria supplied by the PT	• Any failures or warnings

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(QA Manager, Technical Manager)	Provider.	must be investigated for cause. Failures may result in the need to repeat a PT sample to show the problem is corrected.
Internal/External Audits *(QA Manager, Technical Manager, Laboratory Director)*	• Defined in Quality System documentation such as SOPs, QA Manual, etc.	• Non-conformances must be investigated through CAR system and necessary corrections must be made.
Reporting/Calculation Errors *(Analysts, Data Reviewers, Project Managers, Technical Managers, QA Manager, NDSC-QA, Executive Management)*	• NDSC Document No. CW-Q-S-005	• Corrective action is determined by type of error. Follow procedures in NDSC Document No. CW-L-S-002.
Client Complaints *(Project Managers, Laboratory Director, Sales and Marketing)*	• QA Manual, client requirements	• Corrective action is determined by type of complaint. For example, a complaint regarding an incorrect address on a report will result in the report being corrected and then follow-up must be performed on the reasons the address was incorrect (e.g., database needs to be updated).
Health and Safety Violation *(EHS Coordinator, Laboratory Director, Technical Manager)*	• Environmental Health and Safety (EHS) Manual	• Non-conformance is investigated and corrected through the Velocity system.

Notes:
1. Except as noted below for certain compounds, the method blank must be below the reporting limit (for compliance samples reported for the Safe Drinking Water Act (SDWA), the method blank must be below the detection limit). Concentrations up to five times the reporting limit will be allowed for the ubiquitous laboratory and reagent contaminants such as methylene chloride, toluene, acetone, 2-butanone and phthalates provided they appear in similar levels in the reagent blank and samples. This allowance presumes that the reporting limit is significantly below any regulatory limit to which the data are to be compared and that blank subtraction will not occur. For benzene and ethylene dibromide and other analytes for which regulatory limits are extremely close to the reporting limit, the method blank must be below the method reporting limit.

13) PREVENTIVE ACTION / IMPROVEMENT

13.1) Overview
The laboratory's preventive action program improves or eliminates potential causes of nonconforming product and/or nonconformance to the quality system. This preventive action process is a proactive and continuous process of improvement activities that can be initiated through feedback from clients, employees, business providers, and affiliates. The QA Department has the overall responsibility to ensure that the preventive action process is in place, and that relevant information on actions is submitted for management review.

Dedicating resources to an effective preventive action system emphasizes the laboratory's commitment to its QA Program. It is beneficial to identify and address negative trends before they develop into complaints, problems and corrective actions. Additionally, the laboratory continually strives to improve customer service and client satisfaction through continuous improvements to laboratory systems.

Opportunities for improvement may be discovered through any of the following:

- review of the monthly QA Monthly Report,

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- trending NCMs,
- review of control charts and QC results,
- trending proficiency testing (PT) results,
- performance of management system reviews,
- trending client complaints,
- review of processing operations, or
- staff observations.

The QA Monthly Report shows performance indicators in all areas of the laboratory's quality system. These areas include revised client reports, corrective actions, audit findings, internal auditing and data authenticity audits, client complaints, PT samples, holding time violations, SOPs, ethics training, etc. The report is reviewed monthly by the laboratory management, NDSC QA Team and Local and Executive Management. The metrics in the QA Monthly Report are used in evaluating the management and quality system performance on an ongoing basis and provide a tool for measuring risk and identifying areas for improvement.

Items identified as continuous improvement opportunities to the management system may be issued as goals from the annual management systems review, recommendations from internal audits, white papers, Lessons Learned, Technical Services audit report, Technical Best Practices, or as Executive or management initiatives.

The laboratory's corrective action process is integral to implementation of preventive actions. A critical piece of the corrective action process is the implementation of actions to prevent further occurrence of a non-compliance event. Historical review of corrective action and non-conformances provides a valuable mechanism for identifying preventive action opportunities.

13.1.1) The following elements are part of a preventive action/process improvement system:

- Identification of an opportunity for preventive action or process improvement.
- Process for the preventive action or improvement.
- Define the measurements of the effectiveness of the process once undertaken.
- Execution of the preventive action or improvement.
- Evaluation of the plan using the defined measurements.
- Verification of the effectiveness of the preventive action or improvement.
- Close-Out by documenting any permanent changes to the Quality System as a result of the Preventive Action or Process Improvement. Documentation of Preventive Action/process Improvement is incorporated into the monthly QA reports, corrective action process and management review.

13.1.2) Any preventive actions/process improvement undertaken or attempted shall be taken into account during the annual Management Systems Review (Section 16). A highly detailed report is not required; however, a summary of successes and failures within the preventive action program is sufficient to provide management with a measurement for evaluation.

13.2) Management of Change

The Management of Change process is designed to manage significant events and changes that occur within the laboratory. Through these procedures, the potential risks inherent with a new event or change are identified and evaluated. The risks are minimized or eliminated through pre-planning and the development of preventive measures. Examples of the types of changes covered under this system include: Facility Changes, Major Accreditation Changes, Addition or Deletion to Laboratory Capabilities or Instrumentation, Key Personnel Changes, and Laboratory Information Management System (LIMS) changes. This process is initiated by the Laboratory Director and Executive Management.

14) CONTROL OF RECORDS

The laboratory maintains a records management system appropriate to its needs and that complies with applicable standards or regulations as required. The system produces unequivocal, accurate records that document all laboratory activities. The laboratory retains all original observations, calculations and derived data, calibration records and a copy of the analytical report for a minimum of

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five (5) years after it has been issued. Exceptions for programs with longer retention requirements are discussed in Section 14.1.2.

14.1) Overview

The laboratory has established procedures for identification, collection, indexing, access, filing, storage, maintenance and disposal of quality and technical records. A record index is listed in the table below. More detailed information on retention of specific records is provided in NDSC Document No/s. CW-L-P-001 (Records Retention Policy) and CW-L-WI-001 (Records Retention/Storage Schedule). Quality records and files are maintained by the QA department on the Corporate QA server, which is backed up as part of the regular laboratory backup. Records are of two types; either electronic or hard copy paper formats depending on whether the record is computer or hand generated (some records may be in both formats). Technical records such as logbooks and hard copy data are maintained by the appropriate laboratory technical staff until they are archived by QA.

Category	Record Types[1]	Retention Time
Technical Records	• Raw data • Logbooks[2] • Standards • Certificates • Analytical records • MDLs/IDLs/DOCs • Lab reports	5 years from analytical report issue*
Official Documents	• Quality Assurance (QA) Manual • Policies • Standard Operating Procedures (SOPs) • Work Instructions • Policy Memorandums • Manuals • Published methods	Indefinitely
QA Records	• Certifications • Method and Software Validation/Verification Data	Indefinitely
" "	• Internal and External Audits/Responses • Corrective/Preventive Actions • Management Reviews • Data Investigations	5 years from archival* <u>Data Investigations</u>: 5 years or the life of the affected raw data storage, whichever is greater.
Project Records	• Sample receipt and COC documents • Contracts and amendments • Correspondence • QAPP • SAP • Telephone logs • Lab reports	5 years from analytical report issue*
Administrative Records	Financial and Business Operations	Refer to NDSC Document No. CW-L-WI-001
" "	EHS Manual, Permits	Indefinitely
" "	Disposal Records	Indefinitely
" "	Employee Handbook	Indefinitely
" "	Personnel files, Employee Signature & Initials, Administrative Training Records	Refer to HR Manual.
" "	Administrative Policies	Indefinitely

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" "	Technical Training Records	7 years
" "	Legal Records	Indefinitely
" "	HR Records	Refer to NDSC Document No. CW-L-WI-001
" "	IT Records	Refer to NDSC Document No. CW-L-WI-001
" "	NDSC Governance Records	Refer to NDSC Document No. CW-L-WI-001
" "	Sales and Marketing	5 years
" "	Real Estate	Indefinitely

[1]Record Types encompasses hard copy and electronic records.

[2]Examples of Logbook types: maintenance, instrument run, preparation (standard and sample), standards and reagent receipt, archiving, balance verification, temperature (hard copy or electronic records).

*Exceptions listed in Section 14.1.2.

14.1.1) Retention of Records

All records are stored and retained in such a way that they are secure and readily retrievable at the laboratory facility or an offsite location that provides a suitable environment to prevent damage or deterioration and to prevent loss at the laboratory or the offsite location. All records shall be protected against fire, theft, loss, environmental deterioration, and vermin. In the case of electronic records, electronic or magnetic sources, storage media are protected from deterioration caused by magnetic fields and/or electronic deterioration.

Access to the data is limited to laboratory and company employees and shall be documented with an access log. Records archived off-site are stored in a secure location where a record is maintained of any entry into the storage facility. Whether on-site or off-site storage is used, logs are maintained in each storage box to note removal and return of records. Retention of records are maintained on-site at the laboratory for at least one month after their generation and moved offsite for the remainder of the required storage time. Records are maintained for a minimum of five (5) years unless otherwise specified by a client or regulatory requirement.

For raw data and project records, record retention shall be calculated from the date the project report is issued. For other records, such as NDSC Documents, QA, or Administrative Records, the retention time is calculated from the date the record is formally retired. Records related to the programs listed in Section 14.1.2 have lengthier retention requirements and are subject to the requirements therein.

14.1.2) Programs with Longer Retention Requirements

Some regulatory programs have longer record retention requirements than the standard record retention time. These are detailed in the table below with their retention requirements. In these cases, the longer retention requirement is enacted. If special instructions exist such that client data cannot be destroyed prior to notification of the client, the container or box containing that data is marked as to who to contact for authorization prior to destroying the data.

Program	Retention Requirement[1]
Drinking Water - All states	10 years (lab reports and raw data) 10 years - Radiochemistry (project records)
Drinking Water - Lead and Copper Rule	12 years (project records)
Commonwealth of MA - All environmental data 310 CMR 42.14	10 years
FIFRA - 40 CFR Part 160	Retain for life of research or marketing permit for pesticides regulated by EPA
Housing and Urban Development (HUD) - Environmental lead testing	10 years
Alaska	10 years
Louisiana - All	10 years

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Michigan Department of Environmental Quality - all environmental data	10 years
Minnesota Department of Commerce - records for Petrofund program	7 years
Ohio VAP	10 years, and contact state prior to disposal
OSHA	30 years

[1]Extended retention requirements must be noted with the archive documents or addressed in facility-specific records retention procedures.

14.1.3) Record Keeping System

The laboratory has procedures to protect and back-up records stored electronically and to prevent unauthorized access to or amendment of these records. All analytical data is maintained as hard copy or in a secure readable electronic format. For analytical reports that are maintained as copies in PDF format, refer to Section 17.15.1 for more information.

The record keeping system allows for historical reconstruction of all laboratory activities that produced the analytical data, as well as rapid recovery of historical data (records stored off site should be accessible within 2 days of a request for such records). The history of the sample from when the laboratory took possession of the samples must be readily understood through the documentation. This shall include inter-laboratory transfers of samples and/or extracts.

- The records include the identity of personnel involved in sampling, sample receipt, preparation, or testing. All analytical work contains the initials (at least) of the personnel involved. The laboratory's copy of the COC is stored electronically with the applicable job documents in LIMS. The chain of custody would indicate the name of the sampler. If any sampling notes are provided with a job, they are kept with this package.
- All information relating to the laboratory facility's equipment, analytical test methods, and related laboratory activities, such as sample receipt, sample preparation, or data verification are documented.
- The record keeping system facilitates the retrieval of all working files and archived records for inspection and verification purposes. Instrument data is stored sequentially by instrument. A given day's analyses are maintained in the order of the analysis. Run logs are maintained for each instrument or method; a copy of each day's run log or instrument sequence is stored with the data to aid in re-constructing an analytical sequence. Where an analysis is performed without an instrument, bound logbooks or bench sheets are used to record and file data. (Alternatively, this analysis data may be captured entirely in the electronic record in LIMS.) Standard and reagent information is recorded in logbooks or entered into LIMS for each method as required.
- Changes to hardcopy records shall follow the procedures outlined in Section 12 and 17. Changes to electronic records in LIMS or instrument data are recorded in audit trails.
- The reason for a signature or initials on a document is clearly indicated in the records such as "sampled by," "prepared by," "reviewed by", or "analyzed by".
- All generated data except those that are generated by automated data collection systems, are recorded directly, promptly and legibly in permanent dark ink.
- Hard copy data may be scanned into PDF format for record storage as long as the scanning process can be verified in order to ensure that no data is lost and the data files and storage media must be tested to verify the laboratory's ability to retrieve the information prior to the destruction of the hard copy that was scanned.
- Also refer to Section 17.15.1 ("Computer and Electronic Data Related Requirements").

14.2) Technical and Analytical Records

The laboratory retains records of original observations, derived data and sufficient information to establish an audit trail, calibration records, staff records and a copy of each analytical report issued, for a minimum of five years unless otherwise specified by a client or regulatory requirement. The records for each analysis shall contain sufficient information to enable the analysis to be repeated under conditions as close as possible to the original. The records shall include the identity of laboratory personnel responsible for performance of each analysis and reviewing results.

Observations, data and calculations are recorded real-time and are identifiable to the specific task.

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Changes to hardcopy records shall follow the procedures outlined in Section 12 and 17. Changes to electronic records in LIMS or instrument data are recorded in audit trails.

The essential information to be associated with analysis, such as strip charts, tabular printouts, computer data files, analytical notebooks, and run logs, include:

- Laboratory sample ID code;
- Date of analysis; time of analysis is also required if the holding time is seventy-two (72) hours or less, or when time critical steps are included in the analysis (e.g., drying times, incubations, etc.); instrumental analyses have the date and time of analysis recorded as part of their general operations. Where a time critical step exists in an analysis, location for such a time is included as part of the documentation in a specific logbook or on a benchsheet.
- Instrumentation identification and instrument operating conditions/parameters. Operating conditions/parameters are typically recorded in instrument maintenance logs where available.
- Analysis type;
- All manual calculations and manual integrations;
- Analyst's or operator's initials/signature;
- Sample preparation including ID codes, volumes, weights, instrument printouts, meter readings, calculations, reagents;
- Test results;
- Standard and reagent origin, receipt, preparation, and use;
- Calibration criteria, frequency and acceptance criteria;
- Data and statistical calculations, review, confirmation, interpretation, assessment and reporting conventions;
- Quality control protocols and assessment;
- Electronic data security, software documentation and verification, software and hardware audits, backups, and records of any changes to automated data entries; and
- Method performance criteria including expected quality control requirements. These are indicated both in LIMS and on specific analytical report formats.

All logbooks used during receipt, preparation, storage, analysis, and reporting of samples or monitoring of support equipment shall undergo a periodic, documented supervisory or peer review.

14.3) Laboratory Support Activities

In addition to documenting all the above-mentioned activities, the following are retained QA records and project records (previous discussions in this section relate where and how these data are stored):

- All original raw data, whether hard copy or electronic, for calibrations, samples and quality control measures, including analysts' work sheets and data output records (chromatograms, strip charts, and other instrument response readout records);
- A written description or reference to the specific test method used which includes a description of the specific computational steps used to translate parametric observations into a reportable analytical value;
- Copies of final reports;
- Archived SOPs;
- Correspondence relating to laboratory activities for a specific project;
- All corrective action reports, audits and audit responses;
- Proficiency test results and raw data; and
- Results of data review, verification, and crosschecking procedures

14.3.1) Sample Handling Records

Records of all procedures to which a sample is subjected while in the possession of the laboratory are maintained. These include but are not limited to records pertaining to:

- Sample preservation including appropriateness of sample container and compliance with holding time requirements;
- Sample identification, receipt, acceptance or rejection and login;
- Sample storage and tracking including shipping receipts, sample transmittal/COC forms; and

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- Procedures for the receipt and retention of samples, including all provisions necessary to protect the integrity of samples.

14.4) Administrative Records
The laboratory also maintains the administrative records in either electronic or hard copy form. Refer to Section 14.1.

14.5) Records Management, Storage, and Disposal
All records (including those pertaining to test equipment), certificates and reports are safely stored, held secure and in confidence to the client. Certification related records are available upon request.

All information necessary for the historical reconstruction of data is maintained by the laboratory. Records that are stored only on electronic media must be supported by the hardware and software necessary for their retrieval.

Records that are stored or generated by computers or personal computers have hard copy, write-protected backup copies, or an electronic audit trail controlling access.

The laboratory has a record management system (a.k.a., document control) for control of laboratory notebooks, instrument logbooks, standards logbooks, and records for data reduction, validation, storage and reporting. Laboratory notebooks are issued on a per analysis basis, and are numbered sequentially. All data are recorded sequentially within a series of sequential notebooks. Bench sheets are filed sequentially. Standards are maintained in LIMS – no logbooks are used to record that data. Records are considered archived when noted as such in the record management system.

14.5.1) Transfer of Ownership
In the event that the laboratory transfers ownership or goes out of business, the laboratory shall ensure that the records are maintained or transferred according to client's instructions. Upon ownership transfer, record retention requirements shall be addressed in the ownership transfer agreement and the responsibility for maintaining archives is clearly established. In addition, in cases of bankruptcy, appropriate regulatory and state legal requirements concerning laboratory records must be followed. In the event of the closure of the laboratory, all records will revert to the control of NDSC. Should the entire company cease to exist, as much notice as possible will be given to clients and the accrediting bodies who have worked with the laboratory during the previous five (5) years of such action.

14.5.2) Records Disposal
Records are removed from the archive and destroyed after five (5) years unless otherwise specified by a client or regulatory requirement. On a project- or program-specific basis, clients may need to be notified prior to record destruction. Records are destroyed in a manner that ensures their confidentiality such as shredding, mutilation or incineration. (Refer to Section 14.1.)

Electronic copies of records must be destroyed by erasure or physically damaging off-line storage media so no records can be read.

If a third party records management company is hired to dispose of records, a "Certificate of Destruction" (or however named) is required.

15) AUDITS

15.1) Internal Audits
Internal audits are performed to verify that laboratory operations comply with the requirements of the laboratory's quality system and with the external quality programs under which the laboratory operates. Audits are planned and organized by the QA staff. Personnel conducting the audits should be independent of the area being evaluated. Auditors will have sufficient authority, access to work areas,

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and organizational freedom necessary to observe all activities affecting quality and to report the assessments to laboratory management and, when requested, to Executive Management.

Audits are conducted and documented as described in NDSC Document No. CW-Q-S-003 (Internal Auditing). The types and frequency of routine internal audits are described in the table below. Special or ad hoc assessments may be conducted as needed under the direction of the QA staff.

Description	Performed by	Frequency
Quality System Audit	QA Department, QA-approved designee, or NDSC-QA	All areas of the laboratory annually
Method Audits QA Technical Audits	Joint Responsibility: 1. QA Manager or designee 2. Technical Manager or designee (Refer to NDSC SOP CW-Q-S-003)	All methods over 2 years (50% of methods annually)
SOP Method Compliance	Joint Responsibility: 1. QA Manager or designee 2. Technical Manager or designee (Refer to NDSC SOP CW-Q-S-003)	Every 2 years (annually for Drinking Water methods)
Special	QA Department or designee	Surveillance or spot checks performed as needed (e.g., to confirm corrective actions from other audits)
Performance Testing	Analysts with Technical Manager and QA oversight	Twice per year for each TNI Field of Proficiency Testing (FoPT) or as dictated by regulatory requirements

15.1.1) Annual Quality Systems Audit
An annual quality systems audit is required to ensure compliance to analytical methods and SOPs, Eurofins Data Integrity and Ethics Policies (see Section 5.2), TNI quality systems, client and state requirements, and the effectiveness of the internal controls of the analytical process, including but not limited to data review, quality controls, preventive action and corrective action. The completeness of earlier corrective actions is assessed for effectiveness & sustainability. The audit is divided into sections for each operating or support area of the lab, and each section is comprehensive for a given area. The area audits may be performed on a rotating schedule throughout the year to ensure adequate coverage of all areas. This schedule may change as situations in the laboratory warrant.

15.1.2) QA Technical Audits
QA technical audits assess data authenticity and analyst integrity. These audits are based on client projects, associated sample delivery groups, and the methods performed. Reported results are compared to raw data to verify the authenticity of results. The validity of calibrations and QC results are compared to data qualifiers, footnotes, and case narratives. Documentation is assessed by examining run logs and records of manual integrations. Manual calculations are checked. Where possible, electronic audit miner programs (e.g., Chrom AuditMiner) are used to identify unusual manipulations of the data deserving closer scrutiny. QA technical audits will include all methods within a two-year period.

15.1.3) SOP Method Compliance
Compliance of all SOPs with the source methods and compliance of the operational groups with the SOPs will be assessed by the Technical Manager or qualified designee at least every two years. (Annually for methods and administrative SOPs related to Drinking Water compliance methods.) It is also recommended that the work of each newly hired analyst is assessed within 3

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months of working independently, (e.g., completion of method IDOC). In addition, as analysts add methods to their capabilities, (new IDOC) reviews of the analyst work products will be performed within 3 months of completing the documented training.

15.1.4) Special Audits

Special audits are conducted on an as needed basis, generally as a follow up to specific issues such as client complaints, corrective actions, PT results, data audits, system audits, validation comments, regulatory audits or suspected ethical improprieties. Special audits are focused on a specific issue, and report format, distribution, and timeframes are designed to address the nature of the issue.

15.1.5) Performance Testing

The laboratory participates semi-annually in performance audits conducted through the analysis of PT samples provided by a third party. The laboratory participates in the following types of semi-annual PT studies: Drinking Water (DW), Non-Potable Water (WP), Soil/Hazardous Waste (HW), and state-specific studies for Underground Storage Tank Programs (UST). The laboratory also participates annually in PT studies for Drinking Water Microbiology (WSM) and Non-Potable Water Microbiology (WPM).

It is Eurofins policy that PT samples be treated as typical samples in the production process. Furthermore, where PT samples present special or unique problems, in the regular production process they may need to be treated differently, as would any special or unique request submitted by any client. The QA Manager must be consulted and in agreement with any decisions made to treat a PT sample differently due to some special circumstance.

Written investigations for unacceptable PT results are required. (Refer to laboratory SOP No. *CED-Q-NCW-SOP42901*.) In some cases it may be necessary for blind QC samples to be submitted to the laboratory to show a return to control.

15.2) External Audits

External audits are performed when certifying agencies or clients conduct on-site inspections or submit performance testing samples for analysis. It is Eurofins policy to cooperate fully with regulatory authorities and clients. The laboratory makes every effort to provide the auditors with access to personnel, documentation, and assistance. Laboratory supervisors are responsible for providing corrective actions to the QA Manager who coordinates the response. Audit responses are due in the time allotted by the client or agency performing the audit.

The laboratory cooperates with clients and their representatives to monitor the laboratory's performance in relation to work performed for the client. The client may only view data and systems related directly to the client's work. All efforts are made to keep other client information confidential.

15.2.1) Confidential Business Information (CBI) Considerations

During on-site audits, auditors may come into possession of information claimed as business confidential. A business confidentiality claim is defined as "a claim or allegation that business information is entitled to confidential treatment for reasons of business confidentiality or a request for a determination that such information is entitled to such treatment." When information is claimed as business confidential, the laboratory must place on (or attach to) the information at the time it is submitted to the auditor, a cover sheet, stamped or typed legend or other suitable form of notice, employing language such as "trade secret", "proprietary" or "company confidential". Confidential portions of documents otherwise non-confidential must be clearly identified. CBI may be purged of references to client identity by the responsible laboratory official at the time of removal from the laboratory. However, sample identifiers may not be obscured from the information. Additional information regarding CBI can be found in within the 2009 and 2016 TNI standards.

15.3) Audit Findings

Audit findings are documented using the corrective action process and database (see Section 12). The laboratory's corrective action responses may include action plans that could not be completed within a

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predefined timeframe. In these instances, a completion date must be set and agreed to by Operations management and the QA Manager.

Developing and implementing corrective actions to findings is the responsibility of the Technical Manager where the finding originated. Findings that are not corrected by specified due dates are reported monthly to management in the QA monthly report.

If any audit finding casts doubt on the effectiveness of the operations or on the correctness or validity of the laboratory's test results, the laboratory shall take timely corrective action, and shall notify clients in writing if the investigations show that the laboratory results have been affected. Once corrective action is implemented, a follow-up audit is scheduled to ensure that the problem has been corrected.

Clients must be notified promptly in writing of any event such as the identification of defective measuring or test equipment that casts doubt on the validity of results given in any test report or amendment to a test report. The investigation must begin within 24 hours of discovery of the problem and all efforts are made to notify the client within two weeks after the completion of the investigation.

16) MANAGEMENT REVIEWS

16.1) Quality Assurance Report

The QA Department is responsible for preparing a comprehensive monthly metrics report to Management to keep them apprised of current quality issues. This report fosters communication, review, and refinement of the QA system to evaluate the suitability of policies and procedures to meet both regulatory and laboratory quality objectives.

The NDSC QA team compiles information from all of the Environment Testing laboratories' monthly metrics reports for the Executive Management team. This report includes notable information and concerns regarding the laboratories' QA program and a listing of new regulations that may potentially impact the laboratories.

16.2) Annual Management Review

The Laboratory Management team (Laboratory Director, Technical Managers, QA Manager) conducts a review annually of its management systems to ensure its continuing suitability and effectiveness in meeting client and regulatory requirements and to introduce any necessary changes or improvements. It will also provide a platform for defining goals, objectives and action items that feed into the laboratory planning system. NDSC personnel is to be included in this meeting at the discretion of the Laboratory Director. The LIMS review consists of examining any audits, complaints or concerns that have been raised through the year that are related to LIMS. The laboratory will summarize any critical findings that cannot be solved by the lab and report them to NDSC IT.

This management systems review (NDSC SOP No. CW-Q-S-004 and Work Instruction No. CW-Q-WI-003) uses information generated during the preceding year to assess the "big picture" by ensuring that routine actions taken and reviewed on a monthly basis are not components of larger systematic concerns. The monthly review should keep the quality systems current and effective, therefore, the annual review is a formal senior management process to review specific existing documentation. Significant issues from the following documentation are compiled or summarized by the Laboratory Director and QA Manager prior to the review meeting:

- Matters arising from the previous annual review.
- Prior Monthly QA Reports issues.
- Laboratory QA Metrics.
- Review of report reissue requests.
- Review of client feedback and complaints.
- Issues arising from any prior management or staff meetings.
- Minutes from prior senior lab management meetings. Issues that may be raised from these meetings include:
  - Adequacy of staff, equipment and facility resources.
  - Adequacy of policies and procedures.

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    - Future plans for resources and testing capability and capacity.
- The annual internal double blind PT program sample performance (if performed),
- Compliance to the Ethics Policy and Data Integrity Plan. Including any evidence/incidents of inappropriate actions or vulnerabilities related to data Integrity.
- For labs analyzing radioactive samples, also include the following:
    - Radiation health and safety.
    - Radioactive hazardous waste management.
    - Radioactive materials management.
- Evaluation of overall risk, including risks to impartiality, confidentiality, reporting statements of conformity, and nonconforming work.

A report is generated by the QA Manager and Laboratory Director. The report is distributed to the Laboratory Management team, President of the Business Unit, and Quality Director. The report includes, but is not limited to:

- The date of the review and the names and titles of participants.
- A reference to the existing data quality related documents and topics that were reviewed.
- Quality system or operational changes or improvements that will be made as a result of the review [e.g., an implementation schedule including assigned responsibilities for the changes (Action Table)].

Changes to the quality systems requiring update to the laboratory QA Manual shall be included in the next revision of the QA Manual.

16.3) Potential Integrity Related Managerial Reviews

Potential integrity issues (data or business related) must be handled and reviewed in a confidential manner until such time as a follow-up evaluation, full investigation, or other appropriate actions have been completed and issues clarified. The NDSC Document No. CW-L-S-002 (Internal Investigations) shall be followed. All investigations that result in finding of inappropriate activity are documented and include any disciplinary actions involved, corrective actions taken, and all appropriate notifications of clients.

The Eurofins Environment Testing America Presidents, Business Unit Managers, Laboratory Directors, and NDSC QA Team are informed of any current data integrity or data recall investigations via the monthly metrics report.

17) TEST METHODS AND METHOD VALIDATION

17.1) Overview

The laboratory uses methods that are appropriate to meet our clients' requirements and that are within the scope of the laboratory's capabilities. These include sampling, handling, transport, storage and preparation of samples, and, where appropriate, an estimation of the measurement of uncertainty as well as statistical techniques for analysis of environmental data.

Instructions are available in the laboratory for the operation of equipment as well as for the handling and preparation of samples. All instructions, Standard Operating Procedures (SOPs), reference methods and manuals relevant to the working of the laboratory are readily available to all staff. Deviations from published methods are documented (with justification) in the laboratory's approved SOPs. SOPs are submitted to clients and regulatory agencies for review at their request. Significant deviations from published methods require client approval and regulatory approval where applicable.

17.2) Standard Operating Procedures (SOPs)

The laboratory maintains SOPs that accurately reflect all phases of the laboratory such as assessing data integrity, corrective actions, handling customer complaints as well as all analytical methods and sampling procedures. The method SOPs are derived from the most recently promulgated/approved, published methods and are specifically adapted to the laboratory facility. Modifications or clarifications to published methods are clearly noted in the SOPs. All SOPs are controlled in the laboratory.

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- All SOPs contain a revision number, effective date, and appropriate approval signatures. Controlled copies are available to all staff.
- Procedures for writing an SOP are incorporated by reference to NDSC Document No. CW-Q-S-002 (Writing a Standard Operating Procedure).
- SOPs are reviewed at a minimum of every 2 years (annually for Drinking Water method SOPs), and where necessary, revised to ensure continuing suitability and compliance with applicable requirements.

17.3) Laboratory Methods Manual

For each test method, the laboratory shall have available the published referenced method as well as the laboratory developed SOP.

Note: If more stringent standards or requirements are included in a mandated test method or regulation than those specified in this QA manual, the laboratory shall demonstrate that such requirements are met. If it is not clear which requirements are more stringent, the standard from the method or regulation is to be followed. Any exceptions or deviations from the referenced methods or regulations are noted in the specific analytical SOP.

The laboratory maintains an SOP Index for both technical and non-technical SOPs. Technical SOPs are maintained to describe a specific test method. Non-technical SOPs are maintained to describe functions and processes not related to a specific test method.

17.4) Selection of Methods

Since numerous methods and analytical techniques are available, continued communication between the client and laboratory is imperative to assure the correct methods are utilized. Once client methodology requirements are established, this and other pertinent information is summarized by the PM. These mechanisms ensure that the proper analytical methods are applied when the samples arrive for log-in. For non-routine analytical services (e.g., special matrices, non-routine compound lists), the method of choice is selected based on client needs and available technology. The methods selected should be capable of measuring the specific parameter of interest, in the concentration range of interest, and with the required precision and accuracy.

17.4.1) Sources of Methods

Routine analytical services are performed using standard EPA-approved methodology. In some cases, modification of standard approved methods may be necessary to provide accurate analyses of particularly complex matrices. When the use of specific methods for sample analysis is mandated through project or regulatory requirements, only those methods shall be used.

When clients do not specify the method to be used or methods are not required, the methods used will be clearly validated and documented in an SOP and available to clients and/or the end user of the data. Refer to Appendix 6 for a list of the currently accepted U.S. EPA analytical method references used by the laboratory.

The laboratory reviews updated versions to all the aforementioned references for adaptation based upon capabilities, instrumentation, etc., and implements them as appropriate. As such, the laboratory strives to perform only the latest versions of each approved method as regulations allow or require.

Other reference procedures for non-routine analyses may include methods established by specific states (e.g., Underground Storage Tank methods), ASTM or equipment manufacturers. Sample type, source, and the governing regulatory agency requiring the analysis will determine the method utilized.

The laboratory shall inform the client when a method proposed by the client may be inappropriate or out of date. After the client has been informed, and they wish to proceed contrary to the laboratory's recommendation, it will be documented.

17.4.1.1) Client Supplied Methods

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Most of the client-supplied method requirements presented to us involve achieving specific quality control criteria, limits of quantitation (LOQ), and/or method detection limits (MDL) using standard EPA methods. These requirements are communicated to the appropriate technical groups prior to the project start up. Each technical group evaluates the scope of work and the requirements to ensure the criteria can be met using the standard EPA method. The data is monitored to ensure the criteria are met throughout the project. The PM notifies the client if there is a more appropriate method available or if the client's criteria cannot be achieved on a certain sample matrix (i.e., due to matrix or dilutions).

Occasionally, we are asked to transfer a non-standardized method from a client into our lab or to develop a new method, when one is not available. In the case of a method transfer, we set up the client's method and perform some initial evaluation. After the initial evaluation, we may make recommendations on how to improve method performance. If the method appears to be adequate, we determine linearity, specificity, precision, accuracy, MDL, and LOQ by performing calibrations, analyzing method blanks, and carrying out method detection limit and IDOC studies.

In the case of method development, we work with the client and/or data user to determine the level of validation required ensuring that the method meets its intended purpose. In addition to the elements above, we also determine standard and sample stability and robustness depending on the scope of the project. Typically, a standard operating procedure is written and submitted to the client with the results of the validation. These steps are completed prior to analysis of field samples. Data related to the setup of the method are archived.

17.4.1.2) Procedural Deviations

Analysts are required to follow a documented method for all tests performed; and any deviations from analytical methods must be documented, approved, and justified in an appropriate and consistent manner. We classify method deviations as either being a planned deviation or an unplanned deviation. In general, the following information is captured to document both types of situations:

- Description of the situation;
- Reason or justification for the deviation;
- Impact the deviation had on the testing;
- Signature/date of analyst performing the test;
- Signature/date of QA and Laboratory management approving the deviation;
- Signature/date of client approval, if necessary.

Deviations to written procedures are documented in raw data records, ICAT or through the NCM system. Both types of documentation require management review and approval.

17.4.2) Demonstration of Capability

Before the laboratory may institute a new method and begin reporting results, the laboratory shall confirm that it can properly operate the method. In general, this demonstration does not test the performance of the method in real world samples, but in an applicable and available clean matrix sample. If the method is for the testing of analytes that are not conducive to spiking, demonstration of capability may be performed on quality control samples.

A demonstration of capability (DOC; see laboratory SOP No. *CED-R-PE-SOP42903*) is performed whenever there is a change in instrument type (e.g., new instrumentation), matrix, method or personnel (e.g., new analyst).

Note: The laboratory shall have a DOC for all analytes included in the methods that the laboratory performs, and proficiency DOCs for each analyst shall include all analytes that the laboratory routinely performs. Addition of non-routine analytes does not require new DOCs for all analysts if those analysts are already qualified for routine analytes tested using identical chemistry and instrument conditions.

The initial demonstration of capability must be thoroughly documented and approved by the Technical Manager and QA Manager prior to independently analyzing client samples. All associated documentation must be retained in accordance with the laboratory's archiving procedures.

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The laboratory must have an approved SOP, demonstrate satisfactory performance, and conduct an MDL study (when applicable). There may be other requirements as stated within the published method or regulations (e.g., retention time window study).

Note: In some instances, a situation may arise where a client requests that an unusual analyte be reported using a method where this analyte is not normally reported. If the analyte is being reported for regulatory purposes, the method must meet all procedures outlined within this QA Manual (SOP, MDL, and Demonstration of Capability). If the client states that the information is not for regulatory purposes, the result may be reported as long as the following criteria are met:

- The instrument is calibrated for the analyte to be reported using the criteria for the method and ICV/CCV criteria are met (unless an ICV/CCV is not required by the method or criteria are per project DQOs).
- The laboratory's nominal or default reporting limit (RL) is equal to the quantitation limit (QL), must be at or above the lowest non-zero standard in the calibration curve and must be reliably determined. Project RLs are client specified reporting levels which may be higher than the QL. Results reported below the QL must be qualified as estimated values. Also see Section 17.6.1(3), Relationship of Limit of Detection (LOD) to Quantitation Limit (QL).
- The client request is documented and the laboratory informs the client of its procedure for working with unusual compounds. The final report must be footnoted: *Reporting Limit based on the low standard of the calibration curve.*

17.4.3) Initial Demonstration of Capability (IDOC) Procedures

The general procedure for completing an IDOC is summarized below. For a full description, refer to laboratory SOP No. *CED-R-PE-SOP42903* (Laboratory Personnel Training).

a) The analyte(s) shall be diluted in a volume of clean matrix sufficient to prepare four (4) aliquots at the concentration specified by a method or in the laboratory SOP.

b) At least four (4) aliquots shall be prepared and analyzed according to the test method, either concurrently or over a period of days.

c) Using all of the results, calculate the mean recovery in the appropriate reporting units and the standard deviations of the sample (in the same units) for each analyte of interest. When it is not possible to determine mean and standard deviations, such as for presence/absence and logarithmic values, the laboratory shall assess performance against established and documented criteria (refer to the applicable method SOP).

d) Compare the information from (c) above to the corresponding acceptance criteria for precision and accuracy in the test method (if applicable) or in laboratory-generated acceptance criteria (if there are not established mandatory criteria). If all analytes meet the acceptance criteria, the analysis of actual samples may begin. If any one of the analytes does not meet the acceptance criteria, the performance is unacceptable for that analyte.

e) When one or more of the tested analytes fail at least one (1) of the acceptance criteria, the analyst must proceed according to i) or ii) below.

i. Locate and correct the source of the problem and repeat the test for all analytes of interest beginning with b) above.

ii. Beginning with b) above, repeat the test for all analytes that failed to meet criteria.

f) Repeated failure, however, confirms a general problem with the measurement system. If this occurs, locate and correct the source of the problem and repeat the test for all analytes of interest beginning with b).

g) When an analyte not currently found on the laboratory's list of accredited analytes is added to an existing accredited method, an initial demonstration shall be performed for that analyte.

Note: Results of successive LCS analyses can be used to fulfill the DOC requirement.

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17.5) Laboratory Developed Methods and Non-Standard Methods

Any new method developed by the laboratory must be fully defined in an SOP and validated by qualified personnel with adequate resources to perform the method. Method specifications and the relation to client requirements must be clearly conveyed to the client if the method is a non-standard method (not a published or routinely accepted method). The client must also be in agreement to the use of the non-standard method.

17.6) Validation of Methods

Validation is the confirmation by examination and the provision of objective evidence that the particular requirements for a specific intended use are fulfilled.

All non-standard methods, laboratory designed/developed methods, standard methods used outside of their scope, and major modifications to published methods must be validated to confirm they are fit for their intended use. The validation will be as extensive as necessary to meet the needs of the given application. The results are documented with the validation procedure used and contain a statement as to the fitness for use.

17.6.1) Method Validation and Verification Activities for All New Methods

While method validation can take various courses, the following activities can be required as part of method validation. Method validation records are designated QC records and are archived accordingly.

When changes are made to any validated methods, the influence of such changes shall be documented and, if appropriate, a new validation shall be performed.

1. **Determination of Method Selectivity** - method selectivity is the demonstrated ability to discriminate the analyte(s) of interest from other compounds or interferences in the specific sample matrix or matrices. In some cases, to achieve the required selectivity for an analyte, a confirmation analysis is required as part of the method.
2. **Determination of Method Sensitivity** - Sensitivity can be both estimated and demonstrated. Whether a study is required to estimate sensitivity depends on the level of method development required when applying a particular measurement system to a specific set of samples. Detection limit studies are conducted as described in Section 17.7. Where other protocols for estimations and/or demonstrations of sensitivity are required by regulation or client agreement, these shall be followed.
3. **Relationship of Limit of Detection (LOD) to the Limit of Quantitation (LOQ)** - An important characteristic of expression of sensitivity is the distinction between the LOD and the LOQ. The LOD is the minimum level at which the presence of an analyte can be reliably concluded. The LOQ is the minimum concentration of analyte that can be quantitatively determined with acceptable precision and bias, equivalent to the laboratory's routine reporting limit (RL). For most instrumental measurement systems, there is a region where semi-quantitative data is generated around the LOD (both above and below the estimated MDL or LOD) and below the LOQ. In this region, detection of an analyte may be confirmed but quantification of the analyte is unreliable within the accuracy and precision guidelines of the measurement system. When an analyte is detected below the LOQ, and the presence of the analyte is confirmed by meeting the qualitative identification criteria for the analyte, the analyte can be reliably reported, but the amount of the analyte can only be estimated. If data is to be reported in this region, it must be done so with a qualification that denotes the semi-quantitative nature of the result.
4. **Determination of Interferences** - A determination that the method is free from interferences in a blank matrix is performed.
5. **Determination of Range** - Where appropriate to the method, the quantitation range is determined by comparison of the response of an analyte in a curve to established or targeted criteria. Generally the upper quantitation limit is defined by highest acceptable calibration concentration. The lower quantitation limit or QL cannot be lower than the lowest non-zero calibration level, and can be constrained by required levels of bias and precision.
6. **Determination of Accuracy and Precision** - Accuracy and precision studies are generally performed using replicate analyses, with a resulting percent recovery and measure of

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reproducibility (standard deviation, relative standard deviation) calculated and measured against a set of target criteria. (Refer to Section 17.4.3 for Initial Demonstration of Capability.)

7. **Documentation of Method** - The method is formally documented in an SOP. If the method is a minor modification of a standard laboratory method that is already documented in an SOP, an Attachment to the SOP describing the specific differences in the new method is acceptable in place of a separate SOP.
8. **Continued Demonstration of Method Performance** - Continued demonstration of method performance is addressed in the SOP. Continued demonstration of method performance is generally accomplished by batch-specific QC samples such as the LCS and method blanks, or PT samples.

17.7) Method Detection Limit (MDL) / Limit of Detection (LOD)

The MDL is the minimum measured quantity of a substance that can be reported with 99% confidence that the concentration is distinguishable from method blank results, consistent with 40CFR Part 136 Appendix B, (August 2017). The MDL is equivalent to the TNI LOD or DL. The working or final MDL is the higher of the MDL value determined from spikes (MDL_s) and the MDL value determined from blanks (MDL_b). An initial MDL study shall be performed during the method validation process and when the method is altered in a way that can reasonably be expected to change its sensitivity. On-going data are collected during each quarter in which samples are being analyzed. At least once every 13 months the MDL_s and MDL_b are re-calculated and re-evaluated using data collected during the preceding period. Details of the laboratory's procedure for conducting MDL studies are given in Document No. *CED-Q-MDL-SOP42710*.

17.8) Verification of Detection Limits

If it is found during the re-evaluation of detection limit results that more than 5% of the spiked samples do not return positive numeric results that meet all method qualitative identification criteria, then the spiking level shall be increased and the initial MDL study re-performed at the new spiking concentration.

17.9) Instrument Detection Limit (IDL)

The IDL is sometimes used to assess the reasonableness of the MDL or in some cases required by the analytical method or program requirements. IDLs are most commonly used in metals analyses but may be useful in demonstration of instrument performance in other areas.

IDLs are calculated to determine an instrument's sensitivity independent of any preparation method. IDLs may be calculated as the mean of the instrument blank result plus three times the standard deviation of >10 replicate analyses of the reagent blank solution (use zero for the mean if the mean is negative).

17.10) Limit of Quantitation (LOQ)

The LOQ (equivalent to the Reporting Limit, or RL) shall be at a concentration equivalent to the lowest calibration standard concentration, with the exception of methods using a single-point calibration, and shall be greater than the MDL. The LOQ is verified by preparing and analyzing spikes at concentrations 1-2 times the selected LOQ, employing the complete analytical process.

When the laboratory establishes a quantitation limit, it must be initially verified by the analysis of a low level standard or QC sample at 1-2 times the reporting limit or by a DL check samples at or below the LOQ. The LOQ is verified annually thereafter. The annual requirement is waived for methods that have an annually verified MDL. The laboratory will comply with any regulatory requirements.

17.11) Retention Time Windows

Most organic analyses and some inorganic analyses use chromatography techniques for qualitative and quantitative determinations. For every chromatography analysis or as specified in the reference method, each analyte will have a specific time of elution from the column to the detector. This is known as the analyte's retention time. The variance in the expected time of elution is defined as the retention time window. As the key to analyte identification in chromatography, retention time windows must be

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established on every column for every analyte used for that method. These records are kept on-file and available for review. Complete details are available in the laboratory SOPs.

17.12) Evaluation of Selectivity

The laboratory evaluates selectivity by following the checks within the applicable analytical methods, which include mass spectral tuning, second column confirmation, ICP interelement interference checks, chromatography retention time windows, sample blanks, spectrochemical, atomic absorption or fluorescence profiles, co-precipitation evaluations and specific electrode response factors.

17.13) Estimation of Uncertainty of Measurement

Uncertainty is "a parameter associated with the result of a measurement, that characterizes the dispersion of the values that could reasonably be attributed to the measurand" (as defined by the International Vocabulary of Basic and General Terms in Metrology, ISO Geneva, 1993, ISBN 92-67-10175-1). Knowledge of the uncertainty of a measurement provides additional confidence in a result's validity. Its value accounts for all the factors which could possibly affect the result, such as adequacy of analyte definition, sampling, matrix effects and interferences, climatic conditions, variances in weights, volumes, and standards, analytical procedure, and random variation. Some accreditation organizations require the use of an "expanded uncertainty" defined as the range within which the value of the measurand is believed to lie within at least a 95% confidence level with the coverage factor k=2.

Uncertainty is not error. Error is a single value (i.e., the difference between the true result and the measured result). On environmental samples, the true result is never known. The measurement is the sum of the unknown true value and the unknown error. Unknown error is a combination of systematic error, or bias, and random error. Bias varies predictably, constantly, and independently from the number of measurements. Random error is unpredictable, assumed to be Gaussian in distribution, and reducible by increasing the number of measurements.

- The minimum uncertainty associated with results generated by the laboratory can be determined by using the Laboratory Control Sample (LCS) accuracy range for a given analyte. The LCS limits are used to assess the performance of the measurement system since they take into consideration all of the laboratory variables associated with a given test over time (except for variability associated with the sampling and the variability due to matrix effects). The percent recovery of the LCS is compared either to the method-required LCS accuracy limits or to the statistical, historical, in-house LCS accuracy limits.
- To calculate the uncertainty for the specific result reported, multiply the result by the decimal of the lower end of the LCS range percent value for the lower end of the uncertainty range, and multiply the result by the decimal of the upper end of the LCS range percent value for the upper end of the uncertainty range. These calculated values represent expanded uncertainties at approximately the 99% confidence level with a coverage factor of k=3. As an example, for a reported result of 1.0 mg/L with an LCS recovery range of 50 to 150%, the estimated uncertainty in the result would be 1.0 +/- 0.5 mg/L.
- In the case where a well-recognized test method specifies limits to the values of major sources of uncertainty of measurement (e.g., 524.2, 525, etc.) and specifies the form of presentation of calculated results, no further discussion of uncertainty is required.

Further information on the laboratory's procedures for estimating measurement uncertainty can be found in laboratory SOP No. *CED-Q-MU-SOP42898* (Estimating Measurement Uncertainty).

17.14) Sample Reanalysis Guidelines

Because there is a certain level of uncertainty with any analytical measurement, a sample re-preparation (where appropriate) and subsequent analysis (hereafter referred to as 'reanalysis') may result in either a higher or lower value from the initial sample analysis. There are also variables that may be present (e.g., sample homogeneity, analyte precipitation over time, etc.) that may affect the results of a reanalysis. Based on the above comments, the laboratory will reanalyze samples at a client's request with the following caveats. **Client specific Contractual Terms & Conditions for reanalysis protocols may supersede the following items.**

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Homogenous samples: If a reanalysis agrees with the original result to within the RPD limits for MS/MSD or Duplicate analyses, or within ± 1 reporting limit for samples ≤ 5× the reporting limit, the original analysis will be reported. At the client's request, both results may be reported on the same report but not on two separate reports.

- If the reanalysis does not agree (as defined above) with the original result, then the laboratory will investigate the discrepancy and reanalyze the sample a third time for confirmation if sufficient sample is available.
- Any potential charges related to reanalysis are discussed in the contract terms and conditions or discussed at the time of the request. The client will typically be charged for reanalysis unless it is determined that the laboratory was in error.
- Due to the potential for increased variability, reanalysis may not be applicable to non-homogenous, Encore, and sodium bisulfate preserved samples. See the Area Supervisor or Laboratory Director if unsure.

17.15) Control of Data

The laboratory has policies and procedures in place to ensure the authenticity, integrity, and accuracy of the analytical data generated by the laboratory.

17.15.1) Computer and Electronic Data Related Requirements

The three basic objectives of our computer security procedures and policies are shown below.

The laboratory is currently using the Eurofins LIMS System ("ELS", previously known as "TALS"), which has been highly customized to meet the needs of the laboratory.

1.) Maintain the Database Integrity - Assurance that data is reliable and accurate through data verification (review) procedures, password-protecting access, anti-virus protection, data change requirements, as well as an internal LIMS permissions procedure.

- LIMS Database Integrity is achieved through data input validation, internal user controls, documentation of system failures and corrective actions taken, and data change requirements.

- Spreadsheets and other software developed in-house must be verified with documentation through hand calculations prior to use. Cells containing calculations must be lock-protected and controlled.

- Instrument hardware and software adjustments are safeguarded through maintenance logs, audit trails and controlled access.

2.) Ensure Information Availability - Protection against loss of information or service is ensured through scheduled back-ups, stable file server network architecture, secure storage of media, line filter, Uninterruptible Power Supply (UPS), and maintaining older versions of software as revisions are implemented.

3.) Maintain Confidentiality - Ensure data confidentiality through physical access controls such as password protection or website access approval when electronically transmitting data.

17.15.2) Data Reduction

The complexity of the data reduction depends on the analytical method and the number of discrete operations involved (e.g., extractions, dilutions, instrument readings and concentrations). The analyst calculates the final results from the raw data or uses appropriate computer programs to assist in the calculation of final reportable values.

For manual data entry (e.g., Wet Chemistry), the data is reduced by the analyst and then verified by the Department Manager or alternate analyst prior to updating the data in LIMS. The spreadsheets, or any other type of applicable documents, are signed by both the analyst and alternate reviewer to confirm the accuracy of the manual entry(s).

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Manual integration of peaks will be documented and reviewed and the raw data will be flagged using NDSC Document No. CA-Q-S-002 (Acceptable Manual Integration Practices).

Analytical results are reduced to appropriate concentration units specified by the analytical method, taking into account factors such as dilution, sample weight or volume, etc. Blank correction will be applied only when required by the method or per manufacturer's indication; otherwise, it should not be performed. Calculations are independently verified by appropriate laboratory staff. Calculations and data reduction steps for various methods are summarized in the respective analytical SOPs or program requirements.

- All raw data must be retained in the worklist folder, computer file (if appropriate), and/or runlog. All criteria pertinent to the method must be recorded. The documentation is recorded at the time observations or calculations are made and must be signed or initialed/dated (month/day/year). It must be easily identifiable who performed which tasks if multiple people were involved.
- In general, concentration results are reported in milligrams per liter (mg/L) or micrograms per liter (µg/L) for liquids, and milligrams per kilogram (mg/kg) or micrograms per kilogram (µg/kg) for solids. For values greater than 10,000 mg/L, results can be reported in percent (e.g., 10,000 mg/L = 1%). Units are defined in each laboratory SOP.
- In reporting, the analyst or the instrument output records the raw data result using values of known certainty plus one uncertain digit. If final calculations are performed external to LIMS, the results should be entered in LIMS with at least three significant figures. In general, results are presented on the final report with two or three significant figures, depending on client specifications and the formatter used.
- For those methods that do not have an instrument printout or an instrumental output compatible with the LIMS, the raw results and dilution factors are entered directly into LIMS by the analyst, and the software calculates the final result for the analytical report. LIMS has a formatter for significant figure criterion for each analyte.
- The laboratory strives to import data directly from instruments or calculation spreadsheets to ensure that the reported data are free from transcription and calculation errors. For those analyses with an instrumental output compatible with the LIMS, the raw results and dilution factors are transferred into LIMS, electronically after reviewing the quantitation report, and removing unrequested or poor spectrally-matched compounds. The analyst may print a copy of what has been entered to check for errors. This printout and the instrument's printout of calibrations, concentrations, retention times, chromatograms, and mass spectra, if applicable, are retained with the data file. The data file is stored in a monthly folder on the instrument computer; periodically, this file is transferred to the server and, eventually, to a tape file.

17.15.3) Logbook / Worksheet Use Guidelines

Logbooks and worksheets are filled out 'real time' and have enough information on them to trace the events of the applicable analysis/task. (e.g. Calibrations, standards, analyst, sample ID, date, time on short holding time tests, temperatures when applicable, calculations are traceable, etc.)

- Corrections are made following the procedures outlined in Section 12.
- Logbooks are controlled by the QA department. A record is maintained of all logbooks in the lab.
- Unused portions of pages must be "Z'd" out, signed and dated.
- Worksheets are created with the approval of the Technical Manager/QA Manager at the facility. The QA Manager controls all worksheets following the procedures in Section 6.

17.15.4) Review / Verification Procedures

Review procedures are outlined in several laboratory SOPs (i.e., *CED-P-PROJ-SOP42905* for Project Management, *CED-P-SAM-SOP42940* for Sample Control, and *CED-P-REV-SOP42955* for Analytical Data Review) to ensure that reported data are free from calculation and transcription errors; and that QC parameters have been reviewed and evaluated before data is reported. The laboratory also abides by NDSC Document No. CA-Q-S-002 discussing Acceptable Manual Integration Practices to ensure the authenticity of the data.

The general review concepts are discussed below, more specific information can be found in the laboratory SOPs.

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17.15.4.1) Log-In Review - The data review process starts at the sample receipt stage. Sample control personnel review chain-of-custody forms and project instructions from the project management group. This is the basis of the sample information and analytical instructions entered into the LIMS. The log-in instructions are reviewed by the personnel entering the information, and a second level review is conducted by the project management staff.

17.15.4.2) First Level Data Review - The next level of data review occurs with the analysts. As data are generated, analysts review their work to ensure that the results meet project and SOP requirements. First level reviews include inspection of all raw data (e.g., instrument output for continuous analyzers, chromatograms, spectra, and manual integrations), evaluation of calibration/calibration verification data in the day's analytical run, evaluation of QC data, and reliability of sample results. The analyst transfers data into LIMS, data qualifiers are added as needed. All first level reviews are documented.

17.15.4.3) Second Level Data Review - All analytical data are subject to review by a second qualified analyst or supervisor. Second level reviews include inspection of all raw data (e.g., instrument output, chromatograms, and spectra) including 100% of data associated with any changes made by the primary analyst, such as manual integrations or reassignment of peaks to different analytes, or elimination of false negative analytes. The second review also includes evaluation of initial calibration/calibration verification data in the day's analytical run, evaluation of QC data, reliability of sample results, qualifiers and NCM narratives. Manual calculations are checked in second level review. All second level reviews are documented.

Issues that deem further review include the following:

- QC data are outside the specified control limits for accuracy and precision
- Reviewed sample data does not match with reported results
- Unusual detection limit changes are observed
- Samples having unusually high results
- Samples exceeding a known regulatory limit
- Raw data indicating some type of contamination or poor technique
- Inconsistent peak integration
- Transcription errors
- Results outside of calibration range

17.15.4.4) Unacceptable analytical results may require reanalysis of the samples. Any problems are brought to the attention of the Laboratory Director, Project Manager, Quality Director/Manager, Technical Manager, or Supervisor for further investigation. Corrective action is initiated whenever necessary.

17.15.4.5) The results are then entered or directly transferred into the computer database and a PDF is printed for the client.

17.15.4.6) As a final review prior to the release of the report, the Project Manager reviews the results for appropriateness and completeness. This review and approval ensures that client requirements have been met and that the final report has been properly completed. The process includes, but is not limited to, verifying that the COC is followed, cover letters / narratives are present, flags are appropriate, and project specific requirements are met. The Project Manager may also evaluate the validity of results for different test methods given expected chemical relationships.

17.15.4.7) Any project that requires a data package is subject to a tertiary data review for transcription errors and acceptable quality control requirements. The Project Manager then signs the final report. The accounting personnel also check the report for any clerical or invoicing errors. When complete, the report is sent out to the client.

17.15.4.8) A brief overview of sample flow and information through the laboratory, as well as data review and validation, is presented in Section 17.16.

17.15.5) Manual Integrations

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Computerized data systems provide the analyst with the ability to re-integrate raw instrument data in order to optimize the interpretation of the data. Though manual integration of data is an invaluable tool for resolving variations in instrument performance and some sample matrix problems, when used improperly, this technique would make unacceptable data appear to meet quality control acceptance limits. Improper re-integrations lead to legally indefensible data, a poor reputation, or possible laboratory decertification. Because guidelines for re-integration of data are not provided in the methods and most methods were written prior to widespread implementation of computerized data systems, the laboratory trains all analytical staff on proper manual integration techniques using NDSC Document No. CA-Q-S-002 (Acceptable Manual Integration Practices).

- The analyst must adjust baseline or the area of a peak in some situations, for example when two compounds are not adequately resolved or when a peak shoulder needs to be separated from the peak of interest. The analyst must use professional judgment to determine when manual integrating is required. Analysts are encouraged to ask for assistance from a senior analyst or manager when in doubt.
- Analysts shall not increase or decrease peak areas for the sole purpose of achieving acceptable QC recoveries that would have otherwise been unacceptable. The intentional recording or reporting of incorrect information (or the intentional omission of correct information) is against company principles and policy and is grounds for immediate termination.
- Client samples, performance evaluation samples, and quality control samples are all treated equally when determining whether or not a peak area or baseline should be manually adjusted.
- All manual integrations receive a second level review. Manual integrations must be indicated on expanded scale "before" and "after" chromatograms such that the integration performed can be easily evaluated during data review.

17.16) Example - Work Flow

Action	Personnel Involved
Bottle orders generated upon request • Bottles packed and shipped to the client under COC	Client Service Personnel/PM/PMA; Bottle Preparation Personnel
Samples received at the laboratory • Unpacked and reconciled against client paperwork or COC • Sample acceptance documented against completed COC[1]	Sample Login Personnel
Sample storage • Short TATs and hold-time samples are delivered directly to laboratory for analysis • Samples stored in assigned locations (refrigerated walk-in coolers, freezers, VOA refrigerator, etc.)	Sample Login Personnel
Sample receipt acknowledgement sent to client	PM/PMA
Sample acquisition and testing • Analysts retrieve samples from assigned storage • Legal COC samples are signed in-and-out of storage • Remaining sample returned to storage	Sample Login Personnel; Analysts
Preparation and analysis is performed according to selected analytical method and applicable Project notes • Raw data recorded/reviewed[2] • Data imported into LIMS	Analysts
LIMS performs calculations • Data reviewed by primary/secondary analysts • Data approved as final	Data Process (LIMS / Analyst)
Generation, review, and release of reports (automated through LIMS)	PM

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• Electronic copy saved in LIMS	
Electronic data deliverables (EDDs) generated as applicable	EDD Group
Hard copy and electronic batch raw data is archived according to data archiving procedures	Analysts; IT

[1]Refer to Section 21.3

[2]Analyses requiring the analyst's interpretation may involve manual data reduction before entry into LIMS.

18) EQUIPMENT AND CALIBRATIONS

18.1) Overview

The laboratory purchases the most technically advanced analytical instrumentation for sample analyses. Instrumentation is purchased on the basis of accuracy, dependability, efficiency and sensitivity. Each laboratory is furnished with all items of sampling, preparation, analytical testing and measurement equipment necessary to correctly perform the tests for which the laboratory has capabilities. Each piece of equipment is capable of achieving the required accuracy and complies with specifications relevant to the method being performed. Before being placed into use, the equipment (including sampling equipment) is calibrated and checked to establish that it meets its intended specification. The calibration routines for analytical instruments establish the range of quantitation. Calibration procedures are specified in laboratory SOPs. A list of available laboratory instrumentation is presented in Section 18.7.

Equipment is only operated by authorized and trained personnel. Manufacturer’s instructions for equipment use are readily accessible to all appropriate laboratory personnel.

18.2) Preventive Maintenance

The laboratory follows a well-defined maintenance program to ensure proper equipment operation and to prevent the failure of laboratory equipment or instrumentation during use. This program of preventive maintenance helps to avoid delays due to instrument failure.

Routine preventive maintenance procedures and frequency, such as cleaning and replacements, should be performed according to the procedures outlined in the manufacturer's manual. Qualified personnel must also perform maintenance when there is evidence of degradation of peak resolution, a shift in the calibration curve, loss of sensitivity, or failure to continually meet one of the quality control criteria.

Scheduled routine maintenance is defined in each method SOP. It is the responsibility of each Technical Manager to ensure that instrument maintenance logs are kept for all equipment in his/her department. Preventative maintenance procedures are also outlined in analytical SOPs or instrument manuals. (Note: for some equipment, the log used to monitor performance is also the maintenance log. Multiple pieces of equipment may share the same log as long as it is clear as to which instrument is associated with an entry.)

Instrument maintenance logs are controlled and are used to document instrument problems, instrument repair and maintenance activities. Maintenance logs shall be kept for all major pieces of equipment. Instrument maintenance logs may also be used to specify instrument parameters.

- Documentation must include all major maintenance activities such as contracted preventive maintenance and service and in-house activities such as the replacement of electrical components, lamps, tubing, valves, columns, detectors, cleaning and adjustments.
- Each entry in the instrument log includes the analyst's initials, the date, a detailed description of the problem (or maintenance needed/scheduled), a detailed explanation of the solution or maintenance performed, and a verification that the equipment is functioning properly (state what was used to determine a return to control, e.g. CCV run on *‘date’* was acceptable, or instrument recalibrated on *‘date’* with acceptable verification, etc.) must also be documented in the instrument records.

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- When maintenance or repair is performed by an outside agency, service receipts detailing the service performed can be affixed into the logbooks adjacent to pages describing the maintenance performed. This stapled in page must be signed across the page entered and the logbook so that it is clear that a page is missing if only half a signature is found in the logbook.

If an instrument requires repair (subjected to overloading or mishandling), gives suspect results, or otherwise has shown to be defective or outside of specified limits it shall be taken out of operation and tagged as out-of-service or otherwise isolated until such a time as the repairs have been made and the instrument can be demonstrated as operational by calibration and/or verification or other test to demonstrate acceptable performance. The laboratory shall examine the effect of this defect on previous analyses.

In the event of equipment malfunction that cannot be resolved, service shall be obtained from the instrument vendor manufacturer, or qualified service technician, if such a service can be tendered. If on-site service is unavailable, arrangements shall be made to have the instrument shipped back to the manufacturer for repair. Back up instruments, which have been approved, for the analysis shall perform the analysis normally carried out by the malfunctioning instrument. If the back-up is not available and the analysis cannot be carried out within the needed timeframe, the samples shall be subcontracted.

At a minimum, if an instrument is sent out for service or transferred to another facility, it must be recalibrated and the laboratory MDL verified (using an MDLV) prior to return to lab operations.

18.3) Support Equipment

This section applies to all devices that may not be the actual test instrument, but are necessary to support laboratory operations. These include but are not limited to: balances, ovens, refrigerators, freezers, incubators, water baths, temperature measuring devices, thermal/pressure sample preparation devices and volumetric dispensing devices if quantitative results are dependent on their accuracy, as in standard preparation and dispensing or dilution into a specified volume. All raw data records associated with the support equipment are retained to document instrument performance.

18.3.1) Weights and Balances

The accuracy of the balances used in the laboratory is checked every working day, before use, with at least four (4) certified ASTM Class 1 weights spanning the balance's range of use. All balances are placed on level, stable counter tops.

Each balance is calibrated prior to initial serviceable use by an approved external calibration service. An approved external calibration service is a calibration laboratory that is accredited to ISO/IEC 17025 by a recognized accreditation body. Thereafter, all balances are serviced and calibrated annually by a qualified service representative, who supplies the laboratory with a certificate that identifies traceability of the calibration to NIST standards.

All weights (including ASTM Class 1) used for daily balance checks or other purposes are recalibrated/recertified annually to NIST standards by an approved external calibration service.

All of the daily balance verification information is recorded in logbooks, and all of the recalibration certificates issued by the external calibration service are kept on file in the QA Department. Additional information on the verification and operation of balances is found in laboratory SOP No. *CED-R-EQ-SOP42930* (Analytical Balance Operation).

18.3.2) pH, Conductivity and Turbidity Meters

The pH meters used in the laboratory are accurate to ± 0.1 pH units, and have a scale readability of at least 0.05 pH units. The meters automatically compensate for the temperature, and are calibrated with at least two working range buffer solutions before each use.

Conductivity meters used in the laboratory are capable of measuring conductivity with an error not exceeding 1% or one µmho/cm, whichever is greater. The meters are also calibrated before each use with a known standard.

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Turbidity meters are calibrated according to the manufacturer's specifications. All of this information is documented in logbooks, either hard copy or electronic.

Consult pH, Conductivity, and Turbidity method SOPs for further information.

18.3.3) Thermometers

All working thermometers are calibrated or otherwise verified at least on an annual basis with a NIST-traceable reference thermometer. Dial-type thermometers are calibrated quarterly.

- If the temperature measuring device is used over a range of 10 °C or less, then a single point verification within the range of use is acceptable.
- If the temperature measuring device is used over a range of greater than 10 °C, then the verification must bracket the range of use.

Infrared (IR) thermometers used to measure the temperature of samples during sample receipt are calibrated on a semi-annual basis over the full temperature range that the device will be used. This includes ambient (20 to 30 °C), iced (4 °C), and frozen (0 to -5 °C), per the Drinking Water Certification Manual. Each day of use, a single verification of the IR thermometer is made by checking the temperature of a bottle of water at the temperature of interest that contains a calibrated thermometer.

Liquid-in-glass reference thermometers are recalibrated every five years (unless the thermometer has been exposed to temperature extremes or apparent separation of internal liquid) by an approved calibration service, and the provided calibration certificate showing traceability to NIST is kept on file. Electronic (i.e., platinum-RTD) reference thermometers are recalibrated annually. The NIST-traceable reference thermometers have increments of ≤ 1 degree (≤ 0.5 degrees are required for the drinking water microbiological section), and have ranges applicable to method and accreditation requirements. The NIST-traceable reference thermometers are used for no other purpose than to calibrate/verify other temperature measuring devices.

All of this information is documented in logbooks. Monitoring of method-specific temperatures, including incubators, heating blocks, water baths, and ovens, is documented in method-specific logbooks.

More information on this subject is found in laboratory SOP No/s. *CED-R-EQ-SOP42915* (In-House Calibration and Verification of Laboratory Support Equipment), and *CED-R-EQ-SOP42968* (Thermometer Operation).

18.3.4) Refrigerator/Freezer Units, Water Baths, Ovens and Incubators

The temperatures of all refrigerator units and freezers used for sample and standard storage are monitored each working day. Sample storage refrigerator temperatures are kept between > 0°C and ≤ 6°C. Freezer temperatures are kept ≤ -10°C.

Ovens, water baths and incubators are monitored on days of use. Specific temperature settings/ranges can be found in method specific SOPs.

All of this equipment has a unique identification number, and is assigned a calibrated thermometer for monitoring.

All of this information is documented in Daily Temperature Logbooks or method-specific logbooks.

18.3.5) Autopipettors, Dilutors, and Syringes

If quantitative results are dependent on their accuracy, such as in standard preparation or dispensing or dilution into a specified volume, volumetric measuring devices shall be checked for accuracy prior to initial use. Each piece of volumetric equipment is given a unique identification number and the delivery volumes are verified gravimetrically according to the following guidelines:

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- Glass microliter syringes (such as those purchased from Hamilton Company) and Class A glassware are exempt from any verification requirements;
- Disposable or single-use volumetric equipment is verified once per lot, prior to or in conjunction with is first use;
- Mechanical devices are verified prior to first use and on a quarterly basis;
- All other volumetric support equipment is checked for accuracy prior to or in conjunction with its first use.

For those dispensers that are not used for analytical measurements, a label shall be applied to the device stating that it is not calibrated. Any device not regularly verified cannot be used for any quantitative measurements.

Glass microliter syringes are purchased from Hamilton Company or an equivalent manufacturer. Each syringe is traceable to NIST. The laboratory keeps on file an "Accuracy and Precision Statement of Conformance," or however named, from the manufacturer attesting to established precision and accuracy.

Details of the procedures used to verify volumetric equipment are found in laboratory SOP No. *CED-R-EQ-SOP43012* (Pipette Verification Procedures).

18.3.6) Autoclaves

Each batch processed in the autoclave is marked with autoclave tape. The autoclave tape must turn dark to verify sterilization temperatures were achieved. An autoclave maximum-registering thermometer is also used to verify autoclave temperatures with every batch. The duration and temperatures reached during each autoclave batch are recorded in the autoclave logbook.

Sterilization is also verified monthly with "temptubes". A temptube is a small culture tube that contains a solid pellet. The temptube is processed through a normal sterilization cycle. The pellet in the tube must be completely melted as verification that temperatures sufficient for sterilization were maintained for the proper duration.

The autoclave's internal timing device is checked quarterly against a stopwatch to verify the actual time elapsed. The results of this check are documented in the Bacteria QA Logbook.

A spore check is performed on the autoclave on a monthly basis according to the following procedure:

- A sealed ampule containing *Geobacillus stearothermophilus* and Bromocresol Purple (pH indicator) is put through a normal autoclave sterilization cycle. After autoclaving, the autoclaved test ampoule is incubated for 48 hours at 55-60°C along with a control ampule which has not been autoclaved. The control ampule should show a positive test by exhibiting a color change to or toward yellow and/or turbidity. If the control ampule does not show a positive result the test should be considered invalid.
- A successful sterilization cycle would result in the autoclaved test ampule having no color change (remains purple) and no turbidity after incubation. A failed sterilization is indicated by a color change to or toward yellow and/or turbidity in the autoclaved test ampule.
- The spore check test results are documented in the Bacteria QA Logbook.

18.3.7) Other Support Equipment

18.3.7.1) Field Sampling Devices (ISCO Auto Samplers)

Each autosampler (ISCO) is assigned a unique identification number. This number is also recorded on the sampling documentation.

18.3.7.2) Soil Gas Sampling Pumps

The laboratory provides sampling pumps for soil gas collection by clients. Each sampling pump is assigned a unique identification number in order to keep track of the calibration. This number should be recorded by the client on the sampling documentation. Procedures for calibration of sampling pumps are found in laboratory SOP No. *CED-R-EQ-SOP43014* (Calibration of Sampling Pumps).

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18.4) Instrument Calibrations

Calibration of analytical instrumentation is essential to the production of quality data. Strict calibration procedures are followed for each method. These procedures are designed to determine and document the method reporting limits, the working range of the analytical instrumentation, and any fluctuations that may occur from day to day. Generation and review of calibration curves follow laboratory method SOPs and NDSC-QA Document No. CA-Q-P-003 (Calibration Curves and the Selection of Calibration Points).

Sufficient raw data records are retained to allow an outside party to reconstruct all facets of the initial calibration. Records contain, but are not limited to, the following: calibration date, method, instrument, analyst(s) initials or signatures, analysis date, analytes, concentration, response, and type of calibration (average response factor, linear/non-linear regression, or other calculations that may be used to reduce instrument responses to concentration).

Sample results must be quantitated from the initial calibration and may not be quantitated from any continuing instrument calibration verification unless otherwise required by regulation, method or program.

If the initial calibration results are outside of the acceptance criteria, corrective action is performed and any affected samples are reanalyzed if possible. If the reanalysis is not possible, any data associated with an unacceptable initial calibration will be reported with appropriate data qualifiers (refer to Section 12).

Note: Instruments are calibrated initially and as needed after that and at least annually.

18.4.1) Calibration Standards

Calibration standards are prepared using the procedures indicated in the Reagents and Standards section of the determinative method SOP. The minimum number of non-zero calibration standards shall be as follows:

Type of Calibration Curve	Minimum Number of Calibration Standards[b]
Threshold Testing[a]	1
Average Response	4
Linear Fit	5
Quadratic Fit	6

[a]The initial one-point calibration shall be at the project-specified threshold level.
[b]Fewer calibration standards may be used only if equipment firmware or software cannot accommodate the specified number of standards. Documentation detailing that limitation shall be maintained by the laboratory.

Standards for instrument calibration are obtained from a variety of sources. All standards are traceable to national or international standards of measurement, or to national or international standard reference materials.

The lowest concentration calibration standard that is analyzed during an initial calibration must be at or below the stated reporting limit for the method based on the final volume of extract (or sample).

The other concentrations define the working range of the instrument/method or correspond to the expected range of concentrations found in actual samples that are also within the working range of the instrument/method. Results of samples not bracketed by initial instrument calibration standards (within calibration range to at least the same number of significant figures used to report the data) must be reported as having less certainty, e.g., defined qualifiers or flags (additional information may be included in the case narrative). The exceptions to these rules are ICP methods which define the working range with periodic linear dynamic range studies, rather than through the range of concentrations of routine calibration standards.

All initial calibrations are verified with a standard obtained from a second source and traceable to a national standard, when available (or vendor-certified different lot if a second source is not available). For unique situations, such as air analysis where no other source or lot is available, a standard made by

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a different analyst at a different time or a different preparation would be considered a second source. This verification occurs immediately after the calibration curve has been analyzed, and before the analysis of any samples.

18.4.2) Calibration Verification

The calibration relationship established during the initial calibration must be verified initially and at least daily as specified in the laboratory method SOPs in accordance with the referenced analytical methods and in the 2009 and 2016 TNI Standard. The process of calibration verification applies to both external standard and internal standard calibration techniques, as well as to linear and non-linear calibration models. Initial calibration verification (ICV) is with a standard source secondary (second source standard) to the calibration standards, but continuing calibration verifications (CCV) may use the same source standards as the calibration curve.

Note: The process of calibration verification referred to here is fundamentally different from the approach called "calibration" in some methods. As described in those methods, the calibration factors or response factors calculated during continuing calibration verification are used to update the calibration factors or response factors used for sample quantitation. This approach, while employed in other EPA programs, amounts to a daily single-point calibration.

All target analytes and surrogates, including those reported as non-detects, must be included in periodic calibration verifications for purposes of retention time confirmation and to demonstrate that calibration verification criteria are being met.

All samples must be bracketed by periodic analyses of standards that meet the QC acceptance criteria (e.g., calibration and retention time). The frequency is found in the determinative methods or SOPs.

Note: If an internal standard calibration is being used then bracketing calibration verification standards are generally not required, only opening calibration verifications are needed in each analytical batch. The results from these verification standards must meet the calibration verification criteria and the retention time criteria (if applicable).

Generally, the calibrations must be verified by an ICV analyzed immediately following initial calibration and before sample analysis. The ICV may be used as the first bracketing CCV, if criteria for both are met.

A continuing instrument calibration verification (CCV) is generally analyzed at the beginning of each 12-hour analytical shift during which samples are analyzed. The 12-hour analytical shift begins with the injection of the calibration verification standard (or the MS tuning standard in MS methods). The shift ends after the completion of the analysis of the last sample, QC, or standard that can be injected within 12-hours of the beginning of the shift. For methods that have quantitation by external calibration models, a CCV is analyzed at the end of each analytical sequence. Some methods have more frequent CCV requirements. See specific SOPs. Most inorganic methods require the CCV to be analyzed after ever 10 samples or injections, including matrix or batch QC samples.

Note: If an internal standard calibration is being used (e.g., GCMS) then bracketing standards are not required, only daily verifications are needed, except as specified by program or method requirements.

If the results of a CCV are outside the established acceptance criteria and analysis of a second consecutive (and immediate) CCV fails to produce results within acceptance criteria, corrective action shall be performed. Once corrective actions have been completed and documented, the laboratory shall demonstrate acceptable instrument / method performance with successful calibration verification or a new initial calibration shall be performed. Samples analyzed prior to or after the calibration verification failure are to be reanalyzed or the results qualified if calibration verification bracketing is required.

Sample analyses and reporting of data may not occur or continue until the analytical system is calibrated or calibration verified. However, data associated with an unacceptable calibration verification may still be useable under the following special conditions:

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1. When the acceptance criteria for the CCV are exceeded high (i.e., high bias) and the associated samples within the batch are non-detects, then those non-detects may be reported with a case narrative comment explaining the high bias. Otherwise the samples affected by the unacceptable CCV shall be re-analyzed after a new calibration curve has been established, evaluated and accepted; or
2. When the acceptance criteria for the CCV are exceeded low (i.e., low bias), those sample results may be reported if they exceed a maximum regulatory limit/decision level. Otherwise the samples affected by the unacceptable CCV shall be re-analyzed after a new calibration curve has been established, evaluated and accepted. Alternatively, a reporting limit verification standard may be analyzed to demonstrate that there was adequate sensitivity to detect the compound at the reporting limit (if allowed by the method).

Samples reported by the two conditions identified above will be appropriately flagged.

18.5) Tentatively Identified Compounds (TICs) - GC/MS Analysis

For samples containing components not associated with the calibration standards, a library search may be made for the purpose of tentative identification. The necessity to perform this type of identification will be determined by the purpose of the analyses being conducted. For example, the RCRA permit or waste delisting requirements may require the reporting of non-target analytes. Only after visual comparison of sample spectra with the nearest library searches may the analyst assign a tentative identification. Data system library search routines should not use normalization routines that would misrepresent the library or unknown spectra when compared to each other. Additional details are provided in NDSC Document No. CA-Q-QM-001 (Policy on Tentatively Identified Compounds).

Note: If the TIC compound is not part of the client target analyte list but is calibrated by the laboratory and is both qualitatively and/or quantitatively identifiable, it should not be reported as a TIC. If the compound is reported on the same form as true TICs, it should be qualified and/or narrated that the reported compound is qualitatively and quantitatively (if verification in control) reported compared to a known standard that is in control (where applicable).

18.6) GC/MS Tuning

Prior to any GC/MS analytical sequence, including calibration, the instrument parameters for the tune and subsequent sample analyses within that sequence must be set. Alternatively, some methods allow for the tune to only be performed prior to each calibration and not prior to each daily analytical sequence; refer to the applicable method SOPs.

Prior to tuning/auto-tuning the mass spectrometer, the parameters may be adjusted within the specifications set by the manufacturer or the analytical method. These generally do not need any adjustment but it may be required based on the current instrument performance. If the tune verification does not pass it may be necessary to clean the source or perform additional maintenance. Any maintenance is documented in the maintenance log.

18.7) Example - Instrumentation List

Instrument	Number
Autoclave	1
Air incubator	2
Balances (including analytical and top loading)	10
Flashpoint tester	2
Conductivity meter	1
pH meter	2
Lachat QuikChem FIA autoanalyzer	4
Turbidity meter	1
Spectrophotometer (VIS)	1
Colorimeter	2
COD Reactor	3
Midi distillation unit	3

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TKN block digestor	1
Oven/furnace (for solids determination)	3
BOD autoanalyzer	2
Ion Chromatograph	2
Microwave extraction apparatus	1
Ultrasonic extraction apparatus	2
Gas chromatograph/Mass spectrometer	9
Gas chromatograph/ECD	2
Gas chromatograph/FID	4
Gas chromatograph/PID-FID	3
Inductively Coupled Plasma-Atomic Emission Spectrometer (ICP-AES)	2
Inductively Coupled Plasma-Mass Spectrometer (ICP-MS)	2
Cold Vapor Atomic Absorption Spectrometer (CVAAS)	1

19) MEASUREMENT TRACEABILITY

19.1) Overview

Traceability of measurements shall be assured using a system of documentation, calibration, and analysis of reference standards. Laboratory equipment that are peripheral to analysis and whose calibration is not necessarily documented in a test method analysis or by analysis of a reference standard shall be subject to ongoing certifications of accuracy. At a minimum, these must include procedures for checking specifications of ancillary equipment: balances, thermometers, temperature, Deionized (DI) and Reverse Osmosis (RO) water systems, automatic pipettes and other volumetric measuring devices (refer to Section 18.3). With the exception of Class A glassware and glass microliter syringes, periodic and/or initial accuracy checks are performed for all volumetric measuring devices. Wherever possible, subsidiary or peripheral equipment is checked against standard equipment or standards that are traceable to national or international standards. Class A glassware and glass microliter syringes should be routinely inspected for chips, acid etching or deformity (e.g., bent needle). If the Class A glassware or syringe is suspect, the accuracy of the glassware will be assessed prior to use.

19.2) NIST-Traceable Weights and Thermometers

Reference standards of measurement shall be used for calibration only and for no other purpose, unless it can be shown that their performance as reference standards would not be invalidated.

For NIST-traceable weights and thermometers, the laboratory requires that all calibrations be conducted by a calibration laboratory accredited by A2LA, NVLAP (National Voluntary Laboratory Accreditation Program), or another accreditation organization that is a signatory to a MRA (Mutual Recognition Arrangement) of one or more of the following cooperations – ILAC (International Laboratory Accreditation Cooperation) or APLAC (Asia-Pacific Laboratory Accreditation Cooperation). A calibration certificate and scope of accreditation is kept on file at the laboratory.

19.3) Reference Standards / Materials

Reference standards/materials, where commercially available, are traceable to certified reference materials. Commercially prepared reference standards, to the extent available, are purchased from vendors that are accredited to ISO Guide 34 and ISO/IEC Guide 17025. All reference standards from commercial vendors shall be accompanied with a Certificate of Analysis (COA) that includes at least the following information:

- Manufacturer
- Analytes or parameters calibrated
- Identification or lot number

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- Calibration method
- Concentration with associated uncertainties
- Purity

If a standard cannot be purchased from a vendor that supplies a COA, the purity of the standard is documented by analysis. The receipt of all reference standards must be documented. Reference standards are labeled with a unique Standard Identification Number and expiration date. All documentation received with the reference standard is retained as a QC record and references the Standard Identification Number.

All reference, primary and working standards/materials, whether commercially purchased or laboratory prepared, must be checked regularly to ensure that the variability of the standard or material from the true value does not exceed method requirements. The accuracy of calibration standards is checked by comparison with a standard from a second source. In cases where a second standard manufacturer is not available, a vendor certified different lot is acceptable for use as a second source. The appropriate Quality Control (QC) criteria for specific standards are defined in laboratory SOPs. In most cases, the analysis of an Initial Calibration Verification (ICV) or LCS (where there is no sample preparation) is used as the second source confirmation. These checks are generally performed as an integral part of the analysis method (e.g. calibration checks, laboratory control samples).

All standards and materials must be stored and handled according to method or manufacturer's requirements in order to prevent contamination or deterioration. For safety requirements, refer to the laboratory's Environmental Health and Safety Manual/Chemical Hygiene Plan (*CED-S-EHS-QP43267*) and/or laboratory method SOPs.

Standards and reference materials shall not be used after their expiration dates unless their reliability is verified by the laboratory and their use is approved by the Quality Assurance Manager. The laboratory must have documented contingency procedures for re-verifying expired standards.

19.4) Documentation and Labeling of Standards, Reagents, and Reference Materials
Reagents must be at a minimum the purity required in the test method. The date of reagent receipt and the expiration date are documented. The lots for most of the common solvents and acids are tested for acceptability prior to company-wide purchase. [Refer to NDSC Document No. CA-Q-S-001 (Solvent and Acid Lot Testing and Approval).]

All manufacturer or vendor supplied Certificate of Analysis or Purity must be retained, stored appropriately, and readily available for use and inspection. These records are scanned and appended to the standard record in the LIMS. Records must be kept of the date of receipt and date of expiration of standards, reagents and reference materials. In addition, records of preparation of laboratory standards, reagents, and reference materials must be retained, stored appropriately, and be readily available for use and inspection. For detailed information on documentation and labeling, please refer to method specific SOPs as well as laboratory SOP No. *CED-P-STD-SOP42952* (Standards and Reagents - Documentation and Tracking).

Commercial materials purchased for preparation of calibration solutions, spike solutions, etc., are usually accompanied with an assay certificate or the purity is noted on the label. If the assay purity is 96% or better, the weight provided by the vendor may be used without correction. If the assay purity is less than 96% a correction will be made to concentrations applied to solutions prepared from the stock commercial material.

19.4.1) All standards, reagents, and reference materials must be labeled in an unambiguous manner. Standards are logged into the laboratory's LIMS, and are assigned a unique identification number. The following information is typically recorded in the electronic database within the LIMS.

- Standard ID
- Description of Standard
- Department
- Preparer's name
- Final volume and number of vials prepared
- Solvent type and lot number

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- Preparation Date
- Expiration Date
- Standard source type (stock or daughter)
- Standard type (spike, surrogate, other)
- Parent standard ID (if applicable)
- Parent Standard Analyte Concentration (if applicable)
- Parent Standard Amount used (if applicable)
- Component Analytes
- Final concentration of each analyte
- Comment box (text field)

Records are maintained electronically for standard and reference material preparation. These records show the traceability to purchased stocks or neat compounds. These records also include method of preparation, date of preparation, expiration date and preparer's name or initials. Preparation procedures are provided in the method SOPs.

19.4.2) All standards, reagents, and reference materials must be clearly labeled with a minimum of the following information:

- Expiration Date (include prep date for reagents)
- Standard ID from LIMS
- Special Health/Safety warnings if applicable

Records must also be maintained of the date of receipt for commercially purchased items or date of preparation for laboratory prepared items. Special Health/Safety warnings must also be available to the analyst. This information is maintained by the EHS Coordinator.

19.4.3) In addition, the following information may be helpful:

- Date opened (for multi-use containers, if applicable)
- Description of standard (if different from manufacturer's label or if standard was prepared in the laboratory)
- Recommended Storage Conditions
- Concentration (if applicable)
- Initials of analyst preparing standard or opening container

All containers of prepared reagents must include an expiration date and an ID number to trace back to preparation.

Procedures for preparation of reagents can be found in the method SOPs.

Standard ID numbers must be traceable through associated logbooks, worksheets and preparation/analytical batch records.

All reagents and standards must be stored in accordance to the following priority: 1) with the manufacturer's recommendations; 2) with requirements in the specific analytical methods as specified in the laboratory SOP.

20) SAMPLING

20.1) Overview

The laboratory's main responsibility in the sample collection process lies in supplying the sampler with the necessary coolers, reagent water, sample containers, preservatives, sample labels, custody seals, COC forms, ice and packing materials required to properly preserve, pack, and ship samples to the laboratory.

However, the laboratory does provide limited sampling services to a small group of local clients only. The laboratory provides the following field services:

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- Wastewater sampling
- Field parameter analysis (pH, temperature, and residual chlorine).

General field sampling procedures are described in laboratory SOP No. *CED-S-FS-SOP42935*. Procedures for field parameter analysis are described in laboratory SOP No. *CED-S-FS-SOP42936*.

20.2) Sampling Containers

The laboratory offers clean sampling containers for use by clients. These containers are obtained from reputable container manufacturers and meet EPA specifications as required. Certificates of cleanliness for bottles and preservatives are provided by the supplier and are maintained at the laboratory. Alternatively, the certificates may be maintained by the supplier and available to the laboratory on-line.

20.2.1) Preservatives

Upon request, preservatives are provided to the client in pre-cleaned sampling containers. In some cases containers may be purchased pre-preserved from the container supplier. Whether prepared by the laboratory or bought pre-preserved, the grades of the preservatives are at a minimum:

- Hydrochloric Acid – Reagent ACS (Certified VOA Free) or equivalent
- Methanol – Purge and Trap grade
- Nitric Acid – Instra-Analyzed or equivalent
- Sodium Bisulfate – ACS Grade or equivalent
- Sodium Hydroxide – Instra-Analyzed or equivalent
- Sulfuric Acid – Instra-Analyzed or equivalent
- Sodium Thiosulfate – ACS Grade or equivalent

20.3) Definition of Holding Time

The date and time of sampling documented on the COC form establishes the day and time zero. As a general rule, when the maximum allowable holding time is expressed in days (e.g., 14 days, 28 days), the holding time is based on calendar day measured. Holding times expressed in hours (e.g., 8 hours, 24 hours, etc.) are measured from date and time zero. Holding times for analysis include any necessary reanalysis. However, there are some programs that determine holding time compliance based on the date and specific time of analysis compared to the time of sampling regardless of how long the holding time is.

The holding time of composite samples begins at the end of sample compositing, not at the collection of the first sample aliquot in the composite. The EPA interprets the hold time to be the period of time that has elapsed between the end of sampling and the beginning of preparation (or analysis).

20.4) Sampling Containers, Preservation Requirements, Holding Times

The preservation and holding time criteria specified in the laboratory SOPs are derived from the source documents for the methods. If method required holding times or preservation requirements are not met, the reports will be qualified using a flag, footnote or case narrative. As soon as possible or "ASAP" is an EPA designation for tests for which rapid analysis is advised, but for which neither EPA nor the laboratory have a basis for a holding time.

20.5) Sample Aliquots / Subsampling

Taking a representative sub-sample from a container is necessary to ensure that the analytical results are representative of the sample collected in the field. The size of the sample container, the quantity of sample fitted within the container, and the homogeneity of the sample need consideration when sub-sampling for sample preparation. It is the laboratory's responsibility to take a representative subsample or aliquot of the sample provided for analysis.

Analysts should handle each sample as if it is potentially dangerous. At a minimum, safety glasses, gloves, and lab coats must be worn when preparing aliquots for analysis.

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Guidelines on taking sample aliquots and subsampling are located in laboratory SOP No. *CED-P-FPS-SOP42947* (Subsampling and Sample Homogenization).

21) HANDLING OF SAMPLES

21.1) Overview

It is the responsibility of the client to send us representative and/or homogeneous and properly preserved samples of the system from which they are drawn. The laboratory assumes that all multiple sample containers with the same designator/description and bottle type contain a homogeneous, representative sample.

The laboratory provides the appropriate sample containers, required preservative, chain-of-custody (COC) forms, shipping containers, labels, and custody seals. The laboratory also provides trip blanks and analyte-free water for field blanks. Preparation of methanol containers for field preservation of volatile soil samples is available.

Sample management procedures at the laboratory ensure that sample integrity and custody are maintained and documented from sampling/receipt through disposal.

21.2) Chain of Custody (COC)

The COC form is the written documented history of any sample and is initiated when bottles are sent to the field, or at the time of sampling. This form is completed by the sampling personnel and accompanies the samples to the laboratory where it is received and stored under the laboratory's custody. The purpose of the COC form is to provide a legal written record of the handling of samples from the time of collection until they are received at the laboratory. It also serves as the primary written request for analyses from the client to the laboratory. The COC form acts as a purchase order for analytical services when no other contractual agreement is in effect.

21.2.1) Field Documentation

The information the sample collector needs to provide at the time of sampling on the container label is:

- Sample identification
- Date and time
- Preservative

During the sampling process, the COC form is completed and must be legible. This form includes information such as:

- Client name, address, phone number and fax number (if available)
- Project name and/or number
- The sample identification
- Date, time and location of sampling
- Sample collectors name
- The matrix description
- The container description
- The total number of each type of container
- Preservatives used
- Analysis requested
- Requested turnaround time (TAT)
- Any special instructions
- Purchase Order number or billing information (e.g. quote number) if available
- The date and time that each person received or relinquished the sample(s), including their signed name.

When the sampling personnel deliver the samples directly to the laboratory personnel, the samples are stored in a cooler with ice, as applicable, and remain solely in the possession of the client's field technician until the samples are delivered to the laboratory personnel. The sample collector must

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assure that each container is in his/her physical possession or in his/her view at all times, or stored in such a place and manner to preclude tampering. The field technician relinquishes the samples in writing on the COC form to the sample control personnel at the laboratory or to a laboratory courier. When sampling personnel deliver the samples through a common carrier (Fed-Ex, UPS), the COC relinquished date/time is completed by the field personnel and samples are released to the carrier. Samples are only considered to be received by the laboratory when personnel at the fixed laboratory facility have physical contact with the samples.

Note: Independent couriers are not required to sign the COC form. The COC is usually kept in the sealed sample cooler.

21.2.2) Legal / Evidentiary Chain-of-Custody

Samples being tested for litigation may require locked storage and documentation of the time and personnel responsible when the sample is not in storage. This level of documentation is available upon request and procedures to define these activities are in place and include the following:

- A chain-of-custody document is initiated for each bottle type submitted by the client.
- The internal chain of custody is signed each time the sample is stored, removed from storage, or changes hands.
- Client requesting legal internal chain-of-custody documentation receive the completed forms after the analysis is complete.

21.3) Sample Receipt

Samples are received at the laboratory by designated sample receiving personnel and a unique laboratory project identification number is assigned. Each sample container shall be assigned a unique sample identification number that is cross-referenced to the client identification number such that traceability of test samples is unambiguous and documented. Each sample container is affixed with a durable sample identification label. Sample acceptance, receipt, tracking and storage procedures are detailed in laboratory SOP No. *CED-P-SAM-SOP42940* (Customer Service and Login Procedures) and are summarized in the following sections.

21.3.1) Laboratory Receipt

When samples arrive at the laboratory, sample receiving personnel inspect the coolers and samples. The integrity of each sample must be determined by comparing sample labels or tags with the COC and by visual checks of the container for possible damage. Any non-conformance, irregularity, or compromised sample receipt must be documented in LIMS and brought to the immediate attention of the PM/PMA, who will contact the client. The COC, shipping documents, documentation of any non-conformance, irregularity, or compromised sample receipt, record of client contact, and resulting instructions become part of the project record.

Sample receiving personnel check and document the chemical preservation of non-volatile liquid samples after the samples have been entered into the LIMS and before they are released to the laboratory for testing or placed into storage. Any checks of samples to be analyzed for oil and grease or volatile constituents are performed and documented at the time of analysis.

21.4) Sample Acceptance Policy

The laboratory has a written sample acceptance policy (*CED-P-SAM-WI43567*) that clearly outlines the circumstances under which samples shall be accepted or rejected. These include:

1. The COC is filled out correctly.
2. Samples must be properly labeled.
3. Proper sample containers with adequate volume for the analysis and necessary QC.
4. Sample must be preserved according to the requirements of the requested analytical method.
5. Client must notify the lab of any potentially hazardous samples.
6. Sample holding times must be adhered to.
7. The project manager will be notified if any sample is received in damaged condition.

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Data from samples which do not meet these criteria are flagged and the nature of the variation from policy is defined.

21.4.1) After inspecting the samples, the sample receiving personnel sign and date the COC form, make any necessary notes of the samples' conditions and store them in appropriate refrigerators or storage locations.

21.4.2) Any deviations from these checks that question the suitability of the sample for analysis, or incomplete documentation as to the tests required will be resolved by consultation with the client. If the sample acceptance policy criteria are not met, the laboratory shall either:

- Retain all correspondence and/or records of communications with the client regarding the disposition of rejected samples, or
- Fully document any decision to proceed with sample analysis that does not meet sample acceptance criteria.

21.4.3) Once sample acceptance is verified, the samples are logged into LIMS according to laboratory SOP No. *CED-P-SAM-SOP42940* (Customer Service and Login Procedures).

21.5) Sample Storage

In order to avoid deterioration, contamination or damage to a sample during storage and handling, from the time of receipt until all analyses are complete, samples are stored in refrigerators, freezers or protected locations suitable for the sample matrix. In addition, samples to be analyzed for volatile organic compounds are stored in separate refrigerators designated for volatile parameters only. Samples are never to be stored with reagents, standards or materials that may create contamination.

Analysts and technicians retrieve the sample container allocated to their analysis from the designated storage location and place it on a cart, analyze the sample, and return the remaining sample or empty container to the storage location from which it originally came. All samples are kept in the designated storage location for two to four weeks after analysis, which meets or exceeds most sample holding times. After this time period, the samples are moved to the sample archive area where they are stored until disposal. This holding period allows samples to be checked if a discrepancy or question arises. Special arrangements may be made to store samples for longer periods of time.

Access to the laboratory is controlled such that sample storage need not be locked at all times unless a project specifically requires it. Samples are accessible to laboratory personnel only. Visitors to the laboratory are prohibited from entering the sample storage locations and laboratory areas unless accompanied by an employee of Eurofins Cedar Falls.

21.6) Hazardous Samples and Foreign Soils

To minimize exposure to personnel and to avoid potential accidents, hazardous samples are stored in an isolated area designated for hazardous waste only. All hazardous samples are either returned to the client or disposed of appropriately through a hazardous waste disposal firm that lab-packs all hazardous samples and removes them from the laboratory.

The Eurofins Cedar Falls laboratory does not knowingly accept foreign soil samples. (A foreign soil is defined as a soil sample from foreign countries, U.S. territories, or areas within the U.S. that are under Federal Domestic Soil Quarantine.)

21.7) Sample Shipping

In the event that the laboratory needs to ship samples, the samples are placed in a cooler with enough ice to ensure the samples remain just above freezing and at or below 6.0°C during transit. The samples are carefully surrounded by packing material to avoid breakage (yet maintain appropriate temperature). A trip blank is enclosed for those samples requiring water/solid volatile organic analyses (see Note below). The chain-of-custody form is signed by the sample control technician and attached to the shipping paperwork. Samples are generally shipped overnight express or hand-delivered by a Eurofins Cedar Falls courier to maintain sample integrity. All personnel involved with shipping and receiving samples must be trained to maintain the proper chain-of-custody documentation and to keep

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the samples intact and on ice. The NDSC Environmental Health and Safety Manual (*CED-S-EHS-QP43267*) contains additional shipping requirements as well as laboratory SOP No. *CED-P-SAM-SOP42892* (Shipping).

Note: If a client does not request trip blank analysis on the COC or other paperwork, the laboratory will not analyze the trip blanks that were supplied. However, in the interest of good client service, the laboratory will advise the client at the time of sample receipt that it was noted that they did not request analysis of the trip blank; and that the laboratory is providing the notification to verify that they are not inadvertently omitting a key part of regulatory compliance testing.

21.8) Sample Disposal

Samples should be retained for a minimum of 30 days after the project report is sent, however, provisions may be made for earlier disposal of samples once the holding time is exceeded. Some samples are required to be held for longer periods based on regulatory or client requirements (e.g., 60 days after project report is sent). The laboratory must follow the longer sample retention requirements where required by regulation or client agreement. Several possibilities for sample disposal exist: the sample may be consumed completely during analysis, the sample may be returned to the customer or location of sampling for disposal, or the sample may be disposed of in accordance with the laboratory's waste disposal procedures (laboratory SOP No. *CED-S-WD-SOP42937*). All safety protocols in the Environmental Health and Safety Manual/Chemical Hygiene Plan are followed during disposal. Samples are normally maintained in the laboratory no longer than 90 days from receipt unless otherwise requested. Unused portions of samples found or suspected to be hazardous according to state or federal guidelines may be returned to the client upon completion of the analytical work.

If a sample is part of a known litigation, the affected legal authority, sample data user, and/or submitter of the sample must participate in the decision about the sample's disposal. All documentation and correspondence concerning the disposal decision process must be kept on file. Pertinent information includes the date of disposal, nature of disposal (such as sample depletion, hazardous waste facility disposal, return to client), names of individuals who conducted the arrangements and physically completed the task. The laboratory will remove or deface sample labels prior to disposal unless this is accomplished through the disposal method (e.g., samples are incinerated). A Waste Disposal Record should be completed.

22) ASSURING THE QUALITY OF TEST RESULTS

22.1) Overview

In order to assure our clients of the validity of their data, the laboratory continually evaluates the quality of the analytical process. The analytical process is controlled not only by instrument calibration as discussed in Section 18, but also by routine process quality control measurements [e.g., blanks, Laboratory Control Samples (LCS), Matrix Spikes (MS), Duplicates (DU), Surrogates (SU), and Internal Standards (IS)]. These quality control checks are performed as required by the method or regulations to assess precision and accuracy. Quality control samples are to be treated in the exact same manner as the associated field samples being tested. In addition to the routine process quality control samples, Proficiency Testing (PT) Samples (concentrations unknown to laboratory) are analyzed to help ensure laboratory performance.

22.2) Batch Controls

Sample preparation or pre-treatment is commonly required before analysis. Typical preparation steps may include sample homogenization/subsampling, solvent extraction, acid digestion, distillation, reflux, filtration, evaporation, drying, and/or cleanup. During these pre-treatment steps, samples are arranged into discreet manageable groups referred to as preparation (prep) batches. Prep batches provide a means to control variability in sample treatment. Control samples are added to each prep batch to monitor method performance and are processed through the entire analytical procedure with investigative/field samples.

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22.3) Negative Controls

Control Type	Details
Method Blank (MB)	Used to assess preparation and analysis for possible contamination during the preparation and processing steps. The specific frequency of use for the method blank during the analytical sequence is defined in the specific SOP for each analysis. Generally it is 1 for each batch of samples, not to exceed 20 environmental samples. The method blank is prepared from a clean matrix similar to that of the associated samples which is free from target analytes (e.g., reagent water, Ottawa sand, glass beads, etc.) and is processed along with and under the same conditions as the associated samples. The method blank goes through all of the steps of the process (including as necessary: filtration, clean-ups, etc.). Reanalyze for qualify associated sample results when the concentration of a target analyte in the method blank is at or above the reporting limit as established by the method or by regulation, and is greater than 1/10 of the amount measured in the sample.
Calibration Blank	Prepared and analyzed along with calibration standards where applicable. They are prepared using the same reagents that are used to prepare the standards. In some analyses the calibration blank may be included in the calibration curve.
Instrument Blank	Blank reagents or reagent water that may be processed during an analytical sequence in order to assess contamination in the analytical system. In general, instrument blanks are used to differentiate between contamination caused by the analytical system and that caused by the sample handling or sample prep process. Instrument blanks may also be inserted throughout the analytical sequence to minimize the effect of carryover from samples with high analyte content.
Trip Blank[1]	Required to be submitted by the client with each shipment of samples requiring aqueous and solid volatiles analyses (or as specified in the client's project plan). Additionally, trip blanks may be prepared and analyzed for volatile analysis of air samples, when required by the client. A trip blank may be purchased (certified clean) or is prepared by the laboratory by filling a clean container with pure deionized water that has been purged to remove any volatile compounds. Appropriate preservatives are also added to the container. The trip blank is sent with the bottle order and is intended to reflect the environment that the containers are subjected to throughout shipping and handling and help identify possible sources if contamination is found. The field sampler returns the trip blank in the cooler with the field samples.
Field Blank[1]	Are sometimes used for specific projects by the field samplers. A field blank prepared in the field by filling a clean container with pure reagent water and appropriate preservative, if any, for the specific sampling activity being undertaken. (EPA OSWER)
Equipment Blank[1]	Are also sometimes created in the field for specific projects. An equipment blank is a sample of analyte-free media which has been used to rinse common sampling equipment to check effectiveness of decontamination procedures in the field. (TNI)
Storage Blank	Also referred to as refrigerator or freezer blanks, are used to monitor the sample storage units for volatile organic compounds during the storage of VOA samples in the laboratory.

[1]When known, these field QC samples should not be selected for matrix QC as it does not provide information on the behavior of the target compounds in the field samples. Usually, the client sample ID will provide information to identify the field blanks with labels such as "TB", "FB", or "EB."

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Evaluation criteria and corrective action for these controls are defined in the specific standard operating procedure for each analysis.

22.3.1) Negative Controls for Microbiology Methods

Microbiological methods utilize a variety of negative controls throughout the process to ensure that false positive results are not obtained. These controls are critical to the validity of the microbiological analyses. Same of these negative controls are:

Control Type	Details
Sterility Checks (Media)	Are analyzed for each lot of pre-prepared media, ready-to-use media and for each batch of medium prepared by the laboratory.
Sterility Checks (Sample Containers)	Are performed on at least one container per lot of purchased, pre-sterilized containers. If containers are prepared and sterilized by the laboratory, one container pre sterilization batch is checked. Container sterility checks are performed using non-selective growth media.
Sterility Checks (Dilution Water)	Are performed on each batch of dilution water prepared by the laboratory and on each batch of pre-prepared dilution water. All checks are performed using non-selective growth media.
Sterility Checks (Filters)	Are performed on at least one filter from each new lot of membrane filters using non-selective growth media.
Filtration Blanks	Blanks are run at the beginning and end for each sterilized filtration unit used in a filtration series. For pre-sterilized single use funnels, a sterility check is performed on at least one funnel per lot.

Negative culture controls demonstrate that a media does not support growth of non-target organisms and ensures that there is not an atypical positive reaction from the target organisms. Prior to the first use of the media, each lot of pre-prepared selective media or batch of laboratory-prepared selective media is analyzed with at least one known negative culture control as appropriate to the method.

22.4) Positive Controls

Control samples (e.g., QC indicators) are analyzed with each batch of samples to evaluate data based upon (1) method performance [Laboratory Control Sample (LCS)], which entails both the preparation and measurement steps; and (2) matrix effects [Matrix Spike (MS) and Matrix Spike Duplicate (MSD)] or Sample Duplicate (DU), which evaluates field sampling accuracy, precision, representativeness, interferences, and the effect of the matrix on the method performed. Each regulatory program and each method within those programs specify the control samples that are prepared and/or analyzed with a specific batch.

Note that frequency of control samples vary with specific regulatory, methodology and project specific criteria. Complete details on method control samples are as listed in each analytical SOP.

22.4.1) Method Performance Control - Laboratory Control Sample (LCS)

The LCS measures the accuracy of the method in a blank matrix and assesses method performance independent of potential field sample matrix affects in a laboratory batch.

The LCS is prepared from a clean matrix similar to that of the associated samples that is free from target analytes (for example: reagent water, Ottawa sand, glass beads, etc.) and is processed along with and under the same conditions as the associated samples. The LCS is spiked with verified known amounts of analytes or is made of a material containing known and verified amounts of analytes, taken through all preparation and analysis steps along with the field samples. Where there is no preparation taken for an analysis (such as in aqueous volatiles), or when all samples and standards undergo the same preparation and analysis process, a calibration verification standard may be reported as the LCS. In some instances where there is no practical clean solid matrix available, aqueous LCS's may be processed for solid matrices; final results may be calculated as mg/kg or ug/kg, assuming 100% solids and a weight equivalent to the aliquot used for the corresponding field samples, to facilitate comparison with the field samples.

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Certified pre-made reference material purchased from a NIST/A2LA accredited vendor may also be used for the LCS when the material represents the sample matrix or the analyte is not easily spiked (e.g. solid matrix LCS for metals, etc.).

The specific frequency of use for LCS during the analytical sequence is defined in the specific standard operating procedure for each analysis. It is generally 1 for each batch of samples; not to exceed 20 environmental samples.

If the mandated or requested test method, or project requirements, do not specify the spiking components, the laboratory shall spike all reportable components to be reported in the Laboratory Control Sample (and Matrix Spike) where applicable (e.g. no spike of pH). However, in cases where the components interfere with accurate assessment (such as simultaneously spiking chlordane, Toxaphene and PCBs in method 608.3), the test method has an extremely long list of components or components are incompatible, at a minimum, a representative number of the listed components (see below) shall be used to control the test method. The selected components of each spiking mix shall represent all chemistries, elution patterns and masses, permit specified analytes and other client requested components. However, the laboratory shall ensure that all reported components are used in the spike mixture within a two-year time period.

- For methods that have 1-10 target analytes, spike all components.
- For methods that include 11-20 target analytes, spike at least 10 or 80%, whichever is greater.
- For methods with more than 20 target analytes, spike at least 16 components.
- Exception: Due to analyte incompatibility in pesticides, Toxaphene and Chlordane are only spiked at client request based on specific project needs.
- Exception: Due to analyte incompatibility between the various PCB Aroclors, Aroclors 1016 and 1260 are used for spiking as they cover the range of all of the Aroclors. Specific Aroclors may be used by request on a project specific basis.

22.4.2) Positive Controls for Microbiology

Each lot of pre-prepared media (including chromofluorogenic reagent) and each batch of laboratory prepared media is tested with a pure culture of known positive reaction.

22.5) Sample Matrix Controls

Control Type	Details
Matrix Spike (MS)	Use: used to assess the effect sample matrix of the spiked sample has on the precision and accuracy of the results generated by the method used. Typical Frequency[1]: at a minimum, with each matrix-specific batch of samples processed, one MS is carried through the complete analytical procedure. Unless specified by the client, samples used for spiking are randomly selected and rotated between different client projects. If the mandated or requested test method does not specify the spiking components, the laboratory shall spike all reportable components to be reported in the LCS. Refer to the method SOP for complete details. Description: essentially a sample fortified with a known amount of the targeted analyte(s).
Surrogate	Use: measures method performance to sample matrix (Organics only). Typical Frequency[1]: Are added to all samples, standards, and blanks for all organic chromatography methods except when the matrix precludes it use or when a surrogate compound is not available. The recovery of the surrogate compound(s) is compared to the acceptance limits for the specific method. Poor surrogate recovery may indicate a problem with sample composition and shall be reported, with data qualifiers, to the client whose sample produced poor recovery. Description: Are similar to matrix spikes except the analytes are

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	compounds with properties that mimic the analytes of interest and are unlikely to be found in environmental samples.
Duplicates[2]	Use: For a measure of analytical precision, with each matrix-specific batch of samples processed, a matrix duplicate sample (DU), matrix spike duplicate (MSD), or LCS duplicate (LCSD) is carried through the complete analytical procedure. Typical Frequency[1]: Matrix duplicate samples (DU) are usually analyzed with methods that do not require matrix spike analysis. The MSD or LCSD is analyzed at the same frequency as their paired QC type. Description: Performed by analyzing two aliquots of the same field sample independently, or an additional LCS.
Internal Standards	Use: Are spiked into all environmental and quality control samples (including the initial calibration standards) to monitor the qualitative aspect of organic and some inorganic analytical measurements. Typical Frequency[1]: All organic and ICP/ICPMS methods as required by the analytical method. Description: Use to correct for matrix effects and to help troubleshoot variability in analytical response and are assessed after data acquisition. Possible sources of poor internal standard response are sample matrix, poor analytical technique, or poor instrument performance.

[1]See the specific analytical SOP for type and frequency of sample matrix control samples.

[2]LCSDs are normally not performed except when regulatory agencies or client specifications require them. The recoveries for the spiked duplicate samples must meet the same laboratory established recovery limits as the accuracy QC samples. If an LCSD is analyzed both the LCS and LCSD must meet the same recovery criteria and be included in the final report. The precision measurement is reported as "Relative Percent Difference" (RPD). Poor precision between duplicates (except LCS/LCSD) may indicate non-homogeneous matrix or non-representative subsampling techniques.

22.6) Acceptance Criteria (Control Limits)

As mandated by the test method and regulation, each individual analyte in the LCS, MS, or Surrogate Spike is evaluated against the control limits published in the test method. Where there are no established acceptance criteria, the laboratory calculates in-house control limits with the use of control charts or, in some cases, utilizes client project-specific control limits. When this occurs, the regulatory or project limits will supersede the laboratory's in-house limits.

Note: For methods, analytes and matrices with very limited data (e.g., unusual matrices not analyzed often), interim limits are established using available data or by analogy to similar methods or matrices.

Once control limits have been established, they are verified, reviewed, and updated if necessary on an annual basis unless the method requires more frequent updating. Control limits are established per method (as opposed to per instrument) regardless of the number of instruments utilized. Laboratory SOP No. *CED-Q-QC-SOP42899* (Quality Control Limits) describes the process of establishing in-house control limits.

Laboratory-generated percent recovery acceptance (control) limits are generally established by taking ± 3 standard deviations about the average recovery of a minimum of 20-30 data points (more points are preferred).

- Regardless of the calculated limit, the limit should be no tighter than the calibration verification (ICV/CCV), unless the analytical method specifies a tighter limit.
- In-house limits cannot be any wider than those mandated in a regulated analytical method. Client or contract required control limits are evaluated against the laboratory's statistically derived control limits to determine if the data quality objectives (DQOs) can be achieved. If laboratory control limits are not consistent with DQOs, then alternatives must be considered, such as method improvements or use of an alternate analytical method.
- The lowest acceptable recovery limit will be 10% (the analyte must be detectable and identifiable). Exception: The lowest acceptable recovery limit for poor-performing analytes such as

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benzidine will be 5% and the analyte must be detectable and identifiable.
- The maximum acceptable recovery limit will be 150%.
- The maximum acceptable RPD limit will be 35% for waters and 40% for soils. The minimum RPD limit is 10%.
- If either the high or low end of the control limit changes by < 5% from previous, the control chart is visually inspected and, using professional judgment, they may be left unchanged if there is no affect on laboratory ability to meet the existing limits.

22.6.1) The lab must be able to generate a current listing of their control limits and track when the updates are performed. In addition, the laboratory must be able to recreate historical control limits.

22.6.2) A LCS that is within the acceptance criteria establishes that the analytical system is in control and is used to validate the process. Samples that are analyzed with an LCS with recoveries outside of the acceptance limits may be determined as out of control and should be reanalyzed if possible. If reanalysis is not possible, then the results for all affected analytes for samples within the same batch must be qualified when reported. The internal corrective action process (see Section 12) is also initiated if an LCS exceeds the acceptance limits. Sample results may be qualified and reported without reanalysis if:

- The analyte results are below the reporting limit and the LCS is above the upper control limit.
- If the analytical results are above the relevant regulatory limit and the LCS is below the lower control limit.

Or, for TNI work, there are an allowable number of Marginal Exceedances (ME):

<11 analytes	0 marginal exceedances are allowed
11-30 analytes	1 marginal exceedance is allowed
31-50 analytes	2 marginal exceedances are allowed
51-70 analytes	3 marginal exceedances are allowed
71-90 analytes	4 marginal exceedances are allowed
>90 analytes	5 marginal exceedances are allowed

- Marginal exceedances are recovery exceedances between 3 SD and 4 SD from the mean recovery limit. (TNI)
- Marginal exceedances must be random. If the same analyte exceeds the LCS control limit repeatedly, it is an indication of a systematic problem. The source of the error must be located and corrective action taken. The laboratory has a system to monitor marginal exceedances to ensure that they are random.
- Though marginal exceedances may be allowed, the data must still be qualified to indicate it is outside of the normal limits. More detail on marginal exceedance procedures is located in laboratory SOP No. *CED-Q-QC-SOP42900* (Random Marginal Exceedances).

22.6.3) If the MS/MSDs do not meet acceptance limits, the MS/MSD and the associated spiked sample is reported with a qualifier for those analytes that do not meet limits. If obvious preparation errors are suspected, or if requested by the client, unacceptable MS/MSDs are reprocessed and reanalyzed to prove matrix interference. A more detailed discussion of acceptance criteria and corrective action can be found in the method SOPs and in Section 12.

22.6.4) If a surrogate standard falls outside the acceptance limits, and if there is not obvious chromatographic matrix interference, reanalyze the sample to confirm a possible matrix effect. If the recoveries confirm or there was obvious chromatographic interference, results are reported from the original analysis and a qualifier is added. If the reanalysis meets surrogate recovery criteria, the second run is reported (or both are reported if requested by the client). Under certain circumstances, where all of the samples are from the same location and share similar chromatography, the reanalysis

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may be performed on a single sample rather than all of the samples and if the surrogate meets the recovery criteria in the reanalysis, all of the affected samples would require reanalysis.

22.7) Additional Procedures to Assure Quality Control

The laboratory has written and approved method SOPs to assure the accuracy of the test method including calibration (see Section 18), use of certified reference materials (see Section 19) and use of PT samples (see Section 15).

A discussion regarding MDLs, Limit of Detection (LOD) and Limit of Quantitation (LOQ) can be found in Section 17.

- Use of formulae to reduce data is discussed in the method SOPs and in Section 18.
- Selection of appropriate reagents and standards is included in Sections 9 and 19.
- A discussion on selectivity of the test is included in Section 5.
- Constant and consistent test conditions are discussed in Section 4.
- The laboratories sample acceptance policy is discussed in Section 21.

23) REPORTING RESULTS

23.1) Overview

The results of each test are reported accurately, clearly, unambiguously, and objectively in accordance with State and Federal regulations as well as client requirements. Analytical results are issued in a format that is intended to satisfy customer and laboratory accreditation requirements as well as provide the end user with the information needed to properly evaluate the results. Where there is conflict between client requests and laboratory ethics or regulatory requirements, the laboratory's ethical and legal requirements are paramount, and the laboratory will work with the client during project set up to develop an acceptable solution. (Refer to Section 7.)

A variety of report formats are available to meet specific needs.

In cases where a client asks for simplified reports, there must be a written request from the client. There still must be enough information that would show any analyses that were out of conformance (QC out of limits) and there should be a reference to a full report that is made available to the client. Review of reported data is included in Section 17.

23.2) Test Reports

Analytical results are reported in a format that is satisfactory to the client and meets all requirements of applicable accrediting authorities and agencies. A variety of report formats are available to meet specific needs. The report is printed on laboratory letterhead, reviewed, and signed by the appropriate project manager. At a minimum, the standard laboratory report shall contain the following information:

1. A report title (e.g., Analytical Report).
2. The cover page shall include the laboratory name, address and telephone number.
3. A unique identification of the report (e.g., Eurofins Cedar Falls Job #) and on each page an identification in order to ensure the page is recognized as part of the report and a clear identification of the end. Note: page numbers of the report are represented as # of ##, where the first number is the page number and the second is the total number of pages.
4. A copy of the chain of custody (COC). Any COCs involved with subcontracting are also included.
5. The name and address of client and a project name/number, if applicable.
6. Client project manager or other contact.
7. Description and unambiguous identification of the tested sample(s) including the client identification code.
8. Date of receipt of sample, date and time of collection, and date(s) of test preparation and performance, and time of preparation or analysis if the required holding time for either activity is less than or equal to 72 hours.
9. Date reported or date of revision, if applicable.
10. Method of analysis including method code (EPA, Standard Methods, etc.).

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11. Reporting limits.
12. Method detection limits, if requested.
13. Definition of data qualifiers and reporting acronyms (e.g. ND).
14. Sample results, including units.
15. QC data consisting of method blank, surrogate, LCS, and MS/MSD recoveries and control limits.
16. Condition of samples at receipt including temperature. This may be accomplished in a narrative or by attaching sample login sheets.
17. A statement to the effect that the results relate only to the items tested and the sample as received by the laboratory, except when information is provided by the client. When data is provided by the client there shall be a clear identification of it, and a disclaimer shall be put in the report when the client supplied data can affect the validity of the test.
18. A signature and title of the person(s) accepting responsibility for the content of the report and date of issue. Authorized signatories are qualified Project Managers appointed by the Client Service Manager. Note: Refer to NDSC Document No. CA-I-P-002 (Electronic Reporting and Signature Policy) for details on internally applying electronic signatures of approval.
19. When TNI accreditation is required, the laboratory shall certify that the test results meet all requirements of TNI or provide reasons and/or justification if they do not.
20. Where applicable, a narrative to the report that explains the issue(s) and corrective action(s) taken in the event that a specific accreditation or certification requirement was not met.
21. When soil samples are analyzed, a specific identification as to whether soils are reported on a "wet weight" or "dry weight" basis.
22. Appropriate laboratory certification number for the state of origin of the sample, if applicable.
23. If only part of the report is provided to the client (client requests some results before all of it is complete), it must be clearly indicated on the report (e.g., partial report or preliminary report). A complete report must be sent once all of the work has been completed.
24. Any non-Eurofins subcontracted analysis results are provided as a separate report on the official letterhead of the subcontractor. All subcontracting is clearly identified on the report as to which laboratory performed a specific analysis.
25. A Certification Summary Report, where required, will document that, unless otherwise noted, all analytes tested and reported by the laboratory were covered by the noted certifications.
26. Where the laboratory is responsible for the sampling stage, in addition to the requirements listed above, reports containing the results of sampling shall include the following, where necessary for the interpretation of test results:
    - the date of sampling;
    - unambiguous identification of the material sampled;
    - the location of sampling plan and procedures, and deviations, addition to or exclusions from the sample procedures;
    - a reference to the sampling plan and procedures, and deviations, addition to or exclusions from the sample procedures;
    - details of any environmental conditions during sampling that affect the interpretation of test results;
    - information required to evaluate measurement uncertainty for subsequent testing.

23.3) Reporting Level or Report Type

The laboratory offers four levels of quality control reporting. Each level, in addition to its own specific requirements, contains all the information provided in the preceding level. The packages provide the following information in addition to the information described above:

- Level 1 is a report with all of the elements outlined in Section 23.2 above, excluding item 15 (QC data).
- Level 2 is a Level 1 report plus summary information, including results for the method blank, percent recovery for laboratory control samples and matrix spike samples, and the RPD values for all MSD and sample duplicate analyses.
- Level 3 contains all the information supplied in Level 2, but presented on the CLP-like summary forms, and relevant calibration information. A Level 2 report is not included, unless specifically requested. No raw data is provided.
- Level 4 is the same as Level 3 with the addition of all raw supporting data.

In addition to the various levels of QC packaging, the laboratory also provides reports in EDD (see below). Initial reports may be provided to clients by facsimile. Procedures used to ensure client

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confidentiality are outlined in Section 23.7.

23.4) Electronic Data Deliverables (EDD)

EDDs are routinely offered as part of Eurofins Cedar Falls' services in addition to the test report as described in Section 23.2. When TNI accreditation is required and both a test report and EDD are provided to the client, the official version of the test report will be the combined information of the report and the EDD. The laboratory offers a variety of EDD formats including Environmental Quality Information System (EQuIS) in client-specified formats, Illinois EPA, MPCA, Missouri TerraBase, Excel and custom files.

The laboratory project manager submits new EDD specifications to the IT department for review and undergo the contract review process. Once the facility has committed to providing data in a specific electronic format, the coding of the format may need to be performed. This coding is documented, validated, and retained by the IT staff coding the EDD.

EDDs shall be subject to a review to ensure their accuracy and completeness. If EDD generation is automated, review may be reduced to periodic screening if the laboratory can demonstrate that it can routinely generate that EDD without errors. Any revisions to the EDD format must be reviewed until it is demonstrated that it can routinely be generated without errors. If the EDD can be reproduced accurately and if all subsequent EDDs can be produced error-free, each EDD does not necessarily require a review.

23.5) Supplemental Information for Test

The laboratory identifies any unacceptable QC analyses or any other unusual circumstances or observations such as environmental conditions and any non-standard conditions that may have affected the quality of a result. This is typically in the form of a footnote or a qualifier and/or a case narrative explaining the discrepancy.

Numeric results with values outside of the calibration range, either high or low are qualified as estimated.

Where quality system requirements are not met, a statement of compliance/non-compliance with requirements and/or specifications is required, including identification of test results derived from any sample that did not meet TNI sample acceptance requirements such as improper container, holding time, or temperature.

Where applicable, a statement on the estimated uncertainty of measurements; information on uncertainty is needed when a client’s instructions so require.

When, as requested by the client and agreed to by Eurofins Cedar Falls, the report includes a statement of conformity to specification or standard (see Special Services, Section 7.5), the report shall clearly identify:

- to which results the statement applies,
- which specifications, standard or parts thereof are met or not met, and
- the decision rule that was applied, unless the decision rule is inherent in the requested specification or standard, taking into account the level of risk (such as false accept and false reject and statistical assumptions) associated with the decision rule.

23.5.1) Opinions and Interpretations

The test report contains objective information, and generally does not contain subjective information such as opinions and interpretations. If such information is required by the client, the Laboratory Director will determine if a response can be prepared. If so, the Laboratory Director will designate the appropriate member of the management team to prepare a response. The response will be fully documented, and reviewed by the Laboratory Director, before release to the client. There may be additional fees charged to the client at this time, as this is a non-routine function of the laboratory.

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Note: Review of data deliverable packages for submittal to regulatory authorities requires responses to non-conforming data concerning potential impact on data quality. This necessitates a limited scope of interpretation, and this work is performed by the QA Department. This is the only form of "interpretation" of data that is routinely performed by the laboratory.

When opinions or interpretations are included in the report, the laboratory provides an explanation as to the basis upon which the opinions and interpretations have been made. Opinions and interpretations are clearly noted as such and where applicable, a comment should be added suggesting that the client verify the opinion or interpretation with their regulator.

23.6) Environmental Testing Obtained From Subcontractors

If the laboratory is not able to provide the client the requested analysis, the samples are subcontracted following the procedures outlined in the NDSC Document No. CW-L-S-004 (Subcontracting).

Data reported from analyses performed by a subcontractor laboratory are clearly identified as such on the analytical report provided to the client. Results from a subcontract laboratory outside of Eurofins are reported to the client on the subcontract laboratory's original report stationary and the report includes any accompanying documentation.

23.7) Client Confidentiality

The laboratory will ensure the highest standards of quality and integrity of the data and services provided to our clients.

The laboratory is responsible for maintaining in confidence all client information obtained or created. In situations involving the transmission of environmental test results by telephone, facsimile or other electronic means, client confidentiality must be maintained.

The laboratory will not intentionally divulge to any person (other than the client or any other person designated by the client in writing) any information regarding the services provided by the laboratory or any information disclosed to the laboratory by the client. Furthermore, information known to be potentially endangering to national security or an entity's proprietary rights will not be released.

Information about the client obtained from sources other than the client (e.g., complainant, regulators) shall be confidential between client and the laboratory. The source of this information shall be confidential to the laboratory and shall not be shared with the client, unless agreed by the source.

Note 1: This shall not apply to the extent that the information is required to be disclosed by the laboratory under the compulsion of legal process. The laboratory will, to the extent feasible, provide reasonable notice to the client before disclosing the information.

Note 2: Authorized representatives of an accrediting authority are permitted to make copies of any analyses or records relevant to the accreditation process, and copies may be removed from the laboratory for purposes of assessment.

Report deliverable formats are discussed with each new client. If a client requests that reports be e-mailed, the reports are to meet all requirements of this document.

23.8) Format of Reports

The format of reports is designed to accommodate each type of environmental test carried out and to minimize the possibility of misunderstanding or misuse.

23.9) Amendments to Test Reports

Corrections, additions, or deletions to reports are only made when justification arises through supplemental documentation. Justification is documented using the laboratory's corrective action system (refer to Section 12).

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The revised report is retained on the Archive data server, as is the original report. The revised report is stored on the Archive data server under the sample number followed by "Rev(1)". Any further revisions would be identified with Rev(2), Rev(3), and so on.

When the report is re-issued, a notation of "Revision: #" is placed on the cover/signature page of the report, where # is the revision number. A brief explanation of reason for the re-issued report is placed at the top of the narrative page.

23.10) Policies on Client Requests for Amendments

23.10.1) Data Omissions or Reporting Limit Increases

Fundamentally, our policy is simply to not omit previously reported results (including data qualifiers) or to not raise reporting limits and report sample results as ND. This policy has few exceptions, but may include:

- Laboratory error;
- Sample identification is indeterminate (confusion between COC and sample labels);
- An incorrect analysis (not analyte) was requested (e.g., COC lists 8315 but client wanted 8310). A written request for the change is required;
- Incorrect limits reported based on regulatory requirements;
- The requested change has absolutely *no possible* impact on the interpretation of the analytical results and there is *no possibility* of the change being interpreted as misrepresentation by anyone inside or outside of our company.

23.10.2) Multiple Reports

The laboratory does not issue multiple reports for the same work order where there is different information on each report (this does not refer to copies of the same report) unless required to meet regulatory needs and approved by the Laboratory Director and QA.

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A.1) Appendix 1 - List of Governing Documents Applicable to the QA Manual

NDSC SOPs and Policies

NDSC Doc. No.	Title
CA-C-S-001	Work Sharing Process
CA-I-P-002	Electronic Reporting and Signature Policy
CA-L-P-002	Contract Compliance Policy
CA-Q-M-002	Quality Management Plan
CA-Q-P-003	Calibration Curves and the Selection of Calibration Points
CA-Q-QM-001	Guidance on Tentatively Identified Compounds (TICs) - GC/MS Analysis
CA-Q-S-001	Acid and Solvent-Lot Testing and Approval Program
CA-Q-S-002	Manual Integrations
CA-Q-S-006	Detection and Quantitation Limits
CA-Q-S-009	Root Cause Analysis
CA-T-P-001	Qualified Products List
CW-E-M-001	Environmental Health and Safety Manual
CW-F-P-004	Procurement and Contracts Policy
CW-F-S-007	Fixed Asset Acquisition, Retention and Safeguarding
CW-L-P-001	Records Retention Policy
CW-L-P-004	Ethics Policy
CW-L-S-002	Internal Investigations
CW-L-S-004	Subcontracting
CW-Q-S-001	Document Control and Archiving
CW-Q-S-002	Writing a Standard Operating Procedure
CW-Q-S-003	Internal Auditing
CW-Q-S-004	Management Systems Review
CW-Q-S-005	Management of Nonconforming Work Affecting Data Quality

Laboratory SOPs and Policies

Local Doc. No.	Title
CED-P-FPS-SOP42947	Subsampling and Sample Homogenization
CED-P-PROJ-SOP42905	Project and Contract Review Procedures for Meeting Regulatory, Accreditation, and Client Requirements
CED-P-REV-SOP42955	Data Review Procedures
CED-P-SAM-SOP42892	Shipping
CED-P-SAM-SOP42940	Customer Service and Login Procedures
CED-P-SAM-WI43567	Sample Acceptance Policy
CED-P-STD-SOP42952	Standards and Reagents - Documentation and Tracking
CED-Q-DC-SOP42896	Laboratory Document Control Procedures
CED-Q-MU-SOP42898	Estimating Measurement Uncertainty
CED-Q-NCW-	Investigating a Proficiency Testing Failure

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SOP42901	
CED-Q-QC-SOP42899	Quality Control Limits
CED-Q-QC-SOP42900	Random Marginal Exceedances
CED-R-EQ-SOP42915	In-House Calibration and Verification of Laboratory Support Equipment
CED-R-EQ-SOP42930	Analytical Balance Operation
CED-R-EQ-SOP42968	Thermometer Operation
CED-R-EQ-SOP43012	Pipette Verification Procedures
CED-R-EQ-SOP43014	Calibration of Sampling Pumps
CED-R-PE-SOP42903	Laboratory Personnel Training
CED-S-FS-SOP42935	Field Sampling Procedures
CED-S-FS-SOP42936	Field Analysis Procedures
CED-S-WD-SOP42937	Waste Disposal

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A.2) Appendix 2 - List of Laboratory Accreditations, Certifications, and Approvals

The Eurofins Cedar Falls laboratory maintains accreditations, certifications, and approvals with numerous state and national entities. Programs vary but may include on-site audits, reciprocal agreements with another entity, performance testing evaluations, review of the QA Manual, standard operating procedures, method detection limits, training records, etc. At the time of this QA Manual revision, the laboratory has accreditation/certification/approval with the following organizations:

Program	Authority	ID	Type
NELAP	Illinois EPA	200024	Laboratory accreditation (secondary)
NELAP	Kansas Dept. of Health and Environment	E-10341	Laboratory accreditation (secondary)
NELAP	Minnesota Dept. of Health	019-099-319	Laboratory accreditation (secondary)
NELAP	Oregon Health Authority	IA100001	Laboratory accreditation (primary)
State	Colorado Dept. of Labor and Employment/Division of Oil and Public Safety	IA100001 (OR)	Petroleum Storage Tank Program - Laboratory approval
State	Georgia Dept. of Natural Resources	IA100001 (OR)	Laboratory stipulation of certification
State	Iowa Dept. of Natural Resources	007	Laboratory certification
State	North Dakota Dept. of Environmental Quality	R-186	Laboratory certification

The certificates and accredited parameter lists are available for each program/authority at https://www.eurofinsus.com/env under Resources → Certifications.

The laboratory also maintains other approvals and registrations with a variety of organizations and entities. These include:

Program	Authority	ID	Type
Federal	U.S. EPA / Environmental Response Laboratory Network (ERLN)	68HERH22G0014	Basic Ordering Agreement (BOA) - ERLN
Federal	U.S. EPA / Discharge Monitoring Report QA Program (DMR-QA)	IA00018	EPA lab code
Other	TNI LAMS / National Environmental Laboratory Accreditation Management System	TNI00232	TNI lab code
State	Iowa Dept. of Public Health	3063-1-07-ECD	Radioactive materials registration
State	Minnesota Dept. of Commerce	3349	Petrofund contractor registration

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A.3) Appendix 3 - References Used to Prepare the QA Manual

The QAM has been prepared to be consistent with the requirements of the following documents:

- ANSI/ASQC, E4-1994, "Specifications and Guidelines for Quality Management Systems for Environmental Data Collection and Environmental Technology Programs" (America National Standard, January 5, 1995, or most recent version).
- "EPA Requirements for Quality Management Programs" (QA/R-2) (EPA/240/B-01/002, May 31, 2006).
- EPA 600/4-79-019, *Handbook for Analytical Quality Control in Water and Wastewater Laboratories*, EPA, March 1979.
- *Test Methods for Evaluating Solid Waste Physical/Chemical Methods (SW846)*, Third Edition, September 1986; Final Update I, July 1992; Final Update IIA, August 1993; Final Update II, September 1994; Final Update IIB, January 1995; Final Update III, December 1996; Final Update IIIA, April 1998; Final Update IIIB, November 2004; Final Update IV, February 2007; Final Update V, July 2014; Final Update VI (various dates); Final Update VII (various dates).
- Federal Register, 40 CFR Parts 136, 141, 172, 173, 178, 179 and 261.
- Manual for the Certification of Laboratories Analyzing Drinking Water, Fifth Edition (EPA 815-R-05-004, January 2005) and its supplements.
- APHA, *Standard Methods for the Examination of Water and Wastewater*, 20th, 21st, 22nd, 23rd and on-line Editions.

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A.4) Appendix 4 - QA Manual Crosswalk with TNI and ISO/IEC 17025 Standards

Sec. No.	Title	2009 and 2016 TNI Standard Reference	ISO/IEC 17025:2005(E) Reference	ISO/IEC 17025:2017(E) Reference
-	COVER PAGE	V1M2 Sec. 4.2.8.3		
-	TABLE OF CONTENTS	V1M2 Secs. 4.2.8.3-4.2.8.4		8.1.2; 8.2.1
1	INTRODUCTION, SCOPE AND APPLICABILITY	V1M2 Sec. 4.2.8.4		
1.1	Introduction and Compliance References	V1M2 Secs. 1.1; 1.2; 2.0; 3.2; 4.1.2; 4.2.4	4.1.2; 4.2.4	5.3; 5.4; 8.2.4; 8.3.1
1.2	Terms and Definitions	V1M2 Secs. 3.0; 4.2.4	4.2.4	
1.3	Scope / Fields of Testing	V1M2 Secs. 1.2; 4.2.4	4.1.2; 4.2.4	5.3; 5.4; 8.2.1; 8.2.4
1.4	Management of the Manual	V1M2 Secs. 4.2.1; 4.2.7; 4.3.3.2; 4.3.3.3	4.2.1; 4.2.7; 4.3.3.2; 4.3.3.3	5.3
2	MANAGEMENT REQUIREMENTS	V1M2 Sec. 4		8.2.4; 8.2.5
2.1	Overview	V1M2 Secs. 4.1.1; 4.1.3; 4.1.5	4.1.1; 4.1.3; 4.1.5; 4.2.6	5.1; 5.2; 5.5; 5.6; 6.2.1; 6.2.4
2.2	Roles and Responsibilities	V1M2 Secs. 4.1.4; 4.1.5; 4.1.6; 4.2.1; 4.2.6; 5.2.4	4.1.3; 4.1.5; 4.1.6; 4.2.1; 4.2.6; 5.2.4	4.1.1-4.1.3; 4.1.5; 5.5; 5.6; 6.2.1; 6.2.4; 6.2.6; 8.2.2
2.3	Business Continuity and Contingency Plans	V1M2 Secs. 4.1.5; 4.1.7.2; 4.2.7	4.1.5; 4.2.7	
2.4	Organizational Charts	V1M2 Sec. 4.1.5	4.1.3; 4.1.5; 4.2.6	
3	PERSONNEL	V1M2 Secs. 5.2; 5.2.1	5.2.1	6.1; 6.2.3
3.1	Overview	V1M2 Secs. 5.2.2; 5.2.3; 5.2.5	5.2.2; 5.2.3; 5.2.5	6.2.2
3.2	Education and Experience Requirements for Technical Personnel	V1M2 Secs. 5.2.1; 5.2.3; 5.2.4	5.2.1; 5.2.3; 5.2.4	6.2.2-6.2.4
3.3	Training	V1M2 Sec. 5.2.5	5.2.5	4.2.1; 6.2.2; 6.2.4; 6.2.5
3.4	Data Integrity and Ethics Training Program	V1M2 Sec. 4.2.8.1; 5.2.7		4.1.1
4	ACCOMMODATIONS AND ENVIRONMENTAL CONDITIONS	V1M2 Sec. 5.3		6.1; 6.3.1
4.1	Overview	V1M2 Secs. 5.3.1; 5.3.3; 5.3.4; 5.3.5	5.3.1; 5.3.3; 5.3.4; 5.3.5	6.3.1
4.2	Environment	V1M2 Secs. 5.3.1; 5.3.2; 5.3.3; 5.3.4; 5.3.5	5.3.1; 5.3.2; 5.3.3; 5.3.4; 5.3.5	6.3.1-6.3.5
4.3	Work Areas	V1M2 Secs. 5.3.3; 5.3.4; 5.3.5	5.3.3; 5.3.4; 5.3.5	6.3.1
4.4	Responding to Emergencies			
4.5	Building Security	V1M2 Sec. 5.3.4	5.3.4	6.3.4

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5	QUALITY SYSTEM			6.1; 8.2.4
5.1	Quality Policy Statement	V1M2 Secs. 4.1.5; 4.2.2; 4.2.3; 4.2.8.3	4.1.5; 4.2.2; 4.2.3	8.2.3; 8.6.1
5.2	Ethics and Data Integrity	V1M2 Secs. 4.1.5; 4.2.2; 4.2.8.1; 4.16; 5.2.7	4.1.5; 4.2.2	4.1.1-4.1.3; 4.2.1; 6.2.1; 8.2.2; 8.2.3
5.3	Quality System Documentation	V1M2 Secs. 4.1.5; 4.2.2; 4.2.5	4.2.2; 4.2.5	8.2.4
5.4	QA/QC Objectives for the Measurement of Data	V1M2 Sec. 4.2.2	4.1.5; 4.2.2	6.2.4
5.5	Criteria for Quality Indicators			
5.6	Statistical Quality Control			
5.7	Quality System Metrics			
6	DOCUMENT CONTROL	V1M2 Secs. 4.2.7; 4.3.1; 4.3.2.2; 4.3.3.3; 4.3.3.4	4.2.7; 4.3.1; 4.3.2.2; 4.3.3.3; 4.3.3.4	8.2.4; 8.3.1
6.1	Overview			8.2.5; 8.3.1; 8.3.2
6.2	Document Approval and Issue	V1M2 Secs. 4.3.2; 4.3.2.1-4.3.2.3; 4.3.3.1	4.3.2.1; 4.3.2.2; 4.3.2.3; 4.3.3.1	8.2.5; 8.3.2
6.3	Procedures for Document Control Policy	V1M2 Secs. 4.3.2.1-4.3.2.2; 4.3.3.1	4.3.2.1; 4.3.2.2; 4.3.3.1	8.2.5; 8.3.2
6.4	Obsolete Documents	V1M2 Secs. 4.3.2.1-4.3.2.2	4.3.2.1; 4.3.2.2	8.2.5; 8.3.2
7	SERVICE TO THE CLIENT	V1M2 Secs. 4.4.1-4.4.4	4.4.1; 4.4.2; 4.4.3; 4.4.4	7.1.1; 7.1.1.4; 7.1.1.5; 7.1.1.8; 7.1.2.1
7.1	Overview	V1M2 Secs. 4.4.5; 4.5.5; 5.7.1	4.4.5; 5.7.1	
7.2	Review Sequence and Key Personnel	V1M2 Sec. 4.4.5	4.4.5	7.1.1.6
7.3	Balancing Laboratory Capacity and Workload			
7.4	Documentation	V1M2 Sec. 5.7.1	5.7.1	
7.5	Special Services	V1M2 Secs. 4.7.1-4.7.2	4.7.1; 4.7.2	7.1.1.3; 7.1.1.7
7.6	Client Communication	V1M2 Secs. 4.7.1-4.7.2	4.7.1; 4.7.2	7.1.1.7
7.7	Reporting	V1M2 Secs. 4.7.1-4.7.2	4.7.1; 4.7.2	7.1.1.7
7.8	Client Feedback and Surveys	V1M2 Secs. 4.7.1-4.7.2	4.7.1; 4.7.2	7.1.1.7; 8.6.2
8	SUBCONTRACTING OF TESTS	V1M2 Secs. 4.4.3; 4.5.4	4.4.3; 4.5.4	
8.1	Overview	V1M2 Secs. 4.5.1-4.5.3; 4.5.5; 5.3.1	4.5.1; 4.5.2; 4.5.3; 5.3.1	6.6.1; 7.1.2.1; 7.1.2.2
8.2	Qualifying and Monitoring Subcontractors	V1M2 Secs. 4.5.1-4.5.3; 4.5.5	4.5.1; 4.5.2; 4.5.3	6.6.1; 7.1.2.1; 7.1.2.2
8.3	Oversight and Reporting	V1M2 Sec. 4.5.5		
8.4	Subcontracting Procedures			
8.5	Contingency Planning			
8.6	Use of NELAP and A2LA Logo			
9	PURCHASING SERVICES AND SUPPLIES	V1M2 Sec. 4.6.1	4.6.1	

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9.1	Overview	V1M2 Secs. 4.6.2; 4.6.3; 4.6.4	4.6.2; 4.6.3; 4.6.4	6.6.1; 6.6.2
9.2	Glassware	V1M2 Sec. 5.5.13.1		
9.3	Reagents, Standards and Supplies	V1M2 Secs. 4.6.2; 4.6.3; 4.6.4; V1M4 Sec. (2016 1.7.2.5)	4.6.2; 4.6.3; 4.6.4	6.6.1-6.6.3
9.4	Equipment, Instruments and Software			
9.5	Services			
9.6	Suppliers			
10	COMPLAINTS	V1M2 Sec. 4.8	4.8	8.6.1; 8.6.2
10.1	Overview			7.9.1-7.9.3; 8.6.1; 8.6.2
10.2	External Complaints			7.9.2-7.9.7; 8.6.1; 8.6.2
10.3	Internal Complaints			8.6.1; 8.6.2
10.4	Review of Complaints			8.6.1; 8.6.2
11	CONTROL OF NON-CONFORMING WORK	V1M2 Secs. 4.9.1; 5.10.5	4.9.1; 5.10.5	7.10.1
11.1	Overview	V1M2 Secs. 4.9.1; 4.11.3; 4.11.5	4.9.1; 4.11.3; 4.11.5	7.10.1
11.2	Responsibilities and Authorities	V1M2 Secs. 4.9.1; 4.11.3; 4.11.5; 5.2.7	4.9.1; 4.11.3; 4.11.5	7.10.1
11.3	Evaluation of Significance and Action Taken	V1M2 Secs. 4.9.1; 4.11.3; 4.11.5	4.9.1; 4.11.3; 4.11.5	4.1.5; 7.10.1; 7.10.2; 8.5.3
11.4	Prevention of Nonconforming Work	V1M2 Secs. 4.9.2; 4.11.2	4.9.2; 4.11.2	7.10.2; 7.10.3; 8.5.3
11.5	Method Suspension / Restriction (Stop Work Procedures)	V1M2 Secs. 4.9.1; 4.9.2; 4.11.5	4.9.1; 4.9.2; 4.11.5	7.10.1; 7.10.2
12	CORRECTIVE ACTION	V1M2 Sec. 4.11		4.1.4; 4.1.5
12.1	Overview	V1M2 Secs. 4.9.2; 4.11.1; 4.11.2	4.9.2; 4.11.1; 4.11.2; 8.7.1; 8.7.3	7.10.2; 8.7.1; 8.7.3
12.2	General	V1M2 Secs. 4.11.2; 4.11.3	4.11.2; 4.11.3	7.7.2; 8.5.3; 8.7.1
12.3	Closed Loop Corrective Action Process	V1M2 Secs. 4.11.2; 4.11.3; 4.11.4; 4.11.6; 4.11.7; 4.12.2	4.11.2; 4.11.3; 4.11.4; 4.12.2	8.5.3; 8.6.1; 8.7.2
12.4	Basic Corrections	V1M2 Secs. 4.11.1; 4.13.2.3	4.11.1; 4.13.2.3	7.5.2; 8.7.1
12.5	Technical Corrective Actions	V1M2 Sec. 4.11.6		8.7.1
12.6	Example - General Corrective Actions	V1M2 Sec. 4.11.6; V1M4 Secs. (2009 1.7.4.1), (2016 1.7.1.2, 1.7.2.1, 1.7.2.3, 1.7.3.1)	4.11.2	
13	PREVENTIVE ACTION / IMPROVEMENT	V1M2 Secs. 4.10; 4.12.1; 4.12.2	4.10; 4.12.1; 4.12.2	4.1.4
13.1	Overview	V1M2 Secs. 4.15.1; 4.15.2	4.15.1; 4.15.2	8.6.2
13.2	Management of Change			
14	CONTROL OF RECORDS	V1M2 Secs. 4.2.7; 4.13.1.1; 4.13.3	4.2.7; 4.13.1.1	8.4.2

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14.1	Overview	V1M2 Secs. 4.13.1.1-4.13.1.4; 4.13.2.1-4.13.2.3; 4.13.3	4.13.1.1-4.13.1.4; 4.13.2.1-4.13.2.3	8.4.1; 8.4.2
14.2	Technical and Analytical Records	V1M2 Secs. 4.13.2.2-4.13.2.3	4.13.2.2-4.13.2.3	7.5.1; 8.4.2
14.3	Laboratory Support Activities			7.5.2; 8.4.2
14.4	Administrative Records			8.4.2
14.5	Records Management, Storage and Disposal	V1M2 Sec. 4.13.3		4.2.1; 8.4.2
15	AUDITS			
15.1	Internal Audits	V1M2 Secs. 4.2.8.1; 4.14; 4.14.1-4.14.3; 4.14.5; 5.9.1; 5.9.2	4.14.1; 4.14.2; 4.14.3; 5.9.1; 5.9.2	8.6.1; 8.8.1; 8.8.2
15.2	External Audits	V1M2 Secs. 4.14.2; 4.14.3; 4.14.4	4.14.2; 4.14.3; 4.14.4	4.2.1; 8.6.1
15.3	Audit Findings	V1M2 Secs. 4.14.2; 4.14.3; 4.14.5		8.6.1
16	MANAGEMENT REVIEWS	V1M2 Sec. 4.1.6; 4.15; 4.15.1; 4.15.2	4.1.6; 4.15.1; 4.15.2	4.1.4; 8.5.1; 8.6.1; 8.9.1; 8.9.2
16.1	Quality Assurance Report			8.5.1
16.2	Annual Management Review	V1M2 Secs. 4.2.2; 4.15.3	4.2.2	4.1.1; 4.1.4; 4.2.1; 7.1.1.3; 8.2.2; 8.5.1-8.5.3; 8.6.1; 8.9.3
16.3	Potential Integrity Related Managerial Reviews			4.1.5; 8.5.1; 8.6.1
17	TEST METHODS AND METHOD VALIDATION	V1M2 Sec. 5.4.1	5.4.1	7.2.1.1; 8.2.5
17.1	Overview	V1M2 Sec. 5.4.1	5.4.1; 5.4.5.1	6.2.3; 7.2.1.1-7.2.1.3
17.2	Standard Operating Procedures (SOPs)	V1M2 Secs. 4.2.8.5; 4.3.3.1; 5.4.2	4.3.3.1; 5.4.2	7.2.1.4
17.3	Laboratory Methods Manual	V1M2 Sec. 4.2.8.5; (2016 5.4.4.2)		6.2.3
17.4	Selection of Methods	V1M2 Secs. 4.13.3; 5.4.1; 5.4.2; 5.4.3 (2016 5.4.4); V1M4 Secs. 1.4; 1.5.1; 1.6.1; 1.6.2; 1.6.2.1; 1.6.2.2	5.4.1; 5.4.2; 5.4.3; 5.4.4; 5.4.5.1; 5.4.5.2; 5.4.5.3	7.2; 7.2.1.2; 7.2.1.3; 7.1.2.4-7.2.1.7; 7.2.2.1-7.2.2.4
17.5	Laboratory Developed Methods and Non-Standard Methods	V1M2 Sec. 5.4.2 (2016 5.4.4.1-5.4.4.2); V1M4 Sec. 1.5.1	5.4.2; 5.4.4; 5.4.5.2; 5.4.5.3	7.2.1.4-7.2.1.7; 7.2.2.1; 7.2.2.3; 8.2.5
17.6	Validation of Methods	V1M2 Sec. 5.4.2, (2016 5.4.5.4); V1M4 Secs. 1.5.1; 1.5.2; 1.5.2.1; 1.5.2.2; 1.5.3	5.4.2; 5.4.4; 5.4.5.2; 5.4.5.3	7.2.1.6; 7.2.2.1-7.2.2.4
17.7	Method Detection Limit (MDL) / Limit of Detection (LOD)	V1M2 Sec. 5.9.3; V1M4 Secs. 1.5.2; 1.5.2.1; 1.5.2.2	5.4.5.3	7.2.2.3
17.8	Verification of Detection Limits	V1M2 Sec. 5.9.3		

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17.9	Instrument Detection Limit (IDL)	V1M2 Sec. 5.9.3; V1M4 Sec. 1.5.2.1		
17.10	Limit of Quantitation	V1M2 Sec. 5.9.3		
17.11	Retention Time Windows	V1M2 Sec. 5.9.3; V1M4 Sec. 1.5.4; (2009 1.7.3.6), (2016 1.7.2.6)		
17.12	Evaluation of Selectivity	V1M2 Sec. 5.9.3; V1M4 Sec. 1.5.4; (2009 1.7.3.6), (2016 1.7.2.6)		
17.13	Estimation of Uncertainty of Measurement	V1M2 Secs. 5.1.1; 5.1.2; 5.4.6	5.1.1; 5.1.2; 5.4.6.1; 5.4.6.2; 5.4.6.3	7.6.1; 7.6.2; 7.6.3
17.14	Sample Reanalysis Guidelines	V1M2 Sec. 5.9.1	5.9.1	
17.15	Control of Data	V1M2 Secs. 5.4.7.1; 5.4.7.2; 5.9.1	5.4.7.1; 5.4.7.2; 5.9.1	7.11.1-7.11.6
17.16	Example - Work Flow			
18	EQUIPMENT AND CALIBRATIONS	V1M2 Secs. 5.5.4; 5.5.5; 5.5.6	5.5.4; 5.5.5; 5.5.6; 5.6.1	6.1; 6.4.3; 6.4.6; 6.4.9
18.1	Overview	V1M2 Secs. 5.5.1; 5.5.2; 5.5.3; 5.5.5; 5.5.10	5.5.1; 5.5.2; 5.5.3; 5.5.5; 5.5.10; 5.6.1	6.4.1; 6.4.4-6.4.6; 6.4.9; 6.4.11
18.2	Preventive Maintenance	V1M2 Secs. 5.5.1; 5.5.3; 5.5.7; 5.5.9	5.5.1; 5.5.3; 5.5.7; 5.5.9; 5.6.1	6.4.1-6.4.3; 6.4.6; 6.4.10
18.3	Support Equipment	V1M2 Secs. 5.5.10; 5.5.11; 5.5.13.1	5.5.10; 5.5.11; 5.6.2.1.2; 5.6.2.2.1; 5.6.2.2.2	6.4.11; 6.4.12; 6.5.1; 6.5.2; 6.5.3
18.4	Instrument Calibrations	V1M2 Secs. 5.5.8; 5.5.10; 5.6.3.1; V1M4 Sec. 1.7.1.1; (2009 1.7.2), (2016 1.7.1.2)	5.5.8; 5.5.9; 5.5.10; 5.6.1; 5.6.2; 5.6.3.1	6.4.2; 6.4.3; 6.4.6-6.4.8; 6.4.11; 6.4.13; 6.4.14; 6.5.1; 6.5.2
18.5	Tentatively Identified Compounds (TICs) - GC/MS Analysis			
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19	MEASUREMENT TRACEABILITY			
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19.3	Reference Standards / Materials	V1M2 Secs. 5.6.3.1; 5.6.3.2; 5.6.3.3; 5.6.3.4; 5.6.4.1; 5.6.4.2; 5.9.1; 5.9.3	5.6.3.1; 5.6.3.2; 5.6.3.3; 5.6.3.4; 5.9.1	6.4.14
19.4	Documentation and Labeling of Standards, Reagents, and Reference Materials	V1M2 Secs. 5.6.4.2; 5.9.3		
20	SAMPLING			
20.1	Overview	V1M2 Secs. 5.7.1; 5.7.3	5.7.1; 5.7.3	7.3.1; 7.3.2; 7.3.3
20.2	Sampling Containers			

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20.3	Definition of Holding Time			
20.4	Sampling Containers, Preservation Requirements, Holding Times			
20.5	Sample Aliquots / Subsampling	V1M2 Sec. 5.7.1	5.7.1	7.3.1; 7.3.2
21	HANDLING OF SAMPLES			
21.1	Overview	V1M2 Sec. 5.8.1	5.8.1	7.4.1
21.2	Chain of Custody (COC)	V1M2 Secs. 5.7.2; 5.7.4; 5.8.4; 5.8.7.5; 5.8.8; 5.9.1	5.7.2; 5.8.4; 5.9.1	7.1.1.6; 7.4.1
21.3	Sample Receipt	V1M2 Secs. 5.8.1; 5.8.2; 5.8.3; 5.8.5; 5.8.7.3; 5.8.7.4; 5.8.7.5	5.8.2; 5.8.3	7.4.3
21.4	Sample Acceptance Policy	V1M2 Secs. 5.8.6; 5.8.7.2; V1M4 Sec. (2009 1.7.5), (2016 1.7.4)		
21.5	Sample Storage	V1M2 Secs. 5.7.4; 5.8.4	5.8.4	7.4.1; 7.4.4
21.6	Hazardous Samples and Foreign Soils			
21.7	Sample Shipping	V1M2 Sec. 5.8.2	5.8.2	7.4.2
21.8	Sample Disposal			
22	ASSURING THE QUALITY OF TEST RESULTS			
22.1	Overview	V1M2 Secs. 5.9.2; 5.9.3	5.9.2	7.7.2-7.7.3
22.2	Batch Controls	V1M2 Secs. 5.9.2; 5.9.3	5.9.2	7.7.1; 7.7.3
22.3	Negative Controls	V1M2 Secs. 5.9.2; 5.9.3; V1M4 Secs. (2009 1.7.3; 1.7.3.1; 1.7.4.1), (2016 1.7.2; 1.7.2.1; 1.7.3.1)	5.9.2	7.7.1; 7.7.3
22.4	Positive Controls	V1M2 Secs. 5.9.2; 5.9.3; V1M4 Secs. (2009 1.7.3; 1.7.3.2; 1.7.3.2.1; 1.7.3.2.2; 1.7.3.2.3), (2016 1.7.2; 1.7.2.2; 1.7.3.2)	5.9.2	7.7.1; 7.7.3
22.5	Sample Matrix Controls	V1M2 Secs. 5.9.2; 5.9.3; V1M4 Secs. (2009 1.7.3; 1.7.3.3; 1.7.3.3.1; 1.7.3.3.2; 1.7.3.3.3), (2016 1.7.2; 1.7.2.3; 1.7.3.3)	5.9.2	7.7.1; 7.7.3
22.6	Acceptance Criteria (Control	V1M2 Sec. 5.9.3.		7.7.1; 7.7.3

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	Limits)	V1M4 Secs. 1.7.4.2; 1.7.4.3		
22.7	Additional Procedures to Assure Quality Control	V1M2 Sec. 5.9.3; V1M4 Sec. (2009 1.7.3.4), (2016 1.7.2.4)		7.7.1; 7.7.3
23	REPORTING RESULTS			
23.1	Overview	V1M2 Secs. 5.10.1; 5.10.2; 5.10.8	5.10.1; 5.10.2; 5.10.8	7.8.1-7.8.2
23.2	Test Reports	V1M2 Secs. 5.10.1; 5.10.2; 5.10.3.1; 5.10.3.2; 5.10.5; 5.10.6; 5.10.7; 5.10.8; 5.10.10; 5.10.11	5.10.1; 5.10.2; 5.10.3.1; 5.10.3.2; 5.10.5; 5.10.6; 5.10.7; 5.10.8	7.8.2.1; 7.8.2.2; 7.8.3; 7.8.5
23.3	Reporting Level or Report Type	V1M2 Secs. 5.10.1; 5.10.7; 5.10.8	5.10.1; 5.10.7; 5.10.8	
23.4	Electronic Data Deliverables (EDD)			
23.5	Supplemental Information for Test	V1M2 Secs. 5.10.1; 5.10.3.1; 5.10.5	5.10.1; 5.10.3.1; 5.10.5	7.1.1.3; 7.8.6.1; 7.8.6.2; 7.8.7.1-7.8.7.3
23.6	Environmental Testing Obtained from Subcontractors	V1M2 Secs. 4.5.5; 5.10.1; 5.10.6	5.10.1; 5.10.6	
23.7	Client Confidentiality	V1M2 Secs. 4.1.5; 5.10.7	4.1.5; 5.10.7	4.2.1-4.2.4
23.8	Format of Reports	V1M2 Sec. 5.10.8	5.10.8	
23.9	Amendments to Test Reports	V1M2 Sec. 5.10.9	5.10.1; 5.10.9	7.8.8.1-7.8.8.3
23.10	Policies on Client Requests for Amendments	V1M2 Secs. 5.9.1; 5.10.9	5.9.1; 5.10.1; 5.10.5; 5.10.9	

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A.5) Appendix 5 - Terms/Glossary and Acronyms (EL-V1M2 Sec. 3.1)

Terms/Glossary

Acceptance Criteria: Specified limits placed on characteristics of an item, process, or service defined in requirement documents. (ASQC)

Accreditation: The process by which an agency or organization evaluates and recognizes a laboratory as meeting certain predetermined qualifications or standards, thereby accrediting the laboratory.

Accuracy: The degree of agreement between an observed value and an accepted reference value. Accuracy includes a combination of random error (precision) and systematic error (bias) components which are due to sampling and analytical operations; a data quality indicator. (QAMS)

Analyst: The designated individual who performs the "hands-on" analytical methods and associated techniques and who is the one responsible for applying required laboratory practices and other pertinent quality controls to meet the required level of quality.

Analytical Uncertainty: A subset of Measurement Uncertainty that includes all laboratory activities performed as part of the analysis. (TNI)

Anomaly: A condition or event, other than a deficiency, that may affect the quality of the data, whether in the laboratory's control or not.

Assessment: The evaluation process used to measure or establish the performance, effectiveness, and conformance of an organization and/or its systems to defined criteria (to the standards and requirements of laboratory accreditation). (TNI)

Audit: A systematic and independent examination of facilities, equipment, personnel, training, procedures, record-keeping, data validation, data management, and reporting aspects of a system to determine whether QA/QC and technical activities are being conducted as planned and whether these activities will effectively achieve quality objectives. (TNI)

Batch: Environmental samples that are prepared and/or analyzed together with the same process and personnel, using the same lot(s) of reagents. A **preparation batch** is composed of one (1) to twenty (20) environmental samples of the same quality systems matrix, meeting the above mentioned criteria and with a maximum time between the start of processing of the first and last sample in the batch to be twenty-four (24) hours. An **analytical batch** is composed of prepared environmental samples (extracts, digestates or concentrates) which are analyzed together as a group. An analytical batch can include prepared samples originating from various quality system matrices and can exceed twenty (20) samples. (TNI)

Bias: The systematic or persistent distortion of a measurement process, which causes errors in one direction (i.e., the expected sample measurement is different from the sample's true value). (TNI)

Blank: A sample that has not been exposed to the analyzed sample stream in order to monitor contamination during sampling, transport, storage or analysis. The blank is subjected to the usual analytical and measurement process to establish a zero baseline or background value and is sometimes used to adjust or correct routine analytical results. (ASQC)

Calibration: A set of operations that establish, under specified conditions, the relationship between values of quantities indicated by a measuring instrument or measuring system, or values represented by a material measure or a reference material, and the corresponding values realized by standards. (TNI)

1. In calibration of support equipment the values realized by standards are established through the use of reference standards that are traceable to the International System of Units (SI).
2. In calibration according to methods, the values realized by standards are typically established through the use of Reference Materials that are either purchased by the laboratory with a

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certificate of analysis or purity, or prepared by the laboratory using support equipment that has been calibrated or verified to meet specifications.

Calibration Curve: The mathematical relationship between the known values, such as concentrations, of a series of calibration standards and their instrument response. (TNI)

Calibration Standard: A substance or reference material used to calibrate an instrument. (QAMS)

Certified Reference Material (CRM): A reference material accompanied by a certificate, having a value, measurement uncertainty, and stated metrological traceability chain to a national metrology institute. (TNI)

Chain of Custody (COC) Form: Record that documents the possession of the samples from the time of collection to receipt in the laboratory. This record generally includes: the number and types of containers; the mode of collection; the collector; time of collection; preservation; and requested analyses. (TNI)

Compromised Samples: Those samples which are improperly sampled, insufficiently documented (chain of custody and other sample records and/or labels), improperly preserved, collected in improper containers, or exceeding holding times when delivered to a laboratory. Under normal conditions, compromised samples are not analyzed. If emergency situation require analysis, the results must be appropriately qualified.

Confidential Business Information (CBI): Information that an organization designates as having the potential of providing a competitor with inappropriate insight into its management, operation or products. TNI and its representatives agree to safeguard identified CBI and to maintain all information identified as such in full confidentiality.

Confirmation: Verification of the identity of a component through the use of an approach with a different scientific principle from the original method. These may include, but are not limited to Second Column Confirmation; Alternate wavelength; Derivatization; Mass spectral interpretation; Alternative detectors or Additional Cleanup procedures. (TNI)

Conformance: An affirmative indication or judgment that a product or service has met the requirements of the relevant specifications, contract, or regulation; also the state of meeting the requirements. (ANSI/ASQC E4-1994)

Correction: Actions necessary to correct or repair analysis specific non-conformances. The acceptance criteria for method specific QC and protocols as well as the associated corrective actions. The analyst will most frequently be the one to identify the need for this action as a result of calibration checks and QC sample analysis. No significant action is taken to change behavior, process or procedure.

Corrective Action: The action taken to eliminate the causes of an existing nonconformity, defect or other undesirable situation in order to prevent recurrence. (ISO 8402)

Data Integrity: The condition that exists when data are sound, correct, and complete, and accurately reflect activities and requirements. (TNI)

Data Audit: A qualitative and quantitative evaluation of the documentation and procedures associated with environmental measurements to verify that the resulting data are of acceptable quality (i.e., that they meet specified acceptance criteria).

Data Reduction: The process of transforming the number of data items by arithmetic or statistical calculations, standard curves, and concentration factors, and collation into a more useable form. (TNI)

Deficiency: An unauthorized deviation from acceptable procedures or practices, or a defect in an item (ASQC), whether in the laboratory's control or not.

Demonstration of Capability: A procedure to establish the ability of the analyst to generate analytical results of acceptable accuracy and precision. (TNI)

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Document Control: The act of ensuring that documents (and revisions thereto) are proposed, reviewed for accuracy, approved for release by authorized personnel, distributed properly, and controlled to ensure use of the correct version at the location where the prescribed activity is performed. (ASQC)

Duplicate Analyses: The analyses or measurements of the variable of interest performed identically on two subsamples of the same sample. The results from duplicate analyses are used to evaluate analytical or measurement precision but not the precision of sampling, preservation or storage internal to the laboratory. (EPA-QAD)

Equipment Blank: Sample of analyte-free media which has been used to rinse common sampling equipment to check effectiveness of decontamination procedures.

External Standard Calibration: Calibrations for methods that do not utilize internal standards to compensate for changes in instrument conditions.

Field Blank: Blank prepared in the field by filing a clean container with pure de-ionized water and appropriate preservative, if any, for the specific sampling activity being undertaken. (EPA OSWER)

Field of Accreditation: Those matrix, technology/method, and analyte combinations for which the accreditation body offers accreditation.

Holding Times: The maximum time that samples may be held prior to analyses and still be considered valid or not compromised. (40 CFR Part 136)

Internal Standard: A known amount of standard added to a test portion of a sample as a reference for evaluating and controlling the precision and bias of the applied analytical test method. (TNI)

Internal Standard Calibration: Calibrations for methods that utilize internal standards to compensate for changes in instrument conditions.

Instrument Blank: A clean sample (e.g., distilled water) processed through the instrumental steps of the measurement process; used to determine instrument contamination. (EPA-QAD)

Instrument Detection Limit (IDL): The minimum amount of a substance that can be measured with a specified degree of confidence that the amount is greater than zero using a specific instrument. The IDL is associated with the instrumental portion of a specific method only, and sample preparation steps are not considered in its derivation. The IDL is a statistical estimation at a specified confidence interval of the concentration at which the relative uncertainty is ± 100%. The IDL represents a range where qualitative detection occurs on a specific instrument. Quantitative results are not produced in this range.

Laboratory Control Sample (however named, such as laboratory fortified blank, spiked blank, or QC check sample): A sample matrix, free from the analytes of interest, spiked with verified known amounts of analytes or a material containing known and verified amounts of analytes, taken through all preparation and analysis steps of the procedure unless otherwise noted in a reference method. It is generally used to establish intra-laboratory or analyst specific precision and bias or to assess the performance of all or a portion of the measurement system.

An LCS shall be prepared at a minimum of 1 per batch of 20 or less samples per matrix type per sample extraction or preparation method except for analytes for which spiking solutions are not available, such as fixed/volatile solids, settleable solids, moisture, pH, color, temperature, dissolved oxygen, oxygen uptake rate, burn rate, and density/specific gravity. The results of these samples shall be used to determine batch acceptance.

Least Squares Regression (1st Order Curve): The linear least squares regression is a mathematical calculation of a straight line over two axes. The *y*-axis represents the instrument response (or response ratio) of a standard or sample, and the *x*-axis represents the concentration. In the specific case of an unweighted linear least squares regression, the regression calculation will generate a correlation coefficient (*r*) that is a measure of the "goodness of fit" of the regression line to

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the data. An r-value of +1.00 indicates a positive perfect correlation; an r-value of -1.00 indicates a negative perfect correlation; an r-value of 0 indicates no correlation.

However, if the regression line is forced through the origin or the weighting factor is variable, then the coefficient of determination, more often termed r^2, should be used to measure the "goodness of fit", such that $0 \leq r^2 \leq 1$. For consistency, it is acceptable to use r^2 for linear unweighted curves as well. An r^2-value of 1.00 indicates that all variability in response is due to variation in concentration.

In order for the linear regression model to be used for quantitative purposes, r or r^2 should be ≥ 0.995 or 0.990, respectively. Alternatively, the Relative Error or Relative Standard Error may be used to determine calibration function acceptability (see method SOPs).

Limit(s) of Detection (LOD) [a.k.a., Method Detection Limit (MDL)]: The MDL is the minimum measured quantity of a substance that can be reported with 99% confidence that the concentration is distinguishable from method blank results, consistent with 40CFR Part 136 Appendix B, August, 2017.

Limit(s) of Quantitation (LOQ) [a.k.a., Reporting Limit (RL)]: The minimum levels, concentrations, or quantities of a target variable (e.g., target analyte) that can be reported with a specified degree of confidence.

(QS) Matrix: The component or substrate that contains the analyte of interest. For purposes of batch and QC requirement determinations, the following matrix distinctions shall be used:

- *Aqueous:* Any aqueous sample excluded from the definition of Drinking Water or Saline/Estuarine. Includes surface water, groundwater effluents, and TCLP or other extracts.
- *Drinking Water:* Any aqueous sample that has been designated as a potable or potential potable water source.
- *Saline/Estuarine:* Any aqueous sample from an ocean or estuary, or other salt water source such as the Great Salt Lake.
- *Non-Aqueous Liquid:* Any organic liquid with <15% settleable solids.
- *Biological Tissue:* Any sample of a biological origin such as fish tissue, shellfish, or plant material. Such samples shall be grouped according to origin.
- *Solids:* Includes soils, sediments, sludges, and other matrices with >15% settleable solids.
- *Chemical Waste:* A product or by-product of an industrial process that results in a matrix not previously defined.
- *Air & Emissions:* Whole gas or vapor samples including those contained in flexible or rigid wall containers and the extracted concentrated analytes of interest from a gas or vapor that are collected with a sorbant tube, impinger solution, filter, or other device. (TNI)

Matrix Spike (spiked sample or fortified sample): A sample prepared, taken through all sample preparation and analytical steps of the procedure unless otherwise noted in a referenced method, by adding a known amount of target analyte to a specified amount of sample for which an independent test result of target analyte concentration is available. Matrix spikes are used, for example, to determine the effect of the matrix on a method's recovery efficiency.

Matrix Spike Duplicate (spiked sample or fortified sample duplicate): A replicate matrix spike prepared and analyzed to obtain a measure of the precision of the recovery for each analyte.

Method Blank: A sample of a matrix similar to the batch of associated samples (when available) that is free from the analytes of interest and is processed simultaneously with and under the same conditions as samples through all steps of the analytical procedures, and in which no target analytes or interferences are present at concentrations that impact the analytical results for sample analyses.

Method Detection Limit (MDL): See Limit of Detection (LOD).

Negative Control: Measures taken to ensure that a test, its components, or the environment do not cause undesired effects, or produce incorrect test results.

Non-conformance: An indication, judgment, or state of not having met the requirements of the relevant specifications, contract, or regulation.

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Observation: A record of phenomena that (1) may assist in evaluation of the sample data; (2) may be of importance to the project manager and/or the client, and yet not at the time of the observation have any known effect on quality.

Performance Audit: The routine comparison of independently obtained qualitative and quantitative measurement system data with routinely obtained data in order to evaluate the proficiency of an analyst or laboratory.

Positive Control: Measures taken to ensure that a test and/or its components are working properly and producing correct or expected results from positive test subjects.

Precision: The degree to which a set of observations or measurements of the same property, obtained under similar conditions, conform to themselves; a data quality indicator. Precision is usually expressed as standard deviation, variance or range, in either absolute or relative terms. (TNI)

Preservation: Any conditions under which a sample must be kept in order to maintain chemical and/or biological integrity prior to analysis. (TNI)

Proficiency Testing: A means of evaluating a laboratory's performance under controlled conditions relative to a given set of criteria through analysis of unknown samples provided by an external source. (TNI)

Proficiency Testing Program: The aggregate of providing rigorously controlled and standardized environmental samples to a laboratory for analysis, reporting of results, statistical evaluation of the results and the collective demographics and results summary of all participating laboratories. (TNI)

Proficiency Test Sample (PT): A sample, the composition of which is unknown to the laboratory and is provided to test whether the laboratory can produce analytical results within specified acceptance criteria. (TNI)

Quality Assurance: An integrated system of management activities involving planning, implementation, assessment, reporting and quality improvement to ensure that a process, item or service is of the type of quality needed and expected by the client. (TNI)

Quality Assurance [Project] Plan (QAPP): A formal document describing the detailed quality control procedures by which the quality requirements defined for the data and decisions pertaining to a specific project are to be achieved. (EAP-QAD)

Quality Control: The overall system of technical activities that measures the attributes and performance of a process, item, or service against defined standards to verify that they meet the stated requirements established by the customer; operational techniques and activities that are used to fulfill requirements for quality; also the system of activities and checks used to ensure that measurement systems are maintained within prescribed limits, providing protection against "out of control" conditions and ensuring that the results are of acceptable quality. (TNI)

Quality Control Sample: A sample used to assess the performance of all or a portion of the measurement system. One of any number of samples, such as Certified Reference Materials, a quality system matrix fortified by spiking, or actual samples fortified by spiking, intended to demonstrate that a measurement system or activity is in control. (TNI)

Quality Manual: A document stating the management policies, objectives, principles, organizational structure and authority, responsibilities, accountability, and implementation of an agency, organization, or laboratory, to ensure the quality of its product and the utility of its product to its users. (TNI)

Quality System: A structured and documented management system describing the policies, objectives, principles, organizational authority, responsibilities, accountability, and implementation plan of an organization for ensuring quality in its work processes, products (items), and services. The quality system provides the framework for planning, implementing, and assessing work performed by the organization and for carrying out required QA and QC activities. (TNI)

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Raw Data: The documentation generated during sampling and analysis. This documentation includes, but is not limited to, field notes, electronic data, magnetic tapes, untabulated sample results, QC sample results, print outs of chromatograms, instrument outputs, and handwritten records. (TNI)

Record Retention: The systematic collection, indexing and storing of documented information under secure conditions.

Reference Material: Material or substance one or more properties of which are sufficiently homogeneous and well established to be used for the calibration of an apparatus, the assessment of a measurement method, or for assigning values to materials. (TNI)

Reference Standard: Standard used for the calibration of working measurement standards in a given organization or a given location. (TNI)

Reporting Limit (RL): See Limit of Quantitation (LOQ).

Sampling: Activity related to obtaining a representative sample of the object of conformity assessment, according to a procedure.

Second Order Polynomial Curve (Quadratic): The 2nd order curves are a mathematical calculation of a slightly curved line over two axis. The *y*-axis represents the instrument response (or response ratio) of a standard or sample and the *x*-axis represents the concentration. The 2nd order regression will generate a coefficient of determination (COD or r^2) that is a measure of the "goodness of fit" of the quadratic curvature the data. A value of 1.00 indicates a perfect fit. In order to be used for quantitative purposes, r^2 should be ≥ 0.990. Alternatively, the Relative Error or Relative Standard Error may be used to determine calibration function acceptability (see method SOPs).

Selectivity: The ability to analyze, distinguish, and determine a specific analyte or parameter from another component that may be a potential interferent or that may behave similarly to the target analyte or parameter within the measurement system. (TNI)

Sensitivity: The capability of a method or instrument to discriminate between measurement responses representing different levels (e.g., concentrations) of a variable of interest. (TNI)

Spike: A known mass of target analyte added to a blank, sample or sub-sample; used to determine recovery efficiency or for other quality control purposes.

Standard: The document describing the elements of laboratory accreditation that has been developed and established within the consensus principles of standard setting and meets the approval requirements of standard adoption organizations procedures and policies. (TNI)

Standard Operating Procedure (SOP): A written document which details the method for an operation, analysis, or action, with thoroughly prescribed techniques and steps. SOPs are officially approved as the methods for performing certain routine or repetitive tasks. (TNI)

Storage Blank: A blank matrix stored with field samples of a similar matrix (volatiles only) that measures storage contribution to any source of contamination.

Surrogate: A substance with properties that mimic the analyte of interest. It is unlikely to be found in environment samples and is added to them for quality control purposes. Surrogate compounds must be added to all samples, standards, and blanks, for all organic chromatography methods except when the matrix precludes its use or when a surrogate is not available. Poor surrogate recovery may indicate a problem with sample composition and shall be reported to the client whose sample produced poor recovery. (QAMS)

Systems Audit (also Technical Systems Audit): A thorough, systematic, qualitative on-site assessment of the facilities, equipment, personnel, training, procedures, record keeping, data validation, data management, and reporting aspects of a total measurement system. (EPA-QAD)

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Technical Manager: A member of the staff of an environmental laboratory who exercises actual day-to-day supervision of laboratory operations for the appropriate fields of accreditation and reporting of results; also known as an Operations Manager.

Technology: A specific arrangement of analytical instruments, detection systems, and/or preparation techniques.

Traceability: The ability to trace the history, application, or location of an entity by means of recorded identifications. In a calibration sense, traceability relates measuring equipment to national or international standards, primary standards, basic physical constants or properties, or reference materials. In a data collection sense, it relates calculations and data generated throughout the project back to the requirements for the quality of the project. (TNI)

Trip Blank: A blank matrix placed in a sealed container at the laboratory that is shipped, held unopened in the field, and returned to the laboratory in the shipping container with the field samples.

Uncertainty: A parameter associated with the result of a measurement that characterizes the dispersion of the value that could reasonably be attributed to the measured value.

Acronyms

CAR – Corrective Action Report
CCV – Continuing Calibration Verification
CF – Calibration Factor
CFR – Code of Federal Regulations
COC – Chain of Custody
DOC – Demonstration of Capability
DQO – Data Quality Objectives
DUP - Duplicate
EHS – Environmental Health and Safety
EPA – Environmental Protection Agency
GC - Gas Chromatography
GC/MS - Gas Chromatography/Mass Spectrometry
HPLC - High Performance Liquid Chromatography
ICP - Inductively Coupled Plasma Atomic Emission Spectroscopy
ICP/MS – ICP/Mass Spectrometry
ICV – Initial Calibration Verification
IDL – Instrument Detection Limit
IH – Industrial Hygiene
IS – Internal Standard
LCS – Laboratory Control Sample
LCSD – Laboratory Control Sample Duplicate
LIMS – Laboratory Information Management System
LOD – Limit of Detection
LOQ – Limit of Quantitation
MDL – Method Detection Limit
MDLS – MDL Spike Standard
MDLV – MDL Verification Standard
MRL – Method Reporting Limit Check Standard
MS – Matrix Spike
MSD – Matrix Spike Duplicate
SDS - Safety Data Sheet
NELAP - National Environmental Laboratory Accreditation Program
PT – Performance Testing
TNI – The NELAC Institute
QAM – Quality Assurance Manual
QA/QC – Quality Assurance / Quality Control
QAPP – Quality Assurance Project Plan
RE – Relative Error
RF – Response Factor

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RPD – Relative Percent Difference
RSD – Relative Standard Deviation
RSE – Relative Standard Error
SD – Standard Deviation
SOP – Standard Operating Procedure
TAT – Turn-Around-Time
VOA – Volatile Organic Analytes (or Analysis)
VOC – Volatile Organic Compound

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A.6) Appendix 6 - Analytical Method References

Source references for methods include:

- *Guidelines Establishing Test Procedures for the Analysis of Pollutants Under the Clean Water Act: Analysis and Sampling Procedures*; 40CFR Part 136 as amended by Method Update Rules; August 28, 2017 and May 3, 2021.
- *Methods for Chemical Analysis of Water and Wastes*, EPA 600 (4-79-020), revised March 1983 where applicable.
- *Methods for the Determination of Inorganic Substances in Environmental Samples*, EPA-600/R-93/100, August 1993.
- *Methods for the Determination of Metals in Environmental Samples*, EPA/600/4-91/010, June 1991; Supplement I: EPA-600/R-94/111, May 1994.
- *Technical Notes on Drinking Water Methods*, EPA-600/R-94/173, October 1994.
- *NIOSH Manual of Analytical Methods*, 4th Ed., August 1994.
- *Standard Methods for the Examination of Water and Wastewater*, 20th, 21st, 22nd, 23rd on on-line Editions; American Water Works Association, Water Pollution Control Federation, America Public Health Association: Washington, D.C.
- *Test Methods for Evaluating Solid Waste Physical/Chemical Methods (SW846)*, Third Edition, September 1986 and as amended by updates promulgated by U.S. EPA.
- *Annual Book of ASTM Standards*, ASTM International, West Conshohocken, PA.
- Code of Federal Regulation (CFR), Title 40, Parts 136, 141, 172, 173, 178, 179 and 261.
- "Methods for Determination of Inorganic Substances in Water and Fluvial Sediments," (Book 5, Chapter A1), *Techniques of Water-Resources Investigations of the United States Geological Survey*, U.S. Department of the Interior, Denver, CO; Revised 1989 unless otherwise stated.
- State-specific method references include:
  - *Method for Determination of Volatile Petroleum Hydrocarbons (Gasoline)*, Method OA-1, Iowa DNR, Revision 7/27/1993.
  - *Extractable Petroleum Products (And Related Low Volatility Organic Compounds)*, Method OA-2, Iowa DNR, Revision 7/27/1993 and Revision 1/1/2015.
  - *Modified GRO: Method for Determining Gasoline Range Organics*, PUBL-SW-140, Wisconsin DNR, September 1995.
  - *Modified DRO: Method for Determining Diesel Range Organics*, PUBL-SW-141, Wisconsin DNR, September 1995.
  - *Soil Sample Collection and Analysis Procedures, Petroleum Remediation Program*, c-prp4-04, Minnesota Pollution Control Agency, January 2021.
  - *Groundwater Sample Collection and Analysis Procedures, Petroleum Remediation Program*, c-prp4-05, Minnesota Pollution Control Agency, January 2021.
  - *Kansas Method for the Determination of Low-Range Hydrocarbons (LRH)*, Kansas Department of Health and Environment, Revision 1.0, November 2015.
  - *Kansas Method for the Determination of Mid-Range Hydrocarbons (MRH) and High-Range Hydrocarbons (HRH)*, Kansas Department of Health and Environment, Revision 1.0, November 2015.

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A.7) Appendix 7 - Summary of Revisions to this QA Manual

Version 8, effective 08/10/2020
- New manual revision

Version 8.1, effective 11/12/2020
- Sec. 3.1 - Removed reference to AIHA-LAP, LLC policies.
- Sec. 3.3 - Removed reference to Industrial Hygiene samples.
- Sec. 4 - Updated laboratory organization chart.
- Sec. 5.3 - Updated training table to align with current Eurofins TestAmerica requirements.
- Sec. 10.1 - Removed reference to AIHA-LAP, LLC accreditation when qualifying subcontract laboratories.
- Sec. 17.1.5 - Removed reference to participation in proficiency testing schemes through AIHA-PAT Programs, LLC.
- Appendix 2 - Removed listing for AIHA-LAP, LLC.

Version 8.2, effective 05/14/2021
- Sec. 3.4.1 - Clarified that the minimum review frequency of this QA Manual is every two years, but more frequent review is also acceptable.
- Sec. 7.1 - Added statement explaining management's commitment to comply with the international standard.
- Sec. 20.4.1 - Corrected error in the minimum number number of calibration standards.

Version 9, effective 11/19/2021
- Formatted for D4.
- Throughout this document, updated the ID numbers for laboratory documents which are cross-referenced via D4.
- Section 2.2 - Added descriptions for Client Service Manager and Sample Receiving Staff.
- Section 2.2.6 - Added Business Unit Manager to Laboratory Director's title.
- Section 2.3 - Added Department Supervisor/Manager to list of Key Personnel; updated deputy for Client Service Manager.
- Section 2.4 - Created new section for Organizational Charts (formerly named Figure 4-1); added statement about NDSC organizational charts; updated the laboratory's organizational chart.
- Section 3.3 - Updated timeframe of QA training to 90 days of hire.
- Section 5.4.6 - Added extract clean-up as an additional technique for Selectivity.
- Section 5.7 - Added statement that Quality System Metrics are used to evaluate and manage risk.
- Section 6.3 - Updated procedures as they relate to new document database (D4).
- Section 7.4 - Added that the Laboratory Director or his/her designee maintain copies of signed contracts.
- Section 9.3.1 - Removed reference to laboratory consignment system because it has been discontinued.
- Section 10.2 - Changed the complaint submittal contact person from just the QA Manager to the Complaint Handling Team.
- Section 11.3 - Updated document title for NDSC Doc. No. CW-Q-S-005 (formerly entitled *Data Recalls*).
- Section 12.6 - Created new section for example corrective actions (formerly named Table 14-1); updated database where health/safety violations are documented.
- Section 15.1.5 - Added additional details to describe the various proficiency testing studies in which the laboratory participates.
- Section 17.6 - Created new section for Example Work Flow (formerly named Figure 19-1).
- Section 18.3.3 - Clarified that *working* thermometers are calibrated at least annually.
- Section 18.3.4 - Added temperature specification for freezers.
- Section 18.3.5 - Added additional detail to distinguish among various types of volumetric equipment, which may have differing verification requirements.
- Section 18.6 - Updated GC/MS tuning frequency to accommodate methods which allow less-frequent tune analysis.
- Section 18.7 - Created new section for Example Instrumentation List (formerly named Table 20-1).
- Section 21.4 - Created new document reference for Sample Acceptance Policy to make it a stand-alone document (formerly existed as Figure 23-1 within this manual); added criteria for client to

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notify the laboratory if sample is potentially hazardous.
- Section 21.7 - Added cross-reference to laboratory's Shipping SOP.
- Appendix 2 - Separated listing of certifications/accreditations and other approvals into two separate tables; added additional listing for ERLN, DMR-QA, and TNI LAMS programs.
- Appendix 3 - Added version details to several document references.
- Appendix 5 - Added additional detail to definitions of Least Squares Regression and Quadratic Curves; added acronyms for RE and RSE.
- Appendix 6 - Added source references for several state-specific methods.
- Appendix 7 - Created new appendix to track recent changes and revisions to this manual.

Version 9.1 (this document)
- Throughout document, updated legal entity/ownership information from "Eurofins TestAmerica" to Eurofins Environment Testing North Central, LLC ("EETNC").
- Throughout document, updated the laboratory's short business name from "Eurofins TestAmerica Cedar Falls" to "Eurofins Cedar Falls".
- Throughout document, updated the company website address.
- Cover page - Updated company logo, lab name, and confidentiality statement.
- Sec. 2.1 - Updated the description of the company's organizational structure.
- Sec. 2.4 - Updated logo on the laboratory's organizational chart.
- Sec. 21.6 - Removed reference to laboratory SOP *Quarantine Soils Procedure* (discontinued).
- Appendix 1 - Removed *Quarantine Soils Procedure* from "Laboratory SOPs and Policies" table.
- Appendix 2 - Removed reference to the laboratory's USDA-APHIS Foreign Soil Permit (expired and not renewed); updated ERLN BOA number.

CED-P-FPS-SOP42947 General Procedures for Subsampling, Sample Homogenization, and Sample Compositing
CED-P-PROJ-SOP42905 Project and Contract Review Procedures for Meeting Regulatory, Accreditation, and Client Requirements
CED-P-REV-SOP42955 Data Review Procedures
CED-P-SAM-SOP42892 Shipping
CED-P-SAM-SOP42940 Customer Service and Login Procedures
CED-P-SAM-WI43567 Sample Acceptance Policy
CED-P-STD-SOP42952 Standards and Reagents - Documentation and Tracking
CED-Q-CAL-QP44067 Calibration Curves and the Selection of Calibration Points (NDSC-QA)
CED-Q-DC-SOP42896 Laboratory Document Control Procedures
CED-Q-E-SOP44014 Manual Integrations (NDSC-QA)
CED-Q-MDL-SOP42710 Detection and Quantitation Limits (NDSC-QA)
CED-Q-MU-SOP42898 Estimating Measurement Uncertainty
CED-Q-NCW-SOP42901 Investigating a Proficiency Testing Failure
CED-Q-QC-SOP42899 Quality Control Limits
CED-Q-QC-SOP42900 Random Marginal Exceedances
CED-R-EQ-SOP42915 In-House Calibration and Verification of Laboratory Support Equipment
CED-R-EQ-SOP42930 Analytical Balance Operation
CED-R-EQ-SOP42968 Thermometer Operation
CED-R-EQ-SOP43012 Pipette Verification Procedures
CED-R-EQ-SOP43014 Calibration of Sampling Pumps
CED-R-PE-SOP42903 Laboratory Personnel Training
CED-S-EHS-QP43267 Environmental Health and Safety Manual (NDSC)
CED-S-FS-SOP42935 Field Sampling Procedures
CED-S-FS-SOP42936 Field Analysis Procedures
CED-S-WD-SOP42937 Waste Disposal

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Version history

Version	Approval	Revision information	
8.2	22.JUN.2021	Uploaded current Quality Manual to D4	
9	09.NOV.2021	Rewritten in D4; new manual revision	
9.1	25.FEB.2022	Editorial revisions	

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APPENDIX F

STANDARD OPERATING PROCEDURES

1.0 Operation

This section discusses the methodologies for maintenance and use of photoionization detectors (PID) in the field in order to screen for volatile organic compounds (VOCs).

2.0 Objectives and Rationale

The following section summarizes the field procedures and handling for PIDs to ensure accurate results and good maintenance of the equipment. This SOP should be used in conjunction with the user guide for the PID. The user guides are stored with the appropriate PID for reference and should be taken into the field when the PID is being used.

3.0 Equipment and Maintenance

Blackstone owns a MiniRAE 3000 that will be used during field screening activities. The PID is stored in a secure location with the user guide, battery chargers, spare lamps (10.6 and 11.7 eV), spare filters, calibration gas and pressure gauges. For PID-specific information, refer to the user guide for a step-by-step process of using the PID. The PID will require laboratory calibration to verify that the PID is in good working condition. The PID may be sent in for laboratory calibration more frequently if it is malfunctioning and replacing the lamp and filters does not remedy the problem.

Prior to using the PID it is good practice to charge the PID for at least 10 hours. Confirm that the PID is fully charged by checking the battery icon on the PID display. These units can also be powered using disposable batteries and these should be stored and carried with the PID in case of an emergency.

Prior to leaving the field, confirm that all the PID components are properly stowed in the carrying case.

4.0 Calibration

Calibration of the PID should be conducted onsite each time it is used and at the beginning and ending of the field activities. If field activities take longer than a day then the PID should be recalibrated at the beginning and ending of each day. Calibration of the PID should also be completed after replacing the lamp and allowing for a five-minute run period prior to calibration. Calibration completion and results of the calibration should be recorded on the appropriate calibration form.

Calibration of the PID is a two-point process that utilizes fresh air and a designated span gas. Before collecting any PID field measurements, calibrate the PID starting first with fresh air and then completing the span gas calibration. If the fresh air calibration does not result in a 0.0 parts per million (ppm) reading (±10%) then attach the carbon filter and complete the fresh air calibration again. After successfully completing the fresh air calibration, calibrate the PID using the span gas.

Isobutylene is the span gas that is used to complete the second step of the calibration. This calibration should result in a reading of 100 ppm (±10%). Once the calibration is completed and successful, field measurements can be collected. If a reading of 100 ppm (±10%) is not achieved during calibration, repeat the process using the span gas. If again the calibration is not successful, check that all the filters are placed correctly in the PID, restart the device, and complete the span gas calibration again. If the calibration is still leading to a result that is out of the acceptable range then replace the lamp with a lamp of the same rating, allow for the PID to run for at least five minutes, and then complete the two-point

calibration starting with the fresh air calibration.

5.0 Screening Procedure

All samples collected in association with a sampling event should be treated in the same manner so that the results of screening are comparable. Prior to collecting a PID reading, the soil sample should be characterized and then placed in a re-sealable bag. Fill the bag to half full and wait at least ten minutes before collecting a reading from the sample. Disturb a small portion of the soil sample in the sealed bag. Open the bag to less than one inch at the top and the PID sensor should be inserted into the bag. Close the opening around the PID sensor and record the reading from the PID once it has stabilized. Next, remove the PID sensor from the bag and reseal it completely. Additional field screening may be needed per the sampling plan or as specified by the project manager. However, the PID should be the first field screening instrument used when multiple instruments are to be used. After all the field screening is complete, collect the soil sample for analysis from the remaining undisturbed portion of the soil interval within the bag and place into the appropriate sample containers.

The PID should read 0.0 ppm after it has been removed from the bag. Allow for the PID to decrease to a value of 0.0 ppm before using the PID to collect another reading. If the PID does not appear to be responding or is malfunctioning, confirm that the PID is operating correctly by completing a bump test with the span (calibration) gas. Complete any calibration and repairs if the device is not functioning correctly.

The PID should be allowed to run continuously during field activities to monitor the ambient air conditions. If a sustained level of 5 ppm or any unusual chemical odor is observed for at least five minutes, personnel will don a half-face air purifying respirator and follow instructions as set in SOPs.

1.0 Sample Custody Procedures

Sample custody procedures are based on the Environmental Protection Agency (EPA)-recommended procedures which emphasize careful documentation of sample collection and sample transfer. To ensure that all the important information pertaining to each sample is recorded, the documentation procedures listed herein will be executed.

The following custody procedures will be strictly followed in order to maintain and document sample custody. A sample is considered to be under proper custody if:

- It is in actual possession of the responsible person.
- It is in view, following physical possession.
- It is in the possession of a responsible person and is locked or sealed to prevent tampering.
- It is in a secure area awaiting transfer of custody.

2.0 Chain-of-Custody Record

Sample custody is documented by a "Chain-of-Custody Record". The custody record is completed by the individual designated by the Project Manager as being responsible for sample handling and shipment to a designated laboratory. The information recorded will include:

Project Manager	Print the name of the project representative to whom lab reports and correspondence are to be addressed.
Sampler Name	Provide name and signature of sampler/samplers.
Project Number	Print the project number (used on lab reports).
Sample I.D.	Write the identification number of the sample.
Date/Time Sampled	Date and time (military) the sample was collected.
Sample Material	Print the type of material sampled.
Special Instructions	In the special instructions section of the chain-of-custody form; sample method, turnaround time, or other conditions of note may be listed as required in the sampling plan or deemed appropriate in the field. Print or mark the type of analysis and laboratory quantification levels required. Make sure these levels are at least as low as required. Detection limits may be specified in special instructions box.
Relinquished By	Print the name of the person giving up the sample and provide signature. First person to relinquish must be same as sampler.
Company	Print the name of the organization giving up the sample.
Date/Time	Print the date and time at which the sample was given.

Received By	Obtain the signature of the receiving person. Organization Print the name of the receiving organization. Print the date and time at which the sample was received.

The chain-of-custody form will consist of an original and two carbon copies. The sampler will retain the second carbon copy and ship the original and first carbon copy to the lab.

3.0 Transfer of Custody

The field personnel initially taking the sample(s) are responsible for the care and custody of the sample(s) until it is properly transferred or delivered to laboratory personnel. All samples must be accompanied by a chain-of-custody record, consisting of an original and carbonless copy. A second copy is retained in the Blackstone Environmental project file.

When transferring in possession of samples, the individuals relinquishing and receiving will sign, date, and note the time on the record. The condition of the shipping container and the samples if the shipping container is opened shall be noted on the chain of custody form or a sample receipt form, which will remain with the chain-of-custody. The company from which the sample is relinquished and to which it is delivered and the reason for transfer will be noted. This record documents the transfer of samples from the custody of the sampler to that of another person, or the permanent laboratory.

It is the Project Manager's responsibility to ensure that all shipping data are consistent and that they are made part of the permanent job file. The first noted person to relinquish must be the same as the sampler name.

1.0 EQUIPMENT DECONTAMINATION SOP

All non-disposable equipment will be thoroughly decontaminated in accordance to the following procedures prior to leaving a site or containerized for decontamination off site to prevent cross-contamination to other sites. All non-disposable sampling equipment will be thoroughly decontaminated in accordance with the following procedures prior to collecting each sample, between sample points, and at the end of field activities to avoid cross-contamination. Under no circumstances is potentially contaminated equipment to be allowed to leave the site.

Decontamination Procedure (the sampling plan may require a different procedure)

1. Remove as much media from the equipment as possible prior to washing.
2. Wash the equipment using detergent water (Alconox is preferred if compatible with the equipment and analysis to be performed).
3. Rinse the material with tap water.
4. Repeat steps 2 and 3 for two more times.
5. Rinse with deionized water.
6. If required*, rinse with another agent (methanol, acetone, etc.)
7. If step six is required, rinse one more time with deionized water.
8. Place on a rack in a contaminant free area to air dry or wipe dry with a contaminant free towel.

**A solvent rinse is required in the event that oily sheen and or residue is observed. Capture this rinsate in a container provided by the analytical laboratory and return it to the analytical laboratory for proper disposal or containerize with site investigative derived waste (IDW) for proper disposal; whichever is appropriate.*

Drilling Equipment

The drilling subcontractor is responsible for the decontamination of non-disposable drilling equipment (augers, sampling spoons, etc.). The environmental professional should verify that decontamination procedures used by the drilling subcontractor are adequate and fully executed in between sampling locations.

1.0 Investigative Derived Waste SOP

This Standard Operating Procedure (SOP) addresses the management and handling of investigation derived waste (IDW) which includes all soil, groundwater, decontamination rinse water and disposable sampling equipment (such as gloves, sampling filters, etc.) generated while completing environmental site assessment fieldactivities.

When appropriate, soil and drill cuttings will be thin spread on the subject property. If soil and drill cuttings cannot be thin spread on the subject property, cuttings will be containerized in 55-gallon drums, with resealable tops or similar, awaiting property transportation and disposal off site. Decontamination rinse water, including water mixed with Alconox (or similar) from each sampling event will be discharged to a permeable surface on the subject property following assessment activities.

Disposable sampling materials from each sampling event will be bagged and disposed of on-site if possible. If no dumpster is available to the field personnel on the subject property, then this material will be disposed of at the offices of Blackstone.

1.0 Objectives and Rationale

The following sections summarize the procedures for lead-based paint sampling to ensure reliable samples and accurate reporting of all lead bearing substances using a certified x-ray fluorescence (XRF) analyzer. This Standard Operating Procedure (SOP) should be used in conjunction with the XRF SOP (See Appendix F of QAPP) and the XRF user manual. The user manual will be stored with the device.

The certified XRF analyzer will have proper leak tests performed on the analyzer every six months with documentation. The analyzer will be properly stored and braced during transportation and placed as far away from the driver and passengers as possible.

The inspector performing the inspection has been certified through the Iowa Department of Public Health (IDPH) and appropriately trained to safely operate the XRF analyzer.

2.0 Field Sampling Procedure

Pre-calibration and post-calibration tests will be performed on the analyzer during the inspection activities. These tests will be executed by taking the average of three readings performed on a 1.02 milligrams (mg)/centimeter^2 (cm^2) Standard Reference Material (SRM) paint film from National Institute of Standards and Technology (NIST) and then compared to the Performance Characteristic Sheet (PCS) for the device.

Note: a calibration test will also be taken every 4 hours or at the end of the inspection, whichever is sooner. In addition to calibrating the analyzer, a detailed identification scheme illustration will be documented and labeled according to how samples were obtained.

The standard procedure for sampling is to test one component type in each room equivalent. All sampling combinations will be recorded and documented in the report. A room equivalent is defined as an identifiable part of a building such as a room, exterior side, or exterior area of a building (e.g. kitchen, hallway, bathroom, side of exterior).

A component type is made up of a component and substrate. A component is defined as separate parts of a room equivalent (e.g. floor, wall, window sash, door). A substrate is defined as the material of which the component is made (e.g. wood, brick, drywall, metal, plaster, concrete).

1.0 Objectives and Rationale

This section discusses the methodologies to be used for maintenance and use of the portable X-ray fluorescence (XRF) device in the field for soil screening activities. The following section summarizes the field procedures and handling of the XRF to ensure accurate results and good maintenance of the device. This SOP should be used in conjunction with the user manual. The user manual is stored with the XRF and it travels with the device into the field.

2.0 Equipment and Maintenance

Blackstone operates an Innov-X Systems XRF Analyzer. The XRF is stored in a secure location with the user manual, iPAQ and iPAQ accessories, battery and battery charger assembly, power cord, standardization clip, and check standards. Refer to the user manual for XRF step-by-step instructions and information.

Prior to using the XRF, make sure both batteries are fully charged. If the XRF is going to be used over several days, charge both batteries overnight so that the XRF can used the following day. The XRF batteries have a charge indicator; check both before taking the XRF into the field to see that they are fully charged.

Prior to leaving the field at the end of the day, confirm that all of the XRF components and accessories are properly stored away.

3.0 Standardization and Calibration

Standardization of the XRF should be conducted on site each time it is used and at the beginning of field activities each day. Standardization of the XRF should also be completed after replacing the battery or iPAQ unit, restarting the XRF or iPAQ, or after four hours of use.

Following each standardization, the Standard Reference Material (SRM) check standards should be analyzed for at least 1 minute (60 seconds). Results of the calibration check should be recorded on the calibration check log which is stored in the XRF field case. If the measured calibration results have a range that exceed 20% of the reported value for arsenic and lead than increase the exposure time to 120 seconds and reshoot the standard.

After turning on the XRF and iPAQ unit and initiating the Innov-X Systems Analyzer software, a standardization request will appear on the iPAQ. Place the standardization clip, Alloy 316, on the XRF, in front of the analyzing window. Once this is done, start the calibration. The XRF will complete the standardization and will report if it was successful or if any errors were encountered. If the standardization results in errors, check that the clip is situated correctly on the front of the XRF unit and complete the standardization again. If it fails again, restart the XRF and replace the battery and try again. If this is unsuccessful, the XRF offers a soft reset option. If the soft reset standardization is not successful, then contact Innov-X Systems service center at 781-938-5005 for further assistance.

4.0 Screening Procedure

Prior to screening the soil, the soil sample should be placed in a re-sealable bag and agitated to homogenize the sample. Place the sealed bag on a flat surface and then place the XRF directly on the face of the bag. The soil sample should completely fill the XRF analyzer window. The soil sample should have a sample thickness of 0.5 inches to provide an accurate result using the XRF.

Engage the instrument and shoot through the bag into the soil for 60 seconds. Record the XRF sample number and any parameters, as desired by the sampler. It is important to review the XRF results in the field, as the results of this field screening tool are utilized to select the interval for lab analysis. In general, intervals with elevated arsenic and lead screening levels should be selected for laboratory analysis. All results will also be downloaded and saved in the project folder upon returning to the office.

If the XRF malfunctions in the field, restart the device and replace the battery. If it continues to malfunction, check the user manual for what may be causing the issue and call the Innov-X Systems service center at 781-938-5005, if needed.

When the XRF is turned on but not in use, the trigger lock should be on. This prevents accidental radiation exposure to the user and to other personnel on the site.

1.0 Objectives and Rationale

The following sections summarize the field procedures for soil sampling to ensure quality control and to secure fully representative samples are collected that meet the requirements of the sampling plan. Soil samples can be collected from a variety of conditions and locations as required by a permit, a sampling plan, or the project manager. The sampling method may vary. However, basic protocol must be followed to ensure sample integrity, data utility, and employee, public, and environmental safety. Suitable collection equipment will be constructed of a compatible material that does not affect the sample media or the analytical constituents. All samples will be placed into appropriate laboratory–provided sample containers. The sample will then be labeled, logged, and placed in a cooler containing ice in order to preserve sample integrity.

Field personnel should always wear appropriate personal protective equipment while handling sampling equipment and containers, sampling soils, and decontaminating equipment. Disposable nitrile gloves should be changed as each soil horizon/interval is handled.

The procedures for soil collection presented in this Standard Operating Procedure (SOP) are designed to ensure the following:

- all samples and field measurements are consistent with the project objectives;
- samples are collected in a manner that provides the highest level of safety for field personnel, the public, and the environment;
- samples are collected efficiently and provide the highest achievable data quality; and
- ensure no cross-contamination between soil samples via good housekeeping procedures and proper equipment decontamination.

2.0 Sampling Equipment Methodologies

2.1 Surface Soils (soils to a depth of one foot)

Surface soils will be sampled utilizing a spade, scoop, hand auger, or trowel constructed of a material compatible with the analyte of interest and the material sampled. Unless otherwise specified by the sampling plan, a minimum of one inch of soil will be removed to expose fresh soil. The sample will then be collected from fresh soil using the appropriate sampling equipment.

2.2 Subsurface Soils (soils deeper than one feet)

Subsurface soils will be sampled by excavating (greater than 5 feet) or by drilling to the appropriate depth. Samples will not be collected from any drilling method requiring the use of drilling fluids or the flights of any drilling system unless specifically required in the sampling plan.

When collecting the sample with excavation type equipment the following procedure will be followed:

- Excavate to a depth within half of the excavation equipment excavating capacity (½ a backhoe bucket or ½ a spade full);
- Decontaminate the excavation equipment; and
- Collect the sample, focusing on the deep half of the excavated material.

When collecting the sample with drilling equipment use the following procedure:

Hollow Stem Auger Drilling

- If a split spoon sampler is used with a liner constructed of compatible material:
  - Drill to a depth within half the split spoon length above the desired sample depth;
  - Insert an uncontaminated liner; and
  - Continue drilling to collect the sample per established drilling methods.
- If a split spoon sampler is used without a liner:
  - Drill to a depth within half the split spoon length above the desired sample depth;
  - Decontaminate the split spoon per procedures listed in that section; and
  - Continue drilling to collect the sample.

Bucket Augering

- Drill to a depth within half the bucket length above the desired sample depth;
- Decontaminate the bucket; and
- Continue drilling to collect the sample.

Direct Push Technologies

- Push to within one foot of the desired depth;
- Remove the push rod and add the sampler section; and
- Re-push through the sample point.

In some cases, soil conditions will not allow for the removal of the push rod without the collapse of the push hole. In this case a continuous sample method may be employed. If continuous sampling is to be completed, the sampler should be decontaminated prior to collecting the sample.

1.0 Soil Sampling Methodologies

This section discusses the methodologies to be used in collecting soil samples. The collection technique to be used will be based on the test parameters that will be analyzed. All methods utilized must be acceptable according to industry practices.

Sample horizons are chosen for laboratory analysis based on the site-specific sampling and analysis plan (SAP) in conjunction with field observations. Soil borings are logged for observations such as staining or odors and lithology. Field screening tools can be used in conjunction with the observations made by an environmental professional to provide the most useful information possible. Field observation relies on the skill and experience of the field personnel to visually identify signs of the analyte, materials related to the analyte, and process or site conditions that may indicate a relatively higher likelihood of the analyte presence. Experience used in conjunction with field screening, provides an effective tool in maximizing representative data collection. Specific instruments utilized by Blackstone are listed and discussed in the equipment-specific SOPs.

Soil samples/intervals are containerized in a re-sealable bag after the material has been logged. Care should be taken to disturb the sample **as little** as possible during any transfer of soil to the bag and the bag should be sealed in between any activity prior the completion of sample collection.

The soil sample is then field screened as applicable according to the requirements of the SAP. When sampling for Volatile Organic Compounds (VOCs)/Semi-Volatile Organic Compounds (SVOCs), the first field screening conducted should be for organic vapors using a photoionization detector (PID). The

PID is inserted into the bag and the field screening measurement is collected. This measurement in conjunction with physical observations allows the field personnel the opportunity to select the appropriate soil sample/interval for the VOC/SVOC analysis to yield the most valuable data. PID screening should be conducted as quickly as possible from each soil interval bag and samples for VOC analyses should be taken promptly from the least disturbed portion of the soil interval within the selected soil-interval bag. Soil samples are collected in 5-gram portions from each bag using Terra Core® plugs. SVOC samples should be collected immediately following VOC sample collection from the remaining least disturbed portion of the soil interval within the selected soil-interval bag.

XRF screening (when applicable) may be completed following PID screening and VOC/SVOC sample collection. Sample intervals within bags should be broken up and homogenized prior to XRF screening and sampling for inorganics and metals analysis. Following the screening and sampling for VOC/SVOC analyses and metals analysis, samples may be taken from the homogenized baggies for any remaining analytical parameters specified by the SAP.

The following method is used for collection of soil samples for VOC/SVOC analysis:

Method 5035A for VOC/SVOC analysis: Field Preservation, Collection and Handling Instructions of Vials (Sodium Bisulfate / Methanol)

Materials Required

- Two pre-weighted 40 milliliter (ml) glass vials preserved with sodium bisulfate for low level analysis.
- One pre-weighted 40 ml glass vial preserved with methanol for medium-high level analysis
- One 4-ounce glass jar per sample for percent total solids determination
- 1 Terra Core® plug (5-gram soil); A single Terra Core® can be used to collect sample aliquots for each of the vials.

Instructions for Sample Collection

1. With plunger seated in the handle, push the Terra Core® into exposed soil until the sample chamber is filled. A 5-gram sample will be collected.
2. The soil plug should be flush with the mouth of the sampler.
3. Remove any soil or debris from outside of the Terra Core® sampler and any excess soil that extends beyond the mouth of the sampler.
4. Rotate the plunger 90 degrees until it is aligned with the slots in the body. Place the mouth of the sampler into the 40ml glass vial and extrude the sample by pushing the plunger down. Taking care to not touch the plunger to the sample preservative in the glass vial.
5. Quickly place lid back on 40 ml vial and repeat process for each additional vial.
6. Mark each sample container with your site specific sample identification. Do not add any additional labels or tape to the pre-weighted glass vials.
7. Store samples in containers at 4 degrees Celsius (°C). The holding time for VOC analysis is two weeks from the time of sample collection.
8. Manually fill the provided 4-ounce glass container, to capacity, to submit to the laboratory for percent total solid determination. The 4-ounce jar can also be used for laboratory submittal for analysis of polynuclear aromatic hydrocarbons (PAHs), pesticides, and/or polychlorinated byphenyls (PCBs).

Note: Methanol is a flammable substance. Department of Transportation (DOT) requirements must be met if samples will be shipped to the laboratory via couriers such as United Parcel Service (UPS) or Federal Express.

1.0 Objectives and Rationale

The following sections summarize the field procedures for groundwater sampling to ensure quality control and to secure fully representative samples.

Preservation of samples is required to retain integrity. The most common preservation techniques include pH adjustment and temperature control. Field personnel will use the United States (U.S.) Environmental Protection Agency (EPA)-recommended container types and adhere to U.S. EPA recommended preservation techniques and holding times for the parameters of concern.

The procedures presented are designed to ensure the following:

- All sample and field measurements are consistent with project objectives.
- Samples are identified, preserved, and transported in such a manner as to ensure the integrity and validity of the samples.
- Field measurements are collected in a manner to allow for comparison between existing and newly collected data so as to provide an adequate data base for achieving the objectives and ensuring quality.

1.2 Quality Assurance Procedures

The sampler will always wear gloves while measuring water levels, purging wells, sampling wells, and decontaminating equipment. Gloves will be changed after each sample to prevent cross contamination. Pre-washed and pre-preserved sample containers will be provided by the laboratory chosen by Blackstone and will be prepared in accordance with U.S. EPA quality control procedures.

When collecting a sample for a particular analysis (e.g., volatile organic compounds) requiring multiple containers, bottles will be filled from the same bailer or sample tubing, if possible. If an additional sample volume is required to fill the bottles, it will be retrieved in the same manner for consistency. Agitation will be avoided, particularly when volatile organic analyses will be conducted. Bottles will be filled in the order of most volatile to least volatile analysis type from volatile organic compounds (VOCs) to semi-volatile organic compounds (SVOCs) to inorganics. Samples for volatile organic analysis will be collected in glass vials preserved with hydrochloric acid. The sample bottle will be filled allowing no headspace between the liquid and the lid of the vial by filling the bottle such that a meniscus forms over the lip and then fitting the cap securely. Headspace will be checked by inverting the bottle and tapping the lid to see if air bubbles are visible in the bottle. If an air bubble appears, the procedure is repeated. If air bubbles are still present following resampling, an un-preserved vial will be collected, allowing no headspace using the same methodology as is used for filling a preserved vial. The un-preserved vial will be submitted to the laboratory, and the lack of preservative will be indicated on the chain of custody. A note indicating the shortened hold time will also be included on the chain of custody. Groundwater samples will be filled directly from the sampling device into the various bottles, except samples to be analyzed for dissolved metals, which will pass through an appropriate dedicated filter.

2.0 Groundwater Sampling Procedures

2.1 Sampling Procedure for Temporary (Drop Screen) Monitoring Wells

Groundwater is sampled via temporary wells during Environmental Site Assessments using the following procedure:

- A stainless-steel drop screen is placed at the interval of interest.
- A peristaltic pump using dedicated tubing is deployed for purging each temporary well.
- Once turbidity has decreased to ~100 Nephelometric Turbidity Units (NTU), samples are collected via a peristaltic pump.

2.2 Sampling Procedure for Permanent Monitoring Wells

2.2.1 Measurement of Potentiometric Levels

Static water level measurements will be recorded as feet below the measured point elevation (usually from the north side top of casing) to the nearest 0.01 foot. This is measured with a battery-operated water level indicator with tone or light that indicates when the probe has reached water in the well. The procedure below should be followed:

- Rinse probe indicator and tape with deionized water before use at each well.
- Turn meter on and test battery.
- Lower probe slowly into well casing.
- When tone sounds and/or light flashes, raise and lower probe slightly to verify level.
- Measure water level depth to nearest 0.01-foot from the north side of the top of casing or marked point on the casing.
- Turn meter off and measure well depth, if required, making sure that the tape isn't sagging.
- Record the date, time, water level, well depth, and point of measurement on casing (if other than top of casing).

2.2.2 Well Purging /Stabilization

The water standing in the well may not be representative of the formation groundwater quality. Therefore, if the well will be sampled using a technology other than low-flow technology, it is necessary to purge the well prior to sampling to achieve a representative sample. Before purging the well, the static water level must be measured using a water level indicator using the procedure above. After the static water level has been measured and recorded, a pump or bailer will be lowered down the well and the water will be removed.

For a well to be properly purged, the well must have a minimum of three (3) saturated well casing volumes evacuated or the well must be evacuated until dry. If the well is bailed or pumped until dry, it must be allowed to recover and then the sample will be collected from the well. When utilizing low-flow sampling techniques, traditional well purging is not required. Low-flow methods specifically target the screened interval and pull water directly from the formation. This technique reduces disturbance to the water column which decreases turbidity and also places less stress on the surrounding formation.

When conducting low-flow sampling techniques, a peristaltic pump or a bladder pump is lowered to the middle of the screened interval in the well. Water is removed from the well at a rate of 500 milliliters (ml)/minute or less and stabilization parameters are recorded every 3 to 5 minutes. Stabilization parameters include:

- water level (±10%);
- pH (± 0.2 NTU);
- specific conductivity (±10%);

- temperature (±0.5º C);
- dissolved oxygen (± 0.2 mg/L);
- turbidity (±10% or <5 NTU); and
- oxygen reduction potential (ORP) (±10%).

Stabilization is achieved once three consecutive readings are within the stabilization range for all parameters. Sampling using low-flow methods is the preferred technique. However, bailers may also be used in some situations. Situations that would require the use of a bailer include pump malfunction or the inability to use a low-flow pump. For example, if a well is too deep to employ a peristaltic pump, and there is not enough water in the well to reach the inlet of a deployable bladder pump, a bailer or a passive sampling method such as a diffusion sampler would be used.

2.2.3 Sampling procedure

The following procedural steps should be followed when collecting groundwater samples:

- Calibrate all field instruments at the start of each field day per the equipment specific SOP.
- Record the calibration information on the appropriate calibration form.
- Open the monitoring well and record condition.
- Allow for the well to come to equilibrium after it has been opened and then measure static water level using procedures above.
- If a bailer is being utilized to collect the groundwater sample, calculate the volume of three well casings and remove this volume while trying to minimize agitation within the well.

The next three steps apply to sample collection via low-flow pump only and should be ignored when a bailer is used.

- Prepare the sampling device and sample tubing for use.
- Connect a YSI 556 or similar flow cell device in line with the pump, when applicable.
- Begin pumping or purging the well while measuring stabilization parameters as indicated above.
- When stabilization is achieved, fill bottles from most volatile to least volatile (If taking splits / dupes / MS/MSDs, fill the bottles for each analyte at the same time, rather than filling by bottle set).
- Decontaminate the water level meter and any non-dedicated sampling equipment following the decontamination SOP.
- Secure the monitoring well.

3.0 Report Procedure

Following field sampling, employee will prepare a summary report that will include the following components:

1. All recorded sampling documentation;
2. The address of the building or property;
3. The date of the inspection and/or field activities;
4. Testing protocol used (e.g. IAC Chap. 70)
5. The instrument manufacturer, model, serial number, and all other applicable information pertaining to the field devices being used
6. The field personnel and all documentation of licensing/certification
7. The illustration of the identification scheme

APPENDIX G

EPA METHOD 6200

METHOD 6200

FIELD PORTABLE X-RAY FLUORESCENCE SPECTROMETRY FOR THE DETERMINATION OF ELEMENTAL CONCENTRATIONS IN SOIL AND SEDIMENT

SW-846 is not intended to be an analytical training manual. Therefore, method procedures are written based on the assumption that they will be performed by analysts who are formally trained in at least the basic principles of chemical analysis and in the use of the subject technology.

In addition, SW-846 methods, with the exception of required method use for the analysis of method-defined parameters, are intended to be guidance methods which contain general information on how to perform an analytical procedure or technique which a laboratory can use as a basic starting point for generating its own detailed Standard Operating Procedure (SOP), either for its own general use or for a specific project application. The performance data included in this method are for guidance purposes only, and are not intended to be and must not be used as absolute QC acceptance criteria for purposes of laboratory accreditation.

1.0 SCOPE AND APPLICATION

1.1 This method is applicable to the in situ and intrusive analysis of the 26 analytes listed below for soil and sediment samples. Some common elements are not listed in this method because they are considered "light" elements that cannot be detected by field portable x-ray fluorescence (FPXRF). These light elements are: lithium, beryllium, sodium, magnesium, aluminum, silicon, and phosphorus. Most of the analytes listed below are of environmental concern, while a few others have interference effects or change the elemental composition of the matrix, affecting quantitation of the analytes of interest. Generally elements of atomic number 16 or greater can be detected and quantitated by FPXRF. The following RCRA analytes have been determined by this method:

Analytes	CAS Registry No.
Antimony (Sb)	7440-36-0
Arsenic (As)	7440-38-0
Barium (Ba)	7440-39-3
Cadmium (Cd)	7440-43-9
Chromium (Cr)	7440-47-3
Cobalt (Co)	7440-48-4
Copper (Cu)	7440-50-8
Lead (Pb)	7439-92-1
Mercury (Hg)	7439-97-6
Nickel (Ni)	7440-02-0
Selenium (Se)	7782-49-2
Silver (Ag)	7440-22-4
Thallium (Tl)	7440-28-0
Tin (Sn)	7440-31-5

Analytes	CAS Registry No.
Vanadium (V)	7440-62-2
Zinc (Zn)	7440-66-6

In addition, the following non-RCRA analytes have been determined by this method:

Analytes	CAS Registry No.
Calcium (Ca)	7440-70-2
Iron (Fe)	7439-89-6
Manganese (Mn)	7439-96-5
Molybdenum (Mo)	7439-93-7
Potassium (K)	7440-09-7
Rubidium (Rb)	7440-17-7
Strontium (Sr)	7440-24-6
Thorium (Th)	7440-29-1
Titanium (Ti)	7440-32-6
Zirconium (Zr)	7440-67-7

1.2 This method is a screening method to be used with confirmatory analysis using other techniques (e.g., flame atomic absorption spectrometry (FLAA), graphite furnance atomic absorption spectrometry (GFAA), inductively coupled plasma-atomic emission spectrometry, (ICP-AES), or inductively coupled plasma-mass spectrometry, (ICP-MS)). This method's main strength is that it is a rapid field screening procedure. The method's lower limits of detection are typically above the toxicity characteristic regulatory level for most RCRA analytes. However, when the obtainable values for precision, accuracy, and laboratory-established sensitivity of this method meet project-specific data quality objectives (DQOs), FPXRF is a fast, powerful, cost effective technology for site characterization.

1.3 The method sensitivity or lower limit of detection depends on several factors, including the analyte of interest, the type of detector used, the type of excitation source, the strength of the excitation source, count times used to irradiate the sample, physical matrix effects, chemical matrix effects, and interelement spectral interferences. Example lower limits of detection for analytes of interest in environmental applications are shown in Table 1. These limits apply to a clean spiked matrix of quartz sand (silicon dioxide) free of interelement spectral interferences using long (100 -600 second) count times. These sensitivity values are given for guidance only and may not always be achievable, since they will vary depending on the sample matrix, which instrument is used, and operating conditions. A discussion of performance-based sensitivity is presented in Sec. 9.6.

1.4 Analysts should consult the disclaimer statement at the front of the manual and the information in Chapter Two for guidance on the intended flexibility in the choice of methods, apparatus, materials, reagents, and supplies, and on the responsibilities of the analyst for demonstrating that the techniques employed are appropriate for the analytes of interest, in the matrix of interest, and at the levels of concern.

In addition, analysts and data users are advised that, except where explicitly specified in a regulation, the use of SW-846 methods is *not* mandatory in response to Federal testing requirements. The information contained in this method is provided by EPA as guidance to be used by the analyst and the regulated community in making judgments necessary to generate results that meet the data quality objectives for the intended application.

1.5 Use of this method is restricted to use by, or under supervision of, personnel appropriately experienced and trained in the use and operation of an XRF instrument. Each analyst must demonstrate the ability to generate acceptable results with this method.

2.0 SUMMARY OF METHOD

2.1 The FPXRF technologies described in this method use either sealed radioisotope sources or x-ray tubes to irradiate samples with x-rays. When a sample is irradiated with x-rays, the source x-rays may undergo either scattering or absorption by sample atoms. This latter process is known as the photoelectric effect. When an atom absorbs the source x-rays, the incident radiation dislodges electrons from the innermost shells of the atom, creating vacancies. The electron vacancies are filled by electrons cascading in from outer electron shells. Electrons in outer shells have higher energy states than inner shell electrons, and the outer shell electrons give off energy as they cascade down into the inner shell vacancies. This rearrangement of electrons results in emission of x-rays characteristic of the given atom. The emission of x-rays, in this manner, is termed x-ray fluorescence.

Three electron shells are generally involved in emission of x-rays during FPXRF analysis of environmental samples. The three electron shells include the K, L, and M shells. A typical emission pattern, also called an emission spectrum, for a given metal has multiple intensity peaks generated from the emission of K, L, or M shell electrons. The most commonly measured x-ray emissions are from the K and L shells; only metals with an atomic number greater than 57 have measurable M shell emissions.

Each characteristic x-ray line is defined with the letter K, L, or M, which signifies which shell had the original vacancy and by a subscript alpha (α), beta (β), or gamma (γ) etc., which indicates the higher shell from which electrons fell to fill the vacancy and produce the x-ray. For example, a K_α line is produced by a vacancy in the K shell filled by an L shell electron, whereas a K_β line is produced by a vacancy in the K shell filled by an M shell electron. The K_α transition is on average 6 to 7 times more probable than the K_β transition; therefore, the K_α line is approximately 7 times more intense than the K_β line for a given element, making the K_α line the choice for quantitation purposes.

The K lines for a given element are the most energetic lines and are the preferred lines for analysis. For a given atom, the x-rays emitted from L transitions are always less energetic than those emitted from K transitions. Unlike the K lines, the main L emission lines (L_α and L_β) for an element are of nearly equal intensity. The choice of one or the other depends on what interfering element lines might be present. The L emission lines are useful for analyses involving elements of atomic number (Z) 58 (cerium) through 92 (uranium).

An x-ray source can excite characteristic x-rays from an element only if the source energy is greater than the absorption edge energy for the particular line group of the element, that is, the K absorption edge, L absorption edge, or M absorption edge energy. The absorption edge energy is somewhat greater than the corresponding line energy. Actually, the K absorption edge energy is approximately the sum of the K, L, and M line energies of the particular element, and the L absorption edge energy is approximately the sum of the L and M line energies. FPXRF is more sensitive to an element with an absorption edge energy close to but less than

the excitation energy of the source. For example, when using a cadmium-109 source, which has an excitation energy of 22.1 kiloelectron volts (keV), FPXRF would exhibit better sensitivity for zirconium which has a K line energy of 15.77 keV than to chromium, which has a K line energy of 5.41 keV.

2.2 Under this method, inorganic analytes of interest are identified and quantitated using a field portable energy-dispersive x-ray fluorescence spectrometer. Radiation from one or more radioisotope sources or an electrically excited x-ray tube is used to generate characteristic x-ray emissions from elements in a sample. Up to three sources may be used to irradiate a sample. Each source emits a specific set of primary x-rays that excite a corresponding range of elements in a sample. When more than one source can excite the element of interest, the source is selected according to its excitation efficiency for the element of interest.

For measurement, the sample is positioned in front of the probe window. This can be done in two manners using FPXRF instruments, specifically, in situ or intrusive. If operated in the in situ mode, the probe window is placed in direct contact with the soil surface to be analyzed. When an FPXRF instrument is operated in the intrusive mode, a soil or sediment sample must be collected, prepared, and placed in a sample cup. The sample cup is then placed on top of the window inside a protective cover for analysis.

Sample analysis is then initiated by exposing the sample to primary radiation from the source. Fluorescent and backscattered x-rays from the sample enter through the detector window and are converted into electric pulses in the detector. The detector in FPXRF instruments is usually either a solid-state detector or a gas-filled proportional counter. Within the detector, energies of the characteristic x-rays are converted into a train of electric pulses, the amplitudes of which are linearly proportional to the energy of the x-rays. An electronic multichannel analyzer (MCA) measures the pulse amplitudes, which is the basis of qualitative x-ray analysis. The number of counts at a given energy per unit of time is representative of the element concentration in a sample and is the basis for quantitative analysis. Most FPXRF instruments are menu-driven from software built into the units or from personal computers (PC).

The measurement time of each source is user-selectable. Shorter source measurement times (30 seconds) are generally used for initial screening and hot spot delineation, and longer measurement times (up to 300 seconds) are typically used to meet higher precision and accuracy requirements.

FPXRF instruments can be calibrated using the following methods: internally using fundamental parameters determined by the manufacturer, empirically based on site-specific calibration standards (SSCS), or based on Compton peak ratios. The Compton peak is produced by backscattering of the source radiation. Some FPXRF instruments can be calibrated using multiple methods.

3.0 DEFINITIONS

3.1 FPXRF -- Field portable x-ray fluorescence.

3.2 MCA -- Multichannel analyzer for measuring pulse amplitude.

3.3 SSCS -- Site-specific calibration standards.

3.4 FP -- Fundamental parameter.

3.5 ROI -- Region of interest.

3.6 SRM -- Standard reference material; a standard containing certified amounts of metals in soil or sediment.

3.7 eV -- Electron volt; a unit of energy equivalent to the amount of energy gained by an electron passing through a potential difference of one volt.

3.8 Refer to Chapter One, Chapter Three, and the manufacturer's instructions for other definitions that may be relevant to this procedure.

4.0 INTERFERENCES

4.1 The total method error for FPXRF analysis is defined as the square root of the sum of squares of both instrument precision and user- or application-related error. Generally, instrument precision is the least significant source of error in FPXRF analysis. User- or application-related error is generally more significant and varies with each site and method used. Some sources of interference can be minimized or controlled by the instrument operator, but others cannot. Common sources of user- or application-related error are discussed below.

4.2 Physical matrix effects result from variations in the physical character of the sample. These variations may include such parameters as particle size, uniformity, homogeneity, and surface condition. For example, if any analyte exists in the form of very fine particles in a coarser-grained matrix, the analyte's concentration measured by the FPXRF will vary depending on how fine particles are distributed within the coarser-grained matrix. If the fine particles "settle" to the bottom of the sample cup (i.e., against the cup window), the analyte concentration measurement will be higher than if the fine particles are not mixed in well and stay on top of the coarser-grained particles in the sample cup. One way to reduce such error is to grind and sieve all soil samples to a uniform particle size thus reducing sample-to-sample particle size variability. Homogeneity is always a concern when dealing with soil samples. Every effort should be made to thoroughly mix and homogenize soil samples before analysis. Field studies have shown heterogeneity of the sample generally has the largest impact on comparability with confirmatory samples.

4.3 Moisture content may affect the accuracy of analysis of soil and sediment sample analyses. When the moisture content is between 5 and 20 percent, the overall error from moisture may be minimal. However, moisture content may be a major source of error when analyzing samples of surface soil or sediment that are saturated with water. This error can be minimized by drying the samples in a convection or toaster oven. Microwave drying is not recommended because field studies have shown that microwave drying can increase variability between FPXRF data and confirmatory analysis and because metal fragments in the sample can cause arcing to occur in a microwave.

4.4 Inconsistent positioning of samples in front of the probe window is a potential source of error because the x-ray signal decreases as the distance from the radioactive source increases. This error is minimized by maintaining the same distance between the window and each sample. For the best results, the window of the probe should be in direct contact with the sample, which means that the sample should be flat and smooth to provide a good contact surface.

4.5 Chemical matrix effects result from differences in the concentrations of interfering elements. These effects occur as either spectral interferences (peak overlaps) or as x-ray absorption and enhancement phenomena. Both effects are common in soils contaminated with heavy metals. As examples of absorption and enhancement effects; iron (Fe) tends to absorb copper (Cu) x-rays, reducing the intensity of the Cu measured by the detector, while chromium (Cr) will be enhanced at the expense of Fe because the absorption edge of Cr is slightly lower in energy than the fluorescent peak of iron. The effects can be corrected mathematically through the use of fundamental parameter (FP) coefficients. The effects also can be compensated for using SSCS, which contain all the elements present on site that can interfere with one another.

4.6 When present in a sample, certain x-ray lines from different elements can be very close in energy and, therefore, can cause interference by producing a severely overlapped spectrum. The degree to which a detector can resolve the two different peaks depends on the energy resolution of the detector. If the energy difference between the two peaks in electron volts is less than the resolution of the detector in electron volts, then the detector will not be able to fully resolve the peaks.

The most common spectrum overlaps involve the K_β line of element Z-1 with the K_α line of element Z. This is called the K_α/K_β interference. Because the K_α:K_β intensity ratio for a given element usually is about 7:1, the interfering element, Z-1, must be present at large concentrations to cause a problem. Two examples of this type of spectral interference involve the presence of large concentrations of vanadium (V) when attempting to measure Cr or the presence of large concentrations of Fe when attempting to measure cobalt (Co). The V K_α and K_β energies are 4.95 and 5.43 keV, respectively, and the Cr K_α energy is 5.41 keV. The Fe K_α and K_β energies are 6.40 and 7.06 keV, respectively, and the Co K_α energy is 6.92 keV. The difference between the V K_β and Cr K_α energies is 20 eV, and the difference between the Fe K_β and the Co K_α energies is 140 eV. The resolution of the highest-resolution detectors in FPXRF instruments is 170 eV. Therefore, large amounts of V and Fe will interfere with quantitation of Cr or Co, respectively. The presence of Fe is a frequent problem because it is often found in soils at tens of thousands of parts per million (ppm).

4.7 Other interferences can arise from K/L, K/M, and L/M line overlaps, although these overlaps are less common. Examples of such overlap involve arsenic (As) K_α/lead (Pb) L_α and sulfur (S) K_α/Pb M_α. In the As/Pb case, Pb can be measured from the Pb L_β line, and As can be measured from either the As K_α or the As K_β line; in this way the interference can be corrected. If the As K_β line is used, sensitivity will be decreased by a factor of two to five times because it is a less intense line than the As K_α line. If the As K_α line is used in the presence of Pb, mathematical corrections within the instrument software can be used to subtract out the Pb interference. However, because of the limits of mathematical corrections, As concentrations cannot be efficiently calculated for samples with Pb:As ratios of 10:1 or more. This high ratio of Pb to As may result in reporting of a "nondetect" or a "less than" value (e.g., <300 ppm) for As, regardless of the actual concentration present.

No instrument can fully compensate for this interference. It is important for an operator to understand this limitation of FPXRF instruments and consult with the manufacturer of the FPXRF instrument to evaluate options to minimize this limitation. The operator's decision will be based on action levels for metals in soil established for the site, matrix effects, capabilities of the instrument, data quality objectives, and the ratio of lead to arsenic known to be present at the site. If a site is encountered that contains lead at concentrations greater than ten times the concentration of arsenic it is advisable that all critical soil samples be sent off site for confirmatory analysis using other techniques (e.g., flame atomic absorption spectrometry (FLAA), graphite furnance atomic absorption spectrometry (GFAA), inductively coupled plasma-

atomic emission spectrometry, (ICP-AES), or inductively coupled plasma-mass spectrometry, (ICP-MS)).

4.8 If SSCS are used to calibrate an FPXRF instrument, the samples collected must be representative of the site under investigation. Representative soil sampling ensures that a sample or group of samples accurately reflects the concentrations of the contaminants of concern at a given time and location. Analytical results for representative samples reflect variations in the presence and concentration ranges of contaminants throughout a site. Variables affecting sample representativeness include differences in soil type, contaminant concentration variability, sample collection and preparation variability, and analytical variability, all of which should be minimized as much as possible.

4.9 Soil physical and chemical effects may be corrected using SSCS that have been analyzed by inductively coupled plasma (ICP) or atomic absorption (AA) methods. However, a major source of error can be introduced if these samples are not representative of the site or if the analytical error is large. Another concern is the type of digestion procedure used to prepare the soil samples for the reference analysis. Analytical results for the confirmatory method will vary depending on whether a partial digestion procedure, such as Method 3050, or a total digestion procedure, such as Method 3052, is used. It is known that depending on the nature of the soil or sediment, Method 3050 will achieve differing extraction efficiencies for different analytes of interest. The confirmatory method should meet the project-specific data quality objectives (DQOs).

XRF measures the total concentration of an element; therefore, to achieve the greatest comparability of this method with the reference method (reduced bias), a total digestion procedure should be used for sample preparation. However, in the study used to generate the performance data for this method (see Table 8), the confirmatory method used was Method 3050, and the FPXRF data compared very well with regression correlation coefficients (r often exceeding 0.95, except for barium and chromium). The critical factor is that the digestion procedure and analytical reference method used should meet the DQOs of the project and match the method used for confirmation analysis.

4.10 Ambient temperature changes can affect the gain of the amplifiers producing instrument drift. Gain or drift is primarily a function of the electronics (amplifier or preamplifier) and not the detector as most instrument detectors are cooled to a constant temperature. Most FPXRF instruments have a built-in automatic gain control. If the automatic gain control is allowed to make periodic adjustments, the instrument will compensate for the influence of temperature changes on its energy scale. If the FPXRF instrument has an automatic gain control function, the operator will not have to adjust the instrument's gain unless an error message appears. If an error message appears, the operator should follow the manufacturer's procedures for troubleshooting the problem. Often, this involves performing a new energy calibration. The performance of an energy calibration check to assess drift is a quality control measure discussed in Sec. 9.2.

If the operator is instructed by the manufacturer to manually conduct a gain check because of increasing or decreasing ambient temperature, it is standard to perform a gain check after every 10 to 20 sample measurements or once an hour whichever is more frequent. It is also suggested that a gain check be performed if the temperature fluctuates more than 10° F. The operator should follow the manufacturer's recommendations for gain check frequency.

5.0 SAFETY

5.1 This method does not address all safety issues associated with its use. The user is responsible for maintaining a safe work environment and a current awareness file of OSHA regulations regarding the safe handling of the chemicals listed in this method. A reference file of material safety data sheets (MSDSs) should be available to all personnel involved in these analyses.

NOTE: No MSDS applies directly to the radiation-producing instrument because that is covered under the Nuclear Regulatory Commission (NRC) or applicable state regulations.

5.2 Proper training for the safe operation of the instrument and radiation training should be completed by the analyst prior to analysis. Radiation safety for each specific instrument can be found in the operator's manual. Protective shielding should never be removed by the analyst or any personnel other than the manufacturer. The analyst should be aware of the local state and national regulations that pertain to the use of radiation-producing equipment and radioactive materials with which compliance is required. There should be a person appointed within the organization that is solely responsible for properly instructing all personnel, maintaining inspection records, and monitoring x-ray equipment at regular intervals.

Licenses for radioactive materials are of two types, specifically: (1) a general license which is usually initiated by the manufacturer for receiving, acquiring, owning, possessing, using, and transferring radioactive material incorporated in a device or equipment, and (2) a specific license which is issued to named persons for the operation of radioactive instruments as required by local, state, or federal agencies. A copy of the radioactive material license (for specific licenses only) and leak tests should be present with the instrument at all times and available to local and national authorities upon request.

X-ray tubes do not require radioactive material licenses or leak tests, but do require approvals and licenses which vary from state to state. In addition, fail-safe x-ray warning lights should be illuminated whenever an x-ray tube is energized. Provisions listed above concerning radiation safety regulations, shielding, training, and responsible personnel apply to x-ray tubes just as to radioactive sources. In addition, a log of the times and operating conditions should be kept whenever an x-ray tube is energized. An additional hazard present with x-ray tubes is the danger of electric shock from the high voltage supply, however, if the tube is properly positioned within the instrument, this is only a negligible risk. Any instrument (x-ray tube or radioisotope based) is capable of delivering an electric shock from the basic circuitry when the system is inappropriately opened.

5.3 Radiation monitoring equipment should be used with the handling and operation of the instrument. The operator and the surrounding environment should be monitored continually for analyst exposure to radiation. Thermal luminescent detectors (TLD) in the form of badges and rings are used to monitor operator radiation exposure. The TLDs or badges should be worn in the area of maximum exposure. The maximum permissible whole-body dose from occupational exposure is 5 Roentgen Equivalent Man (REM) per year. Possible exposure pathways for radiation to enter the body are ingestion, inhaling, and absorption. The best precaution to prevent radiation exposure is distance and shielding.

6.0 EQUIPMENT AND SUPPLIES

The mention of trade names or commercial products in this manual is for illustrative purposes only, and does not constitute an EPA endorsement or exclusive recommendation for

use. The products and instrument settings cited in SW-846 methods represent those products and settings used during method development or subsequently evaluated by the Agency. Glassware, reagents, supplies, equipment, and settings other than those listed in this manual may be employed provided that method performance appropriate for the intended application has been demonstrated and documented.

6.1 FPXRF spectrometer -- An FPXRF spectrometer consists of four major components: (1) a source that provides x-rays; (2) a sample presentation device; (3) a detector that converts x-ray-generated photons emitted from the sample into measurable electronic signals; and (4) a data processing unit that contains an emission or fluorescence energy analyzer, such as an MCA, that processes the signals into an x-ray energy spectrum from which elemental concentrations in the sample may be calculated, and a data display and storage system. These components and additional, optional items, are discussed below.

6.1.1 Excitation sources -- FPXRF instruments use either a sealed radioisotope source or an x-ray tube to provide the excitation source. Many FPXRF instruments use sealed radioisotope sources to produce x-rays in order to irradiate samples. The FPXRF instrument may contain between one and three radioisotope sources. Common radioisotope sources used for analysis for metals in soils are iron Fe-55 (^{55}Fe), cadmium Cd-109 (^{109}Cd), americium Am-241 (^{241}Am), and curium Cm-244 (^{244}Cm). These sources may be contained in a probe along with a window and the detector; the probe may be connected to a data reduction and handling system by means of a flexible cable. Alternatively, the sources, window, and detector may be included in the same unit as the data reduction and handling system.

The relative strength of the radioisotope sources is measured in units of millicuries (mCi). All other components of the FPXRF system being equal, the stronger the source, the greater the sensitivity and precision of a given instrument. Radioisotope sources undergo constant decay. In fact, it is this decay process that emits the primary x-rays used to excite samples for FPXRF analysis. The decay of radioisotopes is measured in "half-lives." The half-life of a radioisotope is defined as the length of time required to reduce the radioisotopes strength or activity by half. Developers of FPXRF technologies recommend source replacement at regular intervals based on the source's half-life. This is due to the ever increasing time required for the analysis rather than a decrease in instrument performance. The characteristic x-rays emitted from each of the different sources have energies capable of exciting a certain range of analytes in a sample. Table 2 summarizes the characteristics of four common radioisotope sources.

X-ray tubes have higher radiation output, no intrinsic lifetime limit, produce constant output over their lifetime, and do not have the disposal problems of radioactive sources but are just now appearing in FPXRF instruments. An electrically-excited x-ray tube operates by bombarding an anode with electrons accelerated by a high voltage. The electrons gain an energy in electron volts equal to the accelerating voltage and can excite atomic transitions in the anode, which then produces characteristic x-rays. These characteristic x-rays are emitted through a window which contains the vacuum necessary for the electron acceleration. An important difference between x-ray tubes and radioactive sources is that the electrons which bombard the anode also produce a continuum of x-rays across a broad range of energies in addition to the characteristic x-rays. This continuum is weak compared to the characteristic x-rays but can provide substantial excitation since it covers a broad energy range. It has the undesired property of producing background in the spectrum near the analyte x-ray lines when it is scattered by the sample. For this reason a filter is often used between the x-ray tube and the sample to suppress the continuum radiation while passing the characteristic x-rays from the anode. This filter is sometimes incorporated into the window of the x-ray tube. The choice of

accelerating voltage is governed both by the anode material, since the electrons must have sufficient energy to excite the anode, which requires a voltage greater than the absorption edge of the anode material and by the instrument's ability to cool the x-ray tube. The anode is most efficiently excited by voltages 2 to 2.5 times the edge energy (most x-rays per unit power to the tube), although voltages as low as 1.5 times the absorption edge energy will work. The characteristic x-rays emitted by the anode are capable of exciting a range of elements in the sample just as with a radioactive source. Table 3 gives the recommended operating voltages and the sample elements excited for some common anodes.

6.1.2 Sample presentation device -- FPXRF instruments can be operated in two modes: in situ and intrusive. If operated in the in situ mode, the probe window is placed in direct contact with the soil surface to be analyzed. When an FPXRF instrument is operated in the intrusive mode, a soil or sediment sample must be collected, prepared, and placed in a sample cup. For FPXRF instruments operated in the intrusive mode, the probe may be rotated so that the window faces either upward or downward. A protective sample cover is placed over the window, and the sample cup is placed on top of the window inside the protective sample cover for analysis.

6.1.3 Detectors -- The detectors in the FPXRF instruments can be either solid-state detectors or gas-filled, proportional counter detectors. Common solid-state detectors include mercuric iodide (HgI_2), silicon pin diode and lithium-drifted silicon Si(Li). The HgI_2 detector is operated at a moderately subambient temperature controlled by a low power thermoelectric cooler. The silicon pin diode detector also is cooled via the thermoelectric Peltier effect. The Si(Li) detector must be cooled to at least -90 °C either with liquid nitrogen or by thermoelectric cooling via the Peltier effect. Instruments with a Si(Li) detector have an internal liquid nitrogen dewar with a capacity of 0.5 to 1.0 L. Proportional counter detectors are rugged and lightweight, which are important features of a field portable detector. However, the resolution of a proportional counter detector is not as good as that of a solid-state detector. The energy resolution of a detector for characteristic x-rays is usually expressed in terms of full width at half-maximum (FWHM) height of the manganese K_α peak at 5.89 keV. The typical resolutions of the above mentioned detectors are as follows: HgI_2-270 eV; silicon pin diode-250 eV; Si(Li)–170 eV; and gas-filled, proportional counter-750 eV.

During operation of a solid-state detector, an x-ray photon strikes a biased, solid-state crystal and loses energy in the crystal by producing electron-hole pairs. The electric charge produced is collected and provides a current pulse that is directly proportional to the energy of the x-ray photon absorbed by the crystal of the detector. A gas-filled, proportional counter detector is an ionization chamber filled with a mixture of noble and other gases. An x-ray photon entering the chamber ionizes the gas atoms. The electric charge produced is collected and provides an electric signal that is directly proportional to the energy of the x-ray photon absorbed by the gas in the detector.

6.1.4 Data processing units -- The key component in the data processing unit of an FPXRF instrument is the MCA. The MCA receives pulses from the detector and sorts them by their amplitudes (energy level). The MCA counts pulses per second to determine the height of the peak in a spectrum, which is indicative of the target analyte's concentration. The spectrum of element peaks are built on the MCA. The MCAs in FPXRF instruments have from 256 to 2,048 channels. The concentrations of target analytes are usually shown in ppm on a liquid crystal display (LCD) in the instrument. FPXRF instruments can store both spectra and from 3,000 to 5,000 sets of numerical analytical results. Most FPXRF instruments are menu-driven from software built into the

units or from PCs. Once the data–storage memory of an FPXRF unit is full or at any other time, data can be downloaded by means of an RS-232 port and cable to a PC.

6.2 Spare battery and battery charger.

6.3 Polyethylene sample cups -- 31 to 40 mm in diameter with collar, or equivalent (appropriate for FPXRF instrument).

6.4 X-ray window film -- Mylar™, Kapton™, Spectrolene™, polypropylene, or equivalent; 2.5 to 6.0 µm thick.

6.5 Mortar and pestle -- Glass, agate, or aluminum oxide; for grinding soil and sediment samples.

6.6 Containers -- Glass or plastic to store samples.

6.7 Sieves -- 60-mesh (0.25 mm), stainless-steel, Nylon, or equivalent for preparing soil and sediment samples.

6.8 Trowels -- For smoothing soil surfaces and collecting soil samples.

6.9 Plastic bags -- Used for collection and homogenization of soil samples.

6.10 Drying oven -- Standard convection or toaster oven, for soil and sediment samples that require drying.

7.0 REAGENTS AND STANDARDS

7.1 Reagent grade chemicals must be used in all tests. Unless otherwise indicated, it is intended that all reagents conform to the specifications of the Committee on Analytical Reagents of the American Chemical Society, where such specifications are available. Other grades may be used, provided it is first ascertained that the reagent is of sufficiently high purity to permit its use without lessening the accuracy of the determination.

7.2 Pure element standards -- Each pure, single-element standard is intended to produce strong characteristic x-ray peaks of the element of interest only. Other elements present must not contribute to the fluorescence spectrum. A set of pure element standards for commonly sought analytes is supplied by the instrument manufacturer, if designated for the instrument; not all instruments require the pure element standards. The standards are used to set the region of interest (ROI) for each element. They also can be used as energy calibration and resolution check samples.

7.3 Site-specific calibration standards -- Instruments that employ fundamental parameters (FP) or similar mathematical models in minimizing matrix effects may not require SSCS. If the FP calibration model is to be optimized or if empirical calibration is necessary, then SSCSs must be collected, prepared, and analyzed.

7.3.1 The SSCS must be representative of the matrix to be analyzed by FPXRF. These samples must be well homogenized. A minimum of 10 samples spanning the concentration ranges of the analytes of interest and of the interfering elements must be obtained from the site. A sample size of 4 to 8 ounces is recommended, and standard glass sampling jars should be used.

7.3.2 Each sample should be oven-dried for 2 to 4 hr at a temperature of less than 150 °C. If mercury is to be analyzed, a separate sample portion should be dried at ambient temperature as heating may volatilize the mercury. When the sample is dry, all large, organic debris and nonrepresentative material, such as twigs, leaves, roots, insects, asphalt, and rock should be removed. The sample should be homogenized (see Sec. 7.3.3) and then a representative portion ground with a mortar and pestle or other mechanical means, prior to passing through a 60-mesh sieve. Only the coarse rock fraction should remain on the screen.

7.3.3 The sample should be homogenized by using a riffle splitter or by placing 150 to 200 g of the dried, sieved sample on a piece of kraft or butcher paper about 1.5 by 1.5 feet in size. Each corner of the paper should be lifted alternately, rolling the soil over on itself and toward the opposite corner. The soil should be rolled on itself 20 times. Approximately 5 g of the sample should then be removed and placed in a sample cup for FPXRF analysis. The rest of the prepared sample should be sent off site for ICP or AA analysis. The method use for confirmatory analysis should meet the data quality objectives of the project.

7.4 Blank samples -- The blank samples should be from a "clean" quartz or silicon dioxide matrix that is free of any analytes at concentrations above the established lower limit of detection. These samples are used to monitor for cross-contamination and laboratory-induced contaminants or interferences.

7.5 Standard reference materials -- Standard reference materials (SRMs) are standards containing certified amounts of metals in soil or sediment. These standards are used for accuracy and performance checks of FPXRF analyses. SRMs can be obtained from the National Institute of Standards and Technology (NIST), the U.S. Geological Survey (USGS), the Canadian National Research Council, and the national bureau of standards in foreign nations. Pertinent NIST SRMs for FPXRF analysis include 2704, Buffalo River Sediment; 2709, San Joaquin Soil; and 2710 and 2711, Montana Soil. These SRMs contain soil or sediment from actual sites that has been analyzed using independent inorganic analytical methods by many different laboratories. When these SRMs are unavailable, alternate standards may be used (e.g., NIST 2702).

8.0 SAMPLE COLLECTION, PRESERVATION, AND STORAGE

Sample handling and preservation procedures used in FPXRF analyses should follow the guidelines in Chapter Three, "Inorganic Analytes."

9.0 QUALITY CONTROL

9.1 Follow the manufacturer’s instructions for the quality control procedures specific to use of the testing product. Refer to Chapter One for additional guidance on quality assurance (QA) and quality control (QC) protocols. Any effort involving the collection of analytical data should include development of a structured and systematic planning document, such as a Quality Assurance Project Plan (QAPP) or a Sampling and Analysis Plan (SAP), which translates project objectives and specifications into directions for those that will implement the project and assess the results.

9.2 Energy calibration check -- To determine whether an FPXRF instrument is operating within resolution and stability tolerances, an energy calibration check should be run. The energy calibration check determines whether the characteristic x-ray lines are shifting,

which would indicate drift within the instrument. As discussed in Sec. 4.10, this check also serves as a gain check in the event that ambient temperatures are fluctuating greatly (more than 10 °F).

9.2.1 The energy calibration check should be run at a frequency consistent with manufacturer's recommendations. Generally, this would be at the beginning of each working day, after the batteries are changed or the instrument is shut off, at the end of each working day, and at any other time when the instrument operator believes that drift is occurring during analysis. A pure element such as iron, manganese, copper, or lead is often used for the energy calibration check. A manufacturer-recommended count time per source should be used for the check.

9.2.2 The instrument manufacturer's manual specifies the channel or kiloelectron volt level at which a pure element peak should appear and the expected intensity of the peak. The intensity and channel number of the pure element as measured using the source should be checked and compared to the manufacturer's recommendation. If the energy calibration check does not meet the manufacturer's criteria, then the pure element sample should be repositioned and reanalyzed. If the criteria are still not met, then an energy calibration should be performed as described in the manufacturer's manual. With some FPXRF instruments, once a spectrum is acquired from the energy calibration check, the peak can be optimized and realigned to the manufacturer's specifications using their software.

9.3 Blank samples -- Two types of blank samples should be analyzed for FPXRF analysis, specifically, instrument blanks and method blanks.

9.3.1 An instrument blank is used to verify that no contamination exists in the spectrometer or on the probe window. The instrument blank can be silicon dioxide, a polytetraflurorethylene (PTFE) block, a quartz block, "clean" sand, or lithium carbonate. This instrument blank should be analyzed on each working day before and after analyses are conducted and once per every twenty samples. An instrument blank should also be analyzed whenever contamination is suspected by the analyst. The frequency of analysis will vary with the data quality objectives of the project. A manufacturer-recommended count time per source should be used for the blank analysis. No element concentrations above the established lower limit of detection should be found in the instrument blank. If concentrations exceed these limits, then the probe window and the check sample should be checked for contamination. If contamination is not a problem, then the instrument must be "zeroed" by following the manufacturer's instructions.

9.3.2 A method blank is used to monitor for laboratory-induced contaminants or interferences. The method blank can be "clean" silica sand or lithium carbonate that undergoes the same preparation procedure as the samples. A method blank must be analyzed at least daily. The frequency of analysis will depend on the data quality objectives of the project. If the method blank does not contain the target analyte at a level that interferes with the project-specific data quality objectives then the method blank would be considered acceptable. In the absence of project-specific data quality objectives, if the blank is less than the lowest level of detection or less than 10% of the lowest sample concentration for the analyte, whichever is greater, then the method blank would be considered acceptable. If the method blank cannot be considered acceptable, the cause of the problem must be identified, and all samples analyzed with the method blank must be reanalyzed.

9.4 Calibration verification checks -- A calibration verification check sample is used to check the accuracy of the instrument and to assess the stability and consistency of the analysis for the analytes of interest. A check sample should be analyzed at the beginning of each working day, during active sample analyses, and at the end of each working day. The frequency of calibration checks during active analysis will depend on the data quality objectives of the project. The check sample should be a well characterized soil sample from the site that is representative of site samples in terms of particle size and degree of homogeneity and that contains contaminants at concentrations near the action levels. If a site-specific sample is not available, then an NIST or other SRM that contains the analytes of interest can be used to verify the accuracy of the instrument. The measured value for each target analyte should be within ±20 percent (%D) of the true value for the calibration verification check to be acceptable. If a measured value falls outside this range, then the check sample should be reanalyzed. If the value continues to fall outside the acceptance range, the instrument should be recalibrated, and the batch of samples analyzed before the unacceptable calibration verification check must be reanalyzed.

9.5 Precision measurements -- The precision of the method is monitored by analyzing a sample with low, moderate, or high concentrations of target analytes. The frequency of precision measurements will depend on the data quality objectives for the data. A minimum of one precision sample should be run per day. Each precision sample should be analyzed 7 times in replicate. It is recommended that precision measurements be obtained for samples with varying concentration ranges to assess the effect of concentration on method precision. Determining method precision for analytes at concentrations near the site action levels can be extremely important if the FPXRF results are to be used in an enforcement action; therefore, selection of at least one sample with target analyte concentrations at or near the site action levels or levels of concern is recommended. A precision sample is analyzed by the instrument for the same field analysis time as used for other project samples. The relative standard deviation (RSD) of the sample mean is used to assess method precision. For FPXRF data to be considered adequately precise, the RSD should not be greater than 20 percent with the exception of chromium. RSD values for chromium should not be greater than 30 percent. If both in situ and intrusive analytical techniques are used during the course of one day, it is recommended that separate precision calculations be performed for each analysis type.

The equation for calculating RSD is as follows:

$$RSD = (SD/\text{Mean Concentration}) \times 100$$

where:

RSD	=	Relative standard deviation for the precision measurement for the analyte
SD	=	Standard deviation of the concentration for the analyte
Mean concentration	=	Mean concentration for the analyte

The precision or reproducibility of a measurement will improve with increasing count time, however, increasing the count time by a factor of 4 will provide only 2 times better precision, so there is a point of diminishing return. Increasing the count time also improves the sensitivity, but decreases sample throughput.

9.6 The lower limits of detection should be established from actual measured performance based on spike recoveries in the matrix of concern or from acceptable method performance on a certified reference material of the appropriate matrix and within the appropriate calibration range for the application. This is considered the best estimate of the true method sensitivity as opposed to a statistical determination based on the standard deviation of

replicate analyses of a low-concentration sample. While the statistical approach demonstrates the potential data variability for a given sample matrix at one point in time, it does not represent what can be detected or most importantly the lowest concentration that can be calibrated. For this reason the sensitivity should be established as the lowest point of detection based on acceptable target analyte recovery in the desired sample matrix.

9.7 Confirmatory samples -- The comparability of the FPXRF analysis is determined by submitting FPXRF-analyzed samples for analysis at a laboratory. The method of confirmatory analysis must meet the project and XRF measurement data quality objectives. The confirmatory samples must be splits of the well homogenized sample material. In some cases the prepared sample cups can be submitted. A minimum of 1 sample for each 20 FPXRF-analyzed samples should be submitted for confirmatory analysis. This frequency will depend on project-specific data quality objectives. The confirmatory analyses can also be used to verify the quality of the FPXRF data. The confirmatory samples should be selected from the lower, middle, and upper range of concentrations measured by the FPXRF. They should also include samples with analyte concentrations at or near the site action levels. The results of the confirmatory analysis and FPXRF analyses should be evaluated with a least squares linear regression analysis. If the measured concentrations span more than one order of magnitude, the data should be log-transformed to standardize variance which is proportional to the magnitude of measurement. The correlation coefficient (r) for the results should be 0.7 or greater for the FPXRF data to be considered screening level data. If the r is 0.9 or greater and inferential statistics indicate the FPXRF data and the confirmatory data are statistically equivalent at a 99 percent confidence level, the data could potentially meet definitive level data criteria.

10.0 CALIBRATION AND STANDARDIZATION

10.1 Instrument calibration -- Instrument calibration procedures vary among FPXRF instruments. Users of this method should follow the calibration procedures outlined in the operator's manual for each specific FPXRF instrument. Generally, however, three types of calibration procedures exist for FPXRF instruments, namely: FP calibration, empirical calibration, and the Compton peak ratio or normalization method. These three types of calibration are discussed below.

10.2 Fundamental parameters calibration -- FP calibration procedures are extremely variable. An FP calibration provides the analyst with a "standardless" calibration. The advantages of FP calibrations over empirical calibrations include the following:

- No previously collected site-specific samples are necessary, although site-specific samples with confirmed and validated analytical results for all elements present could be used.

- Cost is reduced because fewer confirmatory laboratory results or calibration standards are necessary.

However, the analyst should be aware of the limitations imposed on FP calibration by particle size and matrix effects. These limitations can be minimized by adhering to the preparation procedure described in Sec. 7.3. The two FP calibration processes discussed below are based on an effective energy FP routine and a back scatter with FP (BFP) routine. Each FPXRF FP calibration process is based on a different iterative algorithmic method. The calibration procedure for each routine is explained in detail in the manufacturer's user manual for each FPXRF instrument; in addition, training courses are offered for each instrument.

10.2.1 Effective energy FP calibration -- The effective energy FP calibration is performed by the manufacturer before an instrument is sent to the analyst. Although SSCS can be used, the calibration relies on pure element standards or SRMs such as those obtained from NIST for the FP calibration. The effective energy routine relies on the spectrometer response to pure elements and FP iterative algorithms to compensate for various matrix effects.

Alpha coefficients are calculated using a variation of the Sherman equation, which calculates theoretical intensities from the measurement of pure element samples. These coefficients indicate the quantitative effect of each matrix element on an analyte's measured x-ray intensity. Next, the Lachance Traill algorithm is solved as a set of simultaneous equations based on the theoretical intensities. The alpha coefficients are then downloaded into the specific instrument.

The working effective energy FP calibration curve must be verified before sample analysis begins on each working day, after every 20 samples are analyzed, and at the end of sampling. This verification is performed by analyzing either an NIST SRM or an SSCS that is representative of the site-specific samples. This SRM or SSCS serves as a calibration check. A manufacturer-recommended count time per source should be used for the calibration check. The analyst must then adjust the y-intercept and slope of the calibration curve to best fit the known concentrations of target analytes in the SRM or SSCS.

A percent difference (%D) is then calculated for each target analyte. The %D should be within ±20 percent of the certified value for each analyte. If the %D falls outside this acceptance range, then the calibration curve should be adjusted by varying the slope of the line or the y-intercept value for the analyte. The SRM or SSCS is reanalyzed until the %D falls within ±20 percent. The group of 20 samples analyzed before an out-of-control calibration check should be reanalyzed.

The equation to calibrate %D is as follows:

$$\%D = ((C_s - C_k) / C_k) \times 100$$

where:

%D = Percent difference
C_k = Certified concentration of standard sample
C_s = Measured concentration of standard sample

10.2.2 BFP calibration -- BFP calibration relies on the ability of the liquid nitrogen-cooled, Si(Li) solid-state detector to separate the coherent (Compton) and incoherent (Rayleigh) backscatter peaks of primary radiation. These peak intensities are known to be a function of sample composition, and the ratio of the Compton to Rayleigh peak is a function of the mass absorption of the sample. The calibration procedure is explained in detail in the instrument manufacturer's manual. Following is a general description of the BFP calibration procedure.

The concentrations of all detected and quantified elements are entered into the computer software system. Certified element results for an NIST SRM or confirmed and validated results for an SSCS can be used. In addition, the concentrations of oxygen and silicon must be entered; these two concentrations are not found in standard metals analyses. The manufacturer provides silicon and oxygen concentrations for typical soil types. Pure element standards are then analyzed using a manufacturer-recommended

count time per source. The results are used to calculate correction factors in order to adjust for spectrum overlap of elements.

The working BFP calibration curve must be verified before sample analysis begins on each working day, after every 20 samples are analyzed, and at the end of the analysis. This verification is performed by analyzing either an NIST SRM or an SSCS that is representative of the site-specific samples. This SRM or SSCS serves as a calibration check. The standard sample is analyzed using a manufacturer-recommended count time per source to check the calibration curve. The analyst must then adjust the y-intercept and slope of the calibration curve to best fit the known concentrations of target analytes in the SRM or SSCS.

A %D is then calculated for each target analyte. The %D should fall within ±20 percent of the certified value for each analyte. If the %D falls outside this acceptance range, then the calibration curve should be adjusted by varying the slope of the line the y-intercept value for the analyte. The standard sample is reanalyzed until the %D falls within ±20 percent. The group of 20 samples analyzed before an out-of-control calibration check should be reanalyzed.

10.3 Empirical calibration -- An empirical calibration can be performed with SSCS, site-typical standards, or standards prepared from metal oxides. A discussion of SSCS is included in Sec. 7.3; if no previously characterized samples exist for a specific site, site-typical standards can be used. Site-typical standards may be selected from commercially available characterized soils or from SSCS prepared for another site. The site-typical standards should closely approximate the site's soil matrix with respect to particle size distribution, mineralogy, and contaminant analytes. If neither SSCS nor site-typical standards are available, it is possible to make gravimetric standards by adding metal oxides to a "clean" sand or silicon dioxide matrix that simulates soil. Metal oxides can be purchased from various chemical vendors. If standards are made on site, a balance capable of weighing items to at least two decimal places is necessary. Concentrated ICP or AA standard solutions can also be used to make standards. These solutions are available in concentrations of 10,000 parts per million, thus only small volumes have to be added to the soil.

An empirical calibration using SSCS involves analysis of SSCS by the FPXRF instrument and by a conventional analytical method such as ICP or AA. A total acid digestion procedure should be used by the laboratory for sample preparation. Generally, a minimum of 10 and a maximum of 30 well characterized SSCS, site-typical standards, or prepared metal oxide standards are necessary to perform an adequate empirical calibration. The exact number of standards depends on the number of analytes of interest and interfering elements. Theoretically, an empirical calibration with SSCS should provide the most accurate data for a site because the calibration compensates for site-specific matrix effects.

The first step in an empirical calibration is to analyze the pure element standards for the elements of interest. This enables the instrument to set channel limits for each element for spectral deconvolution. Next the SSCS, site-typical standards, or prepared metal oxide standards are analyzed using a count time of 200 seconds per source or a count time recommended by the manufacturer. This will produce a spectrum and net intensity of each analyte in each standard. The analyte concentrations for each standard are then entered into the instrument software; these concentrations are those obtained from the laboratory, the certified results, or the gravimetrically determined concentrations of the prepared standards. This gives the instrument analyte values to regress against corresponding intensities during the modeling stage. The regression equation correlates the concentrations of an analyte with its net intensity.

The calibration equation is developed using a least squares fit regression analysis. After the regression terms to be used in the equation are defined, a mathematical equation can be developed to calculate the analyte concentration in an unknown sample. In some FPXRF instruments, the software of the instrument calculates the regression equation. The software uses calculated intercept and slope values to form a multiterm equation. In conjunction with the software in the instrument, the operator can adjust the multiterm equation to minimize interelement interferences and optimize the intensity calibration curve.

It is possible to define up to six linear or nonlinear terms in the regression equation. Terms can be added and deleted to optimize the equation. The goal is to produce an equation with the smallest regression error and the highest correlation coefficient. These values are automatically computed by the software as the regression terms are added, deleted, or modified. It is also possible to delete data points from the regression line if these points are significant outliers or if they are heavily weighing the data. Once the regression equation has been selected for an analyte, the equation can be entered into the software for quantitation of analytes in subsequent samples. For an empirical calibration to be acceptable, the regression equation for a specific analyte should have a correlation coefficient of 0.98 or greater or meet the DQOs of the project.

In an empirical calibration, one must apply the DQOs of the project and ascertain critical or action levels for the analytes of interest. It is within these concentration ranges or around these action levels that the FPXRF instrument should be calibrated most accurately. It may not be possible to develop a good regression equation over several orders of analyte concentration.

10.4 Compton normalization method -- The Compton normalization method is based on analysis of a single, certified standard and normalization for the Compton peak. The Compton peak is produced from incoherent backscattering of x-ray radiation from the excitation source and is present in the spectrum of every sample. The Compton peak intensity changes with differing matrices. Generally, matrices dominated by lighter elements produce a larger Compton peak, and those dominated by heavier elements produce a smaller Compton peak. Normalizing to the Compton peak can reduce problems with varying matrix effects among samples. Compton normalization is similar to the use of internal standards in organics analysis. The Compton normalization method may not be effective when analyte concentrations exceed a few percent.

The certified standard used for this type of calibration could be an NIST SRM such as 2710 or 2711. The SRM must be a matrix similar to the samples and must contain the analytes of interests at concentrations near those expected in the samples. First, a response factor has to be determined for each analyte. This factor is calculated by dividing the net peak intensity by the analyte concentration. The net peak intensity is gross intensity corrected for baseline reading. Concentrations of analytes in samples are then determined by multiplying the baseline corrected analyte signal intensity by the normalization factor and by the response factor. The normalization factor is the quotient of the baseline corrected Compton K_α peak intensity of the SRM divided by that of the samples. Depending on the FPXRF instrument used, these calculations may be done manually or by the instrument software.

11.0 PROCEDURE

11.1 Operation of the various FPXRF instruments will vary according to the manufacturers' protocols. Before operating any FPXRF instrument, one should consult the manufacturer's manual. Most manufacturers recommend that their instruments be allowed to warm up for 15 to 30 minutes before analysis of samples. This will help alleviate drift or energy calibration problems later during analysis.

11.2 Each FPXRF instrument should be operated according to the manufacturer's recommendations. There are two modes in which FPXRF instruments can be operated: in situ and intrusive. The in situ mode involves analysis of an undisturbed soil sediment or sample. Intrusive analysis involves collection and preparation of a soil or sediment sample before analysis. Some FPXRF instruments can operate in both modes of analysis, while others are designed to operate in only one mode. The two modes of analysis are discussed below.

11.3 For in situ analysis, remove any large or nonrepresentative debris from the soil surface before analysis. This debris includes rocks, pebbles, leaves, vegetation, roots, and concrete. Also, the soil surface must be as smooth as possible so that the probe window will have good contact with the surface. This may require some leveling of the surface with a stainless-steel trowel. During the study conducted to provide example performance data for this method, this modest amount of sample preparation was found to take less than 5 min per sample location. The last requirement is that the soil or sediment not be saturated with water. Manufacturers state that their FPXRF instruments will perform adequately for soils with moisture contents of 5 to 20 percent but will not perform well for saturated soils, especially if ponded water exists on the surface. Another recommended technique for in situ analysis is to tamp the soil to increase soil density and compactness for better repeatability and representativeness. This condition is especially important for heavy element analysis, such as barium. Source count times for in situ analysis usually range from 30 to 120 seconds, but source count times will vary among instruments and depending on the desired method sensitivity. Due to the heterogeneous nature of the soil sample, in situ analysis can provide only “screening” type data.

11.4 For intrusive analysis of surface or sediment, it is recommended that a sample be collected from a 4- by 4-inch square that is 1 inch deep. This will produce a soil sample of approximately 375 g or 250 cm^3, which is enough soil to fill an 8-ounce jar. However, the exact dimensions and sample depth should take into consideration the heterogeneous deposition of contaminants and will ultimately depend on the desired project-specific data quality objectives. The sample should be homogenized, dried, and ground before analysis. The sample can be homogenized before or after drying. The homogenization technique to be used after drying is discussed in Sec. 4.2. If the sample is homogenized before drying, it should be thoroughly mixed in a beaker or similar container, or if the sample is moist and has a high clay content, it can be kneaded in a plastic bag. One way to monitor homogenization when the sample is kneaded in a plastic bag is to add sodium fluorescein dye to the sample. After the moist sample has been homogenized, it is examined under an ultraviolet light to assess the distribution of sodium fluorescein throughout the sample. If the fluorescent dye is evenly distributed in the sample, homogenization is considered complete; if the dye is not evenly distributed, mixing should continue until the sample has been thoroughly homogenized. During the study conducted to provide data for this method, the time necessary for homogenization procedure using the fluorescein dye ranged from 3 to 5 min per sample. As demonstrated in Secs. 13.5 and 13.7, homogenization has the greatest impact on the reduction of sampling variability. It produces little or no contamination. Often, the direct analysis through the plastic bag is possible without the more labor intensive steps of drying, grinding, and sieving given in Secs. 11.5 and 11.6. Of course, to achieve the best data quality possible all four steps should be followed.

11.5 Once the soil or sediment sample has been homogenized, it should be dried. This can be accomplished with a toaster oven or convection oven. A small aliquot of the sample (20 to 50 g) is placed in a suitable container for drying. The sample should be dried for 2 to 4 hr in the convection or toaster oven at a temperature not greater than 150 °C. Samples may also be air dried under ambient temperature conditions using a 10- to 20-g portion. Regardless of what drying mechanism is used, the drying process is considered complete when a constant sample weight can be obtained. Care should be taken to avoid sample cross-contamination and these measures can be evaluated by including an appropriate method blank sample along with any sample preparation process.

CAUTION: Microwave drying is not a recommended procedure. Field studies have shown that microwave drying can increase variability between the FPXRF data and confirmatory analysis. High levels of metals in a sample can cause arcing in the microwave oven, and sometimes slag forms in the sample. Microwave oven drying can also melt plastic containers used to hold the sample.

11.6 The homogenized dried sample material should be ground with a mortar and pestle and passed through a 60-mesh sieve to achieve a uniform particle size. Sample grinding should continue until at least 90 percent of the original sample passes through the sieve. The grinding step normally takes an average of 10 min per sample. An aliquot of the sieved sample should then be placed in a 31.0-mm polyethylene sample cup (or equivalent) for analysis. The sample cup should be one-half to three-quarters full at a minimum. The sample cup should be covered with a 2.5 µm Mylar (or equivalent) film for analysis. The rest of the soil sample should be placed in a jar, labeled, and archived for possible confirmation analysis. All equipment including the mortar, pestle, and sieves must be thoroughly cleaned so that any cross-contamination is below the established lower limit of detection of the procedure or DQOs of the analysis. If all recommended sample preparation steps are followed, there is a high probability the desired laboratory data quality may be obtained.

12.0 DATA ANALYSIS AND CALCULATIONS

Most FPXRF instruments have software capable of storing all analytical results and spectra. The results are displayed in ppm and can be downloaded to a personal computer, which can be used to provide a hard copy printout. Individual measurements that are smaller than three times their associated SD should not be used for quantitation. See the manufacturer's instructions regarding data analysis and calculations.

13.0 METHOD PERFORMANCE

13.1 Performance data and related information are provided in SW-846 methods only as examples and guidance. The data do not represent required performance criteria for users of the methods. Instead, performance criteria should be developed on a project-specific basis, and the laboratory should establish in-house QC performance criteria for the application of this method. These performance data are not intended to be and must not be used as absolute QC acceptance criteria for purposes of laboratory accreditation.

13.2 The sections to follow discuss three performance evaluation factors; namely, precision, accuracy, and comparability. The example data presented in Tables 4 through 8 were generated from results obtained from six FPXRF instruments (see Sec. 13.3). The soil samples analyzed by the six FPXRF instruments were collected from two sites in the United States. The soil samples contained several of the target analytes at concentrations ranging from "nondetect" to tens of thousands of mg/kg. These data are provided for guidance purposes only.

13.3 The six FPXRF instruments included the TN 9000 and TN Lead Analyzer manufactured by TN Spectrace; the X-MET 920 with a SiLi detector and X-MET 920 with a gas-filled proportional detector manufactured by Metorex, Inc.; the XL Spectrum Analyzer manufactured by Niton; and the MAP Spectrum Analyzer manufactured by Scitec. The TN 9000 and TN Lead Analyzer both have a HgI_2 detector. The TN 9000 utilized an Fe-55, Cd-109, and Am-241 source. The TN Lead Analyzer had only a Cd-109 source. The X-Met 920 with the SiLi detector had a Cd-109 and Am-241 source. The X-MET 920 with the gas-filled proportional detector had only a Cd-109 source. The XL Spectrum Analyzer utilized a silicon pin-diode

detector and a Cd-109 source. The MAP Spectrum Analyzer utilized a solid-state silicon detector and a Cd-109 source.

13.4 All example data presented in Tables 4 through 8 were generated using the following calibrations and source count times. The TN 9000 and TN Lead Analyzer were calibrated using fundamental parameters using NIST SRM 2710 as a calibration check sample. The TN 9000 was operated using 100, 60, and 60 second count times for the Cd-109, Fe-55, and Am-241 sources, respectively. The TN Lead analyzer was operated using a 60 second count time for the Cd-109 source. The X-MET 920 with the Si(Li) detector was calibrated using fundamental parameters and one well characterized site-specific soil standard as a calibration check. It used 140 and 100 second count times for the Cd-109 and Am-241 sources, respectively. The X-MET 920 with the gas-filled proportional detector was calibrated empirically using between 10 and 20 well characterized site-specific soil standards. It used 120 second times for the Cd-109 source. The XL Spectrum Analyzer utilized NIST SRM 2710 for calibration and the Compton peak normalization procedure for quantitation based on 60 second count times for the Cd-109 source. The MAP Spectrum Analyzer was internally calibrated by the manufacturer. The calibration was checked using a well-characterized site-specific soil standard. It used 240 second times for the Cd-109 source.

13.5 Precision measurements -- The example precision data are presented in Table 4. These data are provided for guidance purposes only. Each of the six FPXRF instruments performed 10 replicate measurements on 12 soil samples that had analyte concentrations ranging from "nondetects" to thousands of mg/kg. Each of the 12 soil samples underwent 4 different preparation techniques from in situ (no preparation) to dried and ground in a sample cup. Therefore, there were 48 precision data points for five of the instruments and 24 precision points for the MAP Spectrum Analyzer. The replicate measurements were taken using the source count times discussed at the beginning of this section.

For each detectable analyte in each precision sample a mean concentration, standard deviation, and RSD was calculated for each analyte. The data presented in Table 4 is an average RSD for the precision samples that had analyte concentrations at 5 to 10 times the lower limit of detection for that analyte for each instrument. Some analytes such as mercury, selenium, silver, and thorium were not detected in any of the precision samples so these analytes are not listed in Table 4. Some analytes such as cadmium, nickel, and tin were only detected at concentrations near the lower limit of detection so that an RSD value calculated at 5 to 10 times this limit was not possible.

One FPXRF instrument collected replicate measurements on an additional nine soil samples to provide a better assessment of the effect of sample preparation on precision. Table 5 shows these results. These data are provided for guidance purposes only. The additional nine soil samples were comprised of three from each texture and had analyte concentrations ranging from near the lower limit of detection for the FPXRF analyzer to thousands of mg/kg. The FPXRF analyzer only collected replicate measurements from three of the preparation methods; no measurements were collected from the in situ homogenized samples. The FPXRF analyzer conducted five replicate measurements of the in situ field samples by taking measurements at five different points within the 4-inch by 4-inch sample square. Ten replicate measurements were collected for both the intrusive undried and unground and intrusive dried and ground samples contained in cups. The cups were shaken between each replicate measurement.

Table 5 shows that the precision dramatically improved from the in situ to the intrusive measurements. In general there was a slight improvement in precision when the sample was dried and ground. Two factors caused the precision for the in situ measurements to be poorer. The major factor is soil heterogeneity. By moving the probe within the 4-inch by 4-inch square,

measurements of different soil samples were actually taking place within the square. Table 5 illustrates the dominant effect of soil heterogeneity. It overwhelmed instrument precision when the FPXRF analyzer was used in this mode. The second factor that caused the RSD values to be higher for the in situ measurements is the fact that only five instead of ten replicates were taken. A lesser number of measurements caused the standard deviation to be larger which in turn elevated the RSD values.

13.6 Accuracy measurements -- Five of the FPXRF instruments (not including the MAP Spectrum Analyzer) analyzed 18 SRMs using the source count times and calibration methods given at the beginning of this section. The 18 SRMs included 9 soil SRMs, 4 stream or river sediment SRMs, 2 sludge SRMs, and 3 ash SRMs. Each of the SRMs contained known concentrations of certain target analytes. A percent recovery was calculated for each analyte in each SRM for each FPXRF instrument. Table 6 presents a summary of this data. With the exception of cadmium, chromium, and nickel, the values presented in Table 6 were generated from the 13 soil and sediment SRMs only. The 2 sludge and 3 ash SRMs were included for cadmium, chromium, and nickel because of the low or nondetectable concentrations of these three analytes in the soil and sediment SRMs.

Only 12 analytes are presented in Table 6. These are the analytes that are of environmental concern and provided a significant number of detections in the SRMs for an accuracy assessment. No data is presented for the X-MET 920 with the gas-filled proportional detector. This FPXRF instrument was calibrated empirically using site-specific soil samples. The percent recovery values from this instrument were very sporadic and the data did not lend itself to presentation in Table 6.

Table 7 provides a more detailed summary of accuracy data for one particular FPXRF instrument (TN 9000) for the 9 soil SRMs and 4 sediment SRMs. These data are provided for guidance purposes only. Table 7 shows the certified value, measured value, and percent recovery for five analytes. These analytes were chosen because they are of environmental concern and were most prevalently certified for in the SRM and detected by the FPXRF instrument. The first nine SRMs are soil and the last 4 SRMs are sediment. Percent recoveries for the four NIST SRMs were often between 90 and 110 percent for all analytes.

13.7 Comparability -- Comparability refers to the confidence with which one data set can be compared to another. In this case, FPXRF data generated from a large study of six FPXRF instruments was compared to SW-846 Methods 3050 and 6010 which are the standard soil extraction for metals and analysis by inductively coupled plasma. An evaluation of comparability was conducted by using linear regression analysis. Three factors were determined using the linear regression. These factors were the y-intercept, the slope of the line, and the coefficient of determination (r^2).

As part of the comparability assessment, the effects of soil type and preparation methods were studied. Three soil types (textures) and four preparation methods were examined during the study. The preparation methods evaluated the cumulative effect of particle size, moisture, and homogenization on comparability. Due to the large volume of data produced during this study, linear regression data for six analytes from only one FPXRF instrument is presented in Table 8. Similar trends in the data were seen for all instruments. These data are provided for guidance purposes only.

Table 8 shows the regression parameters for the whole data set, broken out by soil type, and by preparation method. These data are provided for guidance purposes only. The soil types are as follows: soil 1--sand; soil 2--loam; and soil 3--silty clay. The preparation methods are as follows: preparation 1--in situ in the field; preparation 2--intrusive, sample collected and homogenized; preparation 3--intrusive, with sample in a sample cup but sample still wet and not

ground; and preparation 4–intrusive, with sample dried, ground, passed through a 40-mesh sieve, and placed in sample cup.

For arsenic, copper, lead, and zinc, the comparability to the confirmatory laboratory was excellent with r^2 values ranging from 0.80 to 0.99 for all six FPXRF instruments. The slopes of the regression lines for arsenic, copper, lead, and zinc, were generally between 0.90 and 1.00 indicating the data would need to be corrected very little or not at all to match the confirmatory laboratory data. The r^2 values and slopes of the regression lines for barium and chromium were not as good as for the other for analytes, indicating the data would have to be corrected to match the confirmatory laboratory.

Table 8 demonstrates that there was little effect of soil type on the regression parameters for any of the six analytes. The only exceptions were for barium in soil 1 and copper in soil 3. In both of these cases, however, it is actually a concentration effect and not a soil effect causing the poorer comparability. All barium and copper concentrations in soil 1 and 3, respectively, were less than 350 mg/kg.

Table 8 shows there was a preparation effect on the regression parameters for all six analytes. With the exception of chromium, the regression parameters were primarily improved going from preparation 1 to preparation 2. In this step, the sample was removed from the soil surface, all large debris was removed, and the sample was thoroughly homogenized. The additional two preparation methods did little to improve the regression parameters. This data indicates that homogenization is the most critical factor when comparing the results. It is essential that the sample sent to the confirmatory laboratory match the FPXRF sample as closely as possible.

Sec. 11.0 of this method discusses the time necessary for each of the sample preparation techniques. Based on the data quality objectives for the project, an analyst must decide if it is worth the extra time necessary to dry and grind the sample for small improvements in comparability. Homogenization requires 3 to 5 min. Drying the sample requires one to two hours. Grinding and sieving requires another 10 to 15 min per sample. Lastly, when grinding and sieving is conducted, time has to be allotted to decontaminate the mortars, pestles, and sieves. Drying and grinding the samples and decontamination procedures will often dictate that an extra person be on site so that the analyst can keep up with the sample collection crew. The cost of requiring an extra person on site to prepare samples must be balanced with the gain in data quality and sample throughput.

13.8 The following documents may provide additional guidance and insight on this method and technique:

13.8.1 A. D. Hewitt, "Screening for Metals by X-ray Fluorescence Spectrometry/Response Factor/Compton K_α Peak Normalization Analysis," American Environmental Laboratory, pp 24-32, 1994.

13.8.2 S. Piorek and J. R. Pasmore, "Standardless, In Situ Analysis of Metallic Contaminants in the Natural Environment With a PC-Based, High Resolution Portable X-Ray Analyzer," Third International Symposium on Field Screening Methods for Hazardous Waste and Toxic Chemicals, Las Vegas, Nevada, February 24-26, 1993, Vol 2, pp 1135-1151, 1993.

13.8.3 S. Shefsky, "Sample Handling Strategies for Accurate Lead-in-soil Measurements in the Field and Laboratory," *International Symposium of Field Screening Methods for Hazardous Waste and Toxic Chemicals*, Las Vegas, NV, January 29-31, 1997.

14.0 POLLUTION PREVENTION

14.1 Pollution prevention encompasses any technique that reduces or eliminates the quantity and/or toxicity of waste at the point of generation. Numerous opportunities for pollution prevention exist in laboratory operation. The EPA has established a preferred hierarchy of environmental management techniques that places pollution prevention as the management option of first choice. Whenever feasible, laboratory personnel should use pollution prevention techniques to address their waste generation. When wastes cannot be feasibly reduced at the source, the Agency recommends recycling as the next best option.

14.2 For information about pollution prevention that may be applicable to laboratories and research institutions consult *Less is Better: Laboratory Chemical Management for Waste Reduction* available from the American Chemical Society's Department of Government Relations and Science Policy, 1155 16th St., N.W. Washington, D.C. 20036, http://www.acs.org.

15.0 WASTE MANAGEMENT

The Environmental Protection Agency requires that laboratory waste management practices be conducted consistent with all applicable rules and regulations. The Agency urges laboratories to protect the air, water, and land by minimizing and controlling all releases from hoods and bench operations, complying with the letter and spirit of any sewer discharge permits and regulations, and by complying with all solid and hazardous waste regulations, particularly the hazardous waste identification rules and land disposal restrictions. For further information on waste management, consult *The Waste Management Manual for Laboratory Personnel* available from the American Chemical Society at the address listed in Sec. 14.2.

16.0 REFERENCES

1. Metorex, X-MET 920 User's Manual.

2. Spectrace Instruments, "Energy Dispersive X-ray Fluorescence Spectrometry: An Introduction," 1994.

3. TN Spectrace, Spectrace 9000 Field Portable/Benchtop XRF Training and Applications Manual.

4. Unpublished SITE data, received from PRC Environment Management, Inc.

17.0 TABLES, DIAGRAMS, FLOWCHARTS, AND VALIDATION DATA

The following pages contain the tables referenced by this method. A flow diagram of the procedure follows the tables.

TABLE 1

EXAMPLE INTERFERENCE FREE LOWER LIMITS OF DETECTION

Analyte	Chemical Abstract Series Number	Lower Limit of Detection in Quartz Sand (milligrams per kilogram)
Antimony (Sb)	7440-36-0	40
Arsenic (As)	7440-38-0	40
Barium (Ba)	7440-39-3	20
Cadmium (Cd)	7440-43-9	100
Calcium (Ca)	7440-70-2	70
Chromium (Cr)	7440-47-3	150
Cobalt (Co)	7440-48-4	60
Copper (Cu)	7440-50-8	50
Iron (Fe)	7439-89-6	60
Lead (Pb)	7439-92-1	20
Manganese (Mn)	7439-96-5	70
Mercury (Hg)	7439-97-6	30
Molybdenum (Mo)	7439-93-7	10
Nickel (Ni)	7440-02-0	50
Potassium (K)	7440-09-7	200
Rubidium (Rb)	7440-17-7	10
Selenium (Se)	7782-49-2	40
Silver (Ag)	7440-22-4	70
Strontium (Sr)	7440-24-6	10
Thallium (Tl)	7440-28-0	20
Thorium (Th)	7440-29-1	10
Tin (Sn)	7440-31-5	60
Titanium (Ti)	7440-32-6	50
Vanadium (V)	7440-62-2	50
Zinc (Zn)	7440-66-6	50
Zirconium (Zr)	7440-67-7	10

Source: Refs. 1, 2, and 3
These data are provided for guidance purposes only.

TABLE 2

SUMMARY OF RADIOISOTOPE SOURCE CHARACTERISTICS

Source	Activity (mCi)	Half-Life (Years)	Excitation Energy (keV)	Elemental Analysis Range	
Fe-55	20-50	2.7	5.9	Sulfur to Chromium Molybdenum to Barium	K Lines L Lines
Cd-109	5-30	1.3	22.1 and 87.9	Calcium to Rhodium Tantalum to Lead Barium to Uranium	K Lines K Lines L Lines
Am-241	5-30	432	26.4 and 59.6	Copper to Thulium Tungsten to Uranium	K Lines L Lines
Cm-244	60-100	17.8	14.2	Titanium to Selenium Lanthanum to Lead	K Lines L Lines

Source: Refs. 1, 2, and 3

TABLE 3

SUMMARY OF X-RAY TUBE SOURCE CHARACTERISTICS

Anode Material	Recommended Voltage Range (kV)	K-alpha Emission (keV)	Elemental Analysis Range	
Cu	18-22	8.04	Potassium to Cobalt Silver to Gadolinium	K Lines L Lines
Mo	40-50	17.4	Cobalt to Yttrium Europium to Radon	K Lines L Lines
Ag	50-65	22.1	Zinc to Technicium Ytterbium to Neptunium	K Lines L Lines

Source: Ref. 4

Notes: The sample elements excited are chosen by taking as the lower limit the same ratio of excitation line energy to element absorption edge as in Table 2 (approximately 0.45) and the requirement that the excitation line energy be above the element absorption edge as the upper limit (L2 edges used for L lines). K-beta excitation lines were ignored.

TABLE 4

EXAMPLE PRECISION VALUES

Analyte	Average Relative Standard Deviation for Each Instrument at 5 to 10 Times the Lower Limit of Detection					
	TN 9000	TN Lead Analyzer	X-MET 920 (SiLi Detector)	X-MET 920 (Gas-Filled Detector)	XL Spectrum Analyzer	MAP Spectrum Analyzer
Antimony	6.54	NR	NR	NR	NR	NR
Arsenic	5.33	4.11	3.23	1.91	12.47	6.68
Barium	4.02	NR	3.31	5.91	NR	NR
Cadmium	29.84[a]	NR	24.80[a]	NR	NR	NR
Calcium	2.16	NR	NR	NR	NR	NR
Chromium	22.25	25.78	22.72	3.91	30.25	NR
Cobalt	33.90	NR	NR	NR	NR	NR
Copper	7.03	9.11	8.49	9.12	12.77	14.86
Iron	1.78	1.67	1.55	NR	2.30	NR
Lead	6.45	5.93	5.05	7.56	6.97	12.16
Manganese	27.04	24.75	NR	NR	NR	NR
Molybdenum	6.95	NR	NR	NR	12.60	NR
Nickel	30.85[a]	NR	24.92[a]	20.92[a]	NA	NR
Potassium	3.90	NR	NR	NR	NR	NR
Rubidium	13.06	NR	NR	NR	32.69[a]	NR
Strontium	4.28	NR	NR	NR	8.86	NR
Tin	24.32[a]	NR	NR	NR	NR	NR
Titanium	4.87	NR	NR	NR	NR	NR
Zinc	7.27	7.48	4.26	2.28	10.95	0.83
Zirconium	3.58	NR	NR	NR	6.49	NR

These data are provided for guidance purposes only.
Source: Ref. 4

[a] These values are biased high because the concentration of these analytes in the soil samples was near the lower limit of detection for that particular FPXRF instrument.

NR Not reported.

NA Not applicable; analyte was reported but was below the established lower limit detection.

TABLE 5

EXAMPLES OF PRECISION AS AFFECTED BY SAMPLE PREPARATION

Analyte	Average Relative Standard Deviation for Each Preparation Method		
	In Situ-Field	Intrusive-Undried and Unground	Intrusive-Dried and Ground
Antimony	30.1	15.0	14.4
Arsenic	22.5	5.36	3.76
Barium	17.3	3.38	2.90
Cadmium[a]	41.2	30.8	28.3
Calcium	17.5	1.68	1.24
Chromium	17.6	28.5	21.9
Cobalt	28.4	31.1	28.4
Copper	26.4	10.2	7.90
Iron	10.3	1.67	1.57
Lead	25.1	8.55	6.03
Manganese	40.5	12.3	13.0
Mercury	ND	ND	ND
Molybdenum	21.6	20.1	19.2
Nickel[a]	29.8	20.4	18.2
Potassium	18.6	3.04	2.57
Rubidium	29.8	16.2	18.9
Selenium	ND	20.2	19.5
Silver[a]	31.9	31.0	29.2
Strontium	15.2	3.38	3.98
Thallium	39.0	16.0	19.5
Thorium	NR	NR	NR
Tin	ND	14.1	15.3
Titanium	13.3	4.15	3.74
Vanadium	NR	NR	NR
Zinc	26.6	13.3	11.1
Zirconium	20.2	5.63	5.18

These data are provided for guidance purposes only.
Source: Ref. 4

[a] These values may be biased high because the concentration of these analytes in the soil samples was near the lower limit of detection.

ND Not detected.

NR Not reported.

TABLE 6

EXAMPLE ACCURACY VALUES

Analyte	Instrument															
	TN 9000				TN Lead Analyzer				X-MET 920 (SiLi Detector)				XL Spectrum Analyzer			
	n	Range of % Rec.	Mean % Rec.	SD	n	Range of % Rec.	Mean % Rec.	SD	n	Range of % Rec.	Mean % Rec	SD	n	Range of % Rec.	Mean % Rec.	SD
Sb	2	100-149	124.3	NA	--	--	--	--	--	--	--	--	--	--	--	--
As	5	68-115	92.8	17.3	5	44-105	83.4	23.2	4	9.7-91	47.7	39.7	5	38-535	189.8	206
Ba	9	98-198	135.3	36.9	--	--	--	--	9	18-848	168.2	262	--	--	--	--
Cd	2	99-129	114.3	NA	--	--	--	--	6	81-202	110.5	45.7	--	--	--	--
Cr	2	99-178	138.4	NA	--	--	--	--	7	22-273	143.1	93.8	3	98-625	279.2	300
Cu	8	61-140	95.0	28.8	6	38-107	79.1	27.0	11	10-210	111.8	72.1	8	95-480	203.0	147
Fe	6	78-155	103.7	26.1	6	89-159	102.3	28.6	6	48-94	80.4	16.2	6	26-187	108.6	52.9
Pb	11	66-138	98.9	19.2	11	68-131	97.4	18.4	12	23-94	72.7	20.9	13	80-234	107.3	39.9
Mn	4	81-104	93.1	9.70	3	92-152	113.1	33.8	--	--	--	--	--	--	--	--
Ni	3	99-122	109.8	12.0	--	--	--	--	--	--	--	--	3	57-123	87.5	33.5
Sr	8	110-178	132.6	23.8	--	--	--	--	--	--	--	--	7	86-209	125.1	39.5
Zn	11	41-130	94.3	24.0	10	81-133	100.0	19.7	12	46-181	106.6	34.7	11	31-199	94.6	42.5

Source: Ref. 4. These data are provided for guidance purposes only.
n: Number of samples that contained a certified value for the analyte and produced a detectable concentration from the FPXRF instrument.
SD: Standard deviation; NA: Not applicable; only two data points, therefore, a SD was not calculated.
%Rec.: Percent recovery.
-- No data.

TABLE 7

EXAMPLE ACCURACY FOR TN 9000[a]

Standard Reference Material	Arsenic			Barium			Copper			Lead			Zinc		
	Cert. Conc.	Meas. Conc.	%Rec.	Cert. Conc.	Meas. Conc.	%Rec.	Cert. Conc.	Meas. Conc.	%Rec.	Cert. Conc.	Meas. Conc.	%Rec.	Cert. Conc.	Meas. Conc.	%Rec.
RTC CRM-021	24.8	ND	NA	586	1135	193.5	4792	2908	60.7	144742	149947	103.6	546	224	40.9
RTC CRM-020	397	429	92.5	22.3	ND	NA	753	583	77.4	5195	3444	66.3	3022	3916	129.6
BCR CRM 143R	--	--	--	--	--	--	131	105	80.5	180	206	114.8	1055	1043	99.0
BCR CRM 141	--	--	--	--	--	--	32.6	ND	NA	29.4	ND	NA	81.3	ND	NA
USGS GXR-2	25.0	ND	NA	2240	2946	131.5	76.0	106	140.2	690	742	107.6	530	596	112.4
USGS GXR-6	330	294	88.9	1300	2581	198.5	66.0	ND	NA	101	80.9	80.1	118	ND	NA
NIST 2711	105	104	99.3	726	801	110.3	114	ND	NA	1162	1172	100.9	350	333	94.9
NIST 2710	626	722	115.4	707	782	110.6	2950	2834	96.1	5532	5420	98.0	6952	6476	93.2
NIST 2709	17.7	ND	NA	968	950	98.1	34.6	ND	NA	18.9	ND	NA	106	98.5	93.0
NIST 2704	23.4	ND	NA	414	443	107.0	98.6	105	106.2	161	167	103.5	438	427	97.4
CNRC PACS-1	211	143	67.7	--	772	NA	452	302	66.9	404	332	82.3	824	611	74.2
SARM-51	--	--	--	335	466	139.1	268	373	139.2	5200	7199	138.4	2200	2676	121.6
SARM-52	--	--	--	410	527	128.5	219	193	88.1	1200	1107	92.2	264	215	81.4

Source: Ref. 4. These data are provided for guidance purposes only.
[a] All concentrations in milligrams per kilogram.
%Rec.: Percent recovery; ND: Not detected; NA: Not applicable.
-- No data.

TABLE 8

EXAMPLE REGRESSION PARAMETERS FOR COMPARABILITY[1]

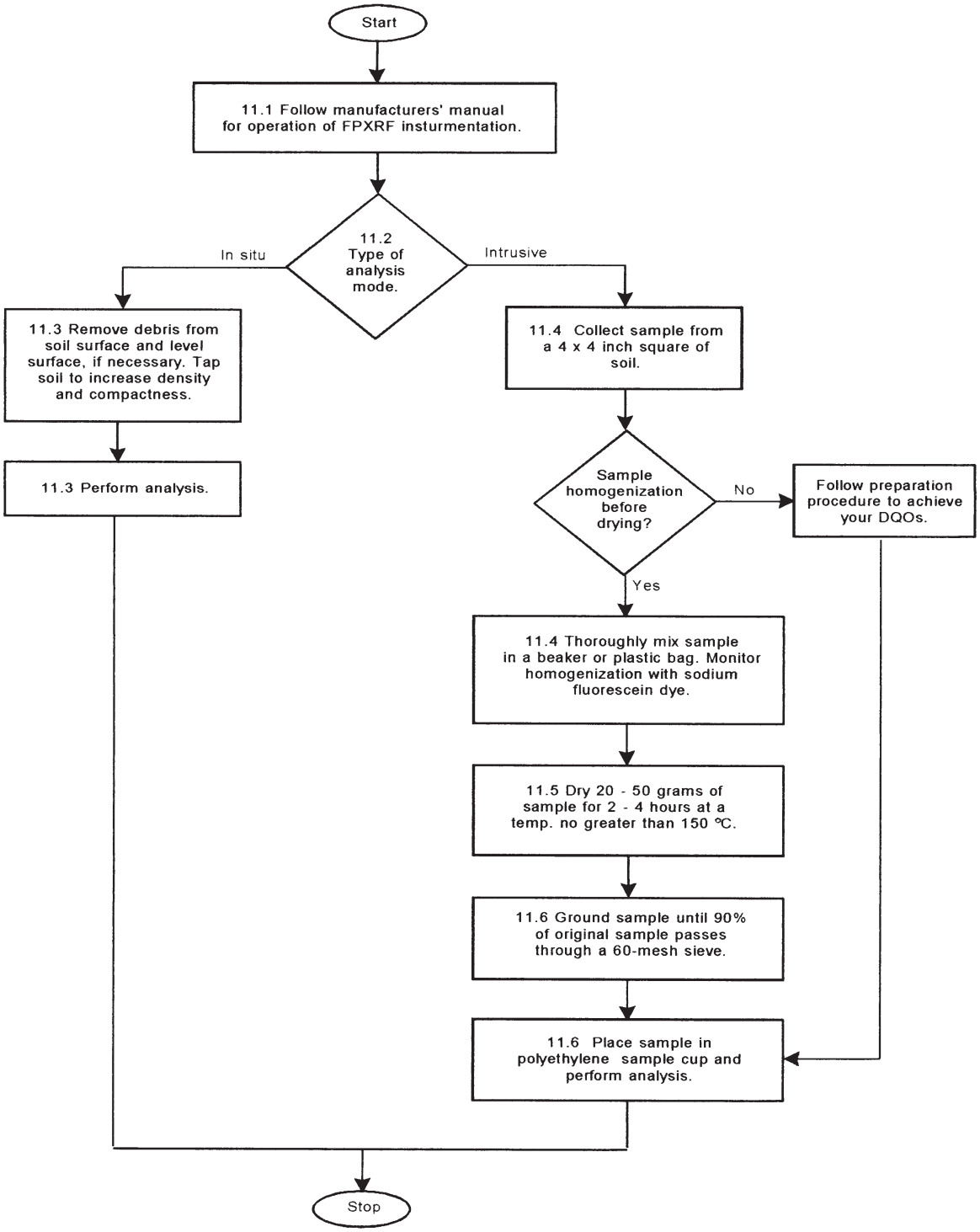
	Arsenic				Barium				Copper			
	n	r^2	Int.	Slope	n	r^2	Int.	Slope	n	r^2	Int.	Slope
All Data	824	0.94	1.62	0.94	1255	0.71	60.3	0.54	984	0.93	2.19	0.93
Soil 1	368	0.96	1.41	0.95	393	0.05	42.6	0.11	385	0.94	1.26	0.99
Soil 2	453	0.94	1.51	0.96	462	0.56	30.2	0.66	463	0.92	2.09	0.95
Soil 3	—	—	—	—	400	0.85	44.7	0.59	136	0.46	16.60	0.57
Prep 1	207	0.87	2.69	0.85	312	0.64	53.7	0.55	256	0.87	3.89	0.87
Prep 2	208	0.97	1.38	0.95	315	0.67	64.6	0.52	246	0.96	2.04	0.93
Prep 3	204	0.96	1.20	0.99	315	0.78	64.6	0.53	236	0.97	1.45	0.99
Prep 4	205	0.96	1.45	0.98	313	0.81	58.9	0.55	246	0.96	1.99	0.96

	Lead				Zinc				Chromium			
	n	r^2	Int.	Slope	n	r^2	Int.	Slope	n	r^2	Int.	Slope
All Data	1205	0.92	1.66	0.95	1103	0.89	1.86	0.95	280	0.70	64.6	0.42
Soil 1	357	0.94	1.41	0.96	329	0.93	1.78	0.93	—	—	—	—
Soil 2	451	0.93	1.62	0.97	423	0.85	2.57	0.90	—	—	—	—
Soil 3	397	0.90	2.40	0.90	351	0.90	1.70	0.98	186	0.66	38.9	0.50
Prep 1	305	0.80	2.88	0.86	286	0.79	3.16	0.87	105	0.80	66.1	0.43
Prep 2	298	0.97	1.41	0.96	272	0.95	1.86	0.93	77	0.51	81.3	0.36
Prep 3	302	0.98	1.26	0.99	274	0.93	1.32	1.00	49	0.73	53.7	0.45
Prep 4	300	0.96	1.38	1.00	271	0.94	1.41	1.01	49	0.75	31.6	0.56

Source: Ref. 4. These data are provided for guidance purposes only.

[1] Log-transformed data

n: Number of data points; r^2: Coefficient of determination; Int.: Y-intercept

— No applicable data

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