QUALITY ASSURANCE PROJECT PLAN (QAPP)
FOR
STORAGE TANK PROGRAM (STP) SAMPLING

WYOMING DEPARTMENT OF ENVIRONMENTAL QUALITY (WDEQ)
SOLID AND HAZARDOUS WASTE DIVISION

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SOLID AND HAZARDOUS WASTE DIVISION

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1.0 PROJECT MANAGEMENT

1.1 Distribution List

Brian Lovett, WDEQ Administration, QA Officer
Karen L. Halvorsen, P.E., WDEQ STP Manager, STP QA Representative
Adrian Ducharme, P.G., WDEQ STP District 1 Supervisor
Sterling Roberts, P.E., WDEQ STP District 2 Supervisor
Scott Forister, P.E., WDEQ STP District 3 Supervisor
Lindy Johnson, P.E., WDEQ STP Project Manager
Hal Hatfield, P.G., WDEQ STP Project Manager
Paul Wollenzien, WDEQ STP Project Manager
Wayne VanDamme, P.G., WDEQ STP Project Manager
WDEQ STP Prequalified Engineering Consultants (see website for current list)
Fran Chambus, EPA, Wyoming Project Officer (QAPP is provided annually to EPA with the LUST Prevention grant work plan)
This QAPP is available on the WDEQ STP website

1.2 Project Organization

The WDEQ Administration QA Officer (QAO) indicated on the Distribution List is designated as the Project Quality Assurance Manager. The QAO oversees the QAPP review and comment process and concurs on all WDEQ programs' QAPPs. The QAO is the primary contact for interaction between the USEPA Regional QA Program and WDEQ quality management activities.

The Storage Tank Program (STP) Manager is designated as the STP Quality Assurance Representative (QAR). As QAR, he or she has the following authority and responsibilities:

A. Be the official contact for all STP quality assurance matters.

B. Review and revise, as necessary, this STP QAPP.

C. Identify and respond to STP quality assurance (QA) needs.

D. Maintains the official, approved STP QAPP.

The QAR and QAO will remain independent of direct project involvement and "day-to-day" operations. The QAO will remain independent from the STP project managers and consultants generating data for the STP.

1.2.1 Project Managers

If necessary, project managers shall discuss the objectives and scope of each sampling project with the QAR. Responsibilities of the project manager include:

A. Sampling During Tank Pulls or Other Activities Not Contracted to a Third Party. Coordinating equipment and vehicle needs and ensuring that sampling protocols and custody procedures are followed, including arranging for the transport or shipment of samples to the laboratory. Project managers will maintain a field log book. The project manager will collect all pertinent field data (i.e., chain of custody, analytical parameters, copies of field log book, etc.) and file these data in the project records file. The project manager is also responsible for calling the laboratory on the day the samples are due to arrive at the laboratory to ensure that they did in fact arrive.

B. Sampling Done by a Third Party. Ensuring the third party contractor or consultant has this QAPP and a project/site-specific Sample Analysis Plan (SAP) in place. The Project Manager will maintain the most current, official SAP for projects he/she is managing.

1.2.2 Engineering Consultants

STP-prequalified engineering consultants completing work for the STP are responsible for preparation of a project/site-specific SAP. The SAP is approved by the STP project manager before work is started. The consultant is responsible for following this QAPP and the project/site-specific SAP during completion of all work on the project.

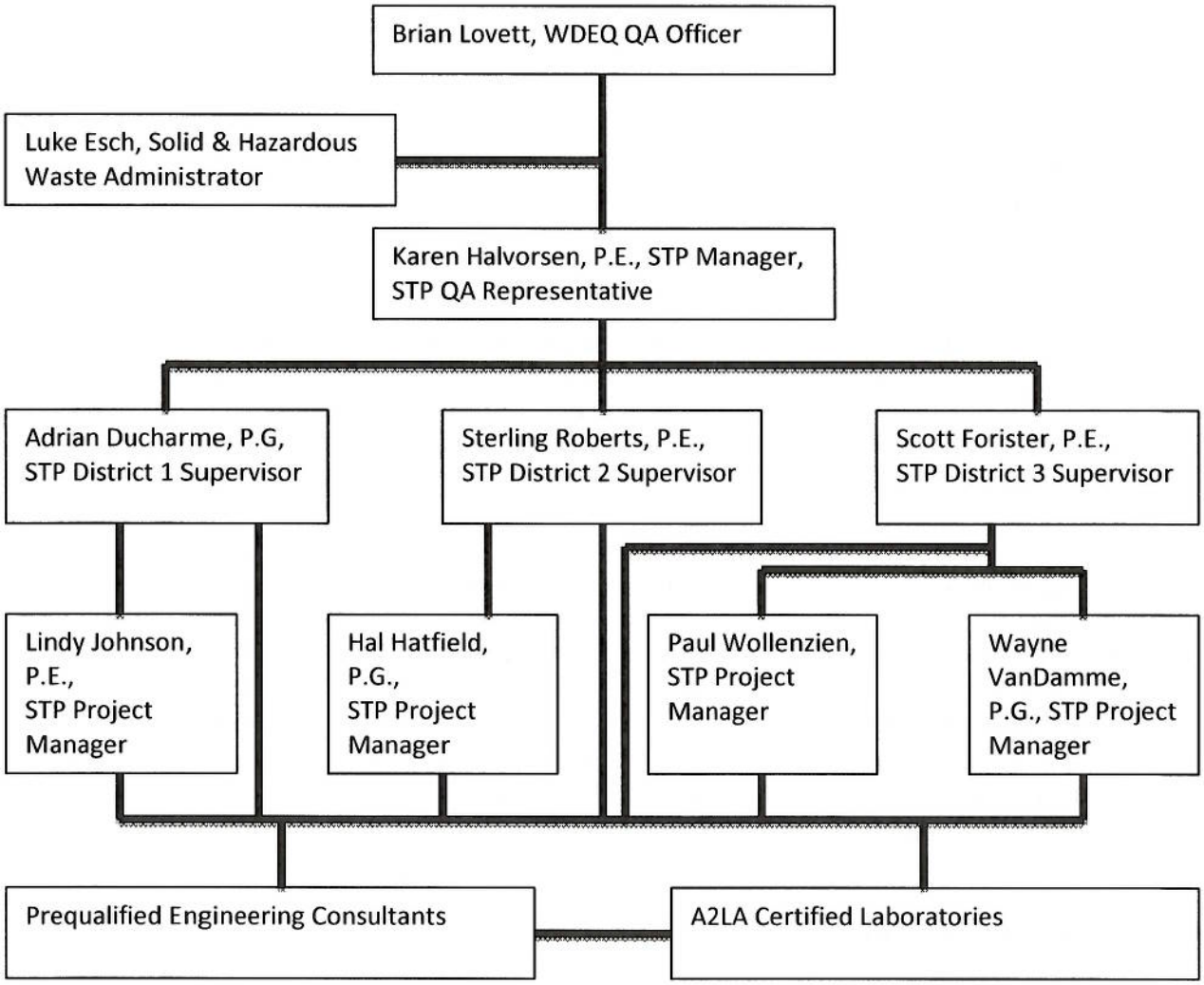
Consultants are selected using Wyoming Procurement Rules and Regulations. Consultants are selected using a "qualifications-based" approach and are prequalified using a Statement of Qualifications process. Requests for Statements of Interest (SOIs) are solicited for each STP project from the list of prequalified consultants. SOIs are reviewed by a committee of three STP staff members knowledgeable in the selection process and the work necessary to complete the project. The committee shortlists three consultants to submit a technical and cost proposal. These three consultants are interviewed, and the committee selects the most qualified consultant to complete the project. All prequalified consultants have expertise in environmental engineering, data collection, and data analyses. The current prequalified consultant list is available on the STP website.

1.2.3 Laboratories

Only laboratories accredited for the Wyoming Storage Tank Program by the American Association for Laboratory Accreditation (A2LA) may be used on STP projects. The current laboratory list is available on the STP website. Laboratory management and technical requirements must be met by all accredited laboratories to maintain their accreditation. Requirements are described in the latest revision to "R211 – Specific Requirements: Wyoming Storage Tank Remediation Testing Laboratory Accreditation Program" developed by A2LA (attached to this QAPP). Therefore, laboratory requirements are not discussed in this QAPP.

1.2.4 Organization Chart

STP QAPP ORGANIZATION CHART



1.3 Problem Definition/Background

The Wyoming Department of Environmental Quality/Solid & Hazardous Waste Division's Storage Tank Program has been actively remediating program-eligible contaminated sites since 1991. The STP initiates aggressive environmental remedial actions at the highest priority sites using available resources. Authority for this work is provided by Article 14 of the Wyoming Environmental Quality Act. STP Guidance Document #7 (attached to this QAPP) provides sampling and laboratory analytical requirements and STP remediation standards and action limits.

The implementation of STP actions at eligible sites will encompass the collection, preservation, and transportation of environmental samples in accordance with EPA- and state-approved methods and quality assurance procedures.

The overall QA objective is to develop and implement procedures for field sampling, chain-of-custody, laboratory analysis, and reporting that will produce well-documented data of known quality that can be used to determine the presence, magnitude, and extent of contamination at a site. Data are used by the STP to justify spending state funds for corrective action at eligible sites or to determine that no further action is required at a site. Project/site-specific sampling methods and objectives will be addressed in project/site-specific SAPs. Project/site-specific SAPs are prepared by consultants under contract with WDEQ to complete investigation and remediation at eligible STP sites.

Some sampling events do not allow for formal project/site-specific SAP development. These events may be driven by public health concerns or immediate response or emergencies. In these cases the STP has determined that an immediate threat to human health or the environment exists and/or the situation may not be apparent or accessible after time is taken for planning activities to be completed. These are referred to as emergency response sampling events. Copies of field notes and related documents for the emergency response sampling event will be placed in the project file and provided with the emergency response report. The field notes and emergency response report will identify why the sample(s) were taken, sample locations, analytes and methods, chain of custody, etc.

1.4 Project/Task Description

The state and its consultants will be generating environmental data in support of the STP. The type of work that will be performed under the program typically involves soil and groundwater sampling and analyses and pilot testing. Air sampling for explosive vapors is also completed at some sites when warranted. Data will be required for risk assessment, site characterization, evaluation of remedial alternatives, engineering design for remedial response activities conducted for or by the state, and closure determination.

Project/site-specific tasks are stated in the scope of work (template scope of work attached to this QAPP) attached to the consultant's contract or amendment. Project/site-specific geographic

locations, sampling requirements, procedures, equipment, record requirements, and work schedules will be discussed in project/site-specific SAP prepared by the consultant.

Resource and time constraints, if applicable to a specific project, are discussed in the scope of work attached to the consultant's contract or amendment and/or the project/site-specific SAP prepared by the consultant.

1.5 Quality Objectives and Criteria

Data are collected in order to make environmentally sound decisions and justify spending state funds on remediation or making determinations to close sites. Data quality objectives (DQOs) are the full set of performance constraints needed to complete a project, including a specification of the level of uncertainty that a decision maker is willing to accept. The DQOs state the level of uncertainty that is acceptable from data collection activities. DQOs also define the data quality necessary to make a certain decision. Project/site-specific DQOs are required to produce reliable data that are consistent with the intended use. The following will be considered when establishing DQOs for a particular project:

A. Decision(s) to be made or questions to be answered,

B. Characterization of physical and chemical properties of the media to be sampled,

C. Action and detection limits for STP constituents of concern (CoC),

D. Sampling and analytical errors, and

E. Anticipated concentration ranges of each CoC.

Project/site-specific DQOs will be included in project/site-specific SAP prepared by the consultant and approved by the STP Manager. The SAP will include the performance/measurement criteria for all information to be collected, acceptance criteria for information obtained from existing data, and the range of anticipated concentrations of each parameter of interest. Action limits are identified in STP Guidance Document #7, and laboratory detection limits are identified in the "R211 – Specific Requirements: Wyoming Storage Tank Remediation Testing Laboratory Accreditation Program" document developed by A2LA.

1.5.1 Data Quality Indicators

The objective for the Quality Assurance/Quality Control (QA/QC) program is to ensure the quality of data. Performance and acceptance criteria are often expressed in terms of data quality indicators. The principal indicators of data quality are precision, bias, accuracy, representativeness, comparability, completeness, and sensitivity.

Precision

Precision is a measure of mutual agreement among multiple measurements of the same property, usually under identical or substantially similar conditions. Precision is estimated by means of duplicate/replicate QC analyses. These samples should contain concentrations of a target analyte above the method detection limit (MDL) and may involve the use of matrix spikes.

Field duplicate samples should be obtained, preserved, transported, and analyzed in the same manner as a routine sample.

The common data quality indicators for precision are range, variance or standard deviation, relative range, and relative standard deviation. The range is the difference between the largest and smallest values. The variance or standard deviation is the statistical measure of the spread of data calculated from two or more measured values. The relative range is the range divided by the mean of the data set. The relative standard deviation is calculated from two or more values divided by the mean of those values. These values can indicate random errors or fluctuations in the measurement process.

Bias

Bias is a systematic or persistent distortion of a measurement process that causes error in one direction.

A bias data quality indicator is a quantitative indicator of the magnitude of systematic error resulting from biased sampling design, calibration errors, response factor shifts, unaccounted-for interferences, and chronic laboratory contamination.

Accuracy

Accuracy is the closeness of agreement between an observed value and an accepted reference value. When applied to a set of observed values, accuracy will be a combination of random error (precision) and of a common systematic error (or bias) component. Accuracy, as expressed in percent bias, indicates the systematic error in an analytical method. Negative values indicate underestimating while positive values indicate overestimating. As bias approaches zero, accuracy increases. Accuracy will be monitored with the use of field blanks. Project/site-specific SAPs shall indicate the number of field blanks to be taken per sampling event. At least one field blank shall be collected for each sampling event.

Representativeness

Representativeness expresses the degree to which data accurately and precisely represents a characteristic of a population, parameter variations at a sampling point, a process condition, or an environmental condition. Representativeness is a qualitative parameter that is dependent upon the proper design of the sampling program and proper laboratory protocol. It is the goal of this sampling program to obtain representative samples during each sampling procedure. This goal is

accomplished through following acceptable sampling procedures and state-of-the art sampling methodology.

Comparability

Comparability is a qualitative parameter expressing the confidence with which one data set can be compared with another. The extent to which existing and planned analytical data will be comparable depends on the similarity of sampling and analytical methods.

The data collected should be maintained in standard units (e.g., milligrams per liter [mg/l], micrograms per liter [ug/l], milligrams per kilogram [mg/k]).

Use of standard units of measure will provide uniformity. All data will be acquired by application of standard methodologies.

Completeness

Completeness is a measure of the amount of valid data obtained from a measurement system compared to the amount that was expected to be obtained under correct normal conditions.

Sensitivity

Sensitivity reflects the capability of a method or instrument to discriminate between measurement responses representing different levels of the variable of interest. The various ways to determine sensitivity is by the method detection limit (MDL), instrument detection limit (IDL), or the laboratory quantitation limit.

1.6 Special Training/Certification

Consultants will specify in the project/site-specific SAP the training program in place for personnel conducting sampling for the STP. All laboratories completing analyses for the STP must be American Association for Laboratory Accreditation (A2LA) certified.

The competency of staff employed for environmental data collection and use for the STP is ensured by the District Supervisors. District Supervisors have competency and experience in performing environmental data collection and use activities. The prerequisites for staff to perform data collection and use activities include technical education and experience as well as training on program/project goals. Project Managers work under District Supervisors, as necessary, until they are deemed competent in data collection and use. All staff attend training to gain expertise in using environmental data as needed and funding is available. District Supervisors are responsible for assuring that Project Managers are appropriately trained. Deficiencies in training or requests for training are brought to the attention of the STP Manager who will attempt to identify training programs and funding necessary to complete training. Training certifications are maintained by the employee.

1.7 Documentation and Records

The most current version of this QAPP is available on the STP website. The QAPP is reviewed annually when the LUST Cleanup Grant Work Plan is submitted to EPA. If any revisions are necessary, the revisions will be made, and copies will be delivered electronically to the distribution list by the STP QA Representative. The revision date is noted in the header of the QAPP.

Maintenance of records is a necessary component of each project. Records provide direct evidence and support for the necessary technical interpretations, judgments, and discussions concerning project activities. Records must directly support current or ongoing technical studies and activities, and shall provide the historical evidence needed for later reviews and analyses. Records shall be legible; identifiable; retrievable; and protected against damage, deterioration, or loss.

Documentation and records shall be archived using state archiving procedures and kept indefinitely. Analytical data are uploaded by the consultant to the STP GIS. Electronic files are stored on the state's servers and backed up nightly according to the state's procedures.

The types of documents and records that will be kept are described below.

1.7.1 Site Records

Site records are maintained in the STP database and include tank and release information, site owner/operator contact names and addresses, facility identification number, and priority ranking. Site information is also maintained by the project manager and may include a site description and map, previous site investigations, associated permits, county and state records, interviews, and photographs. Meeting notes, telephone conversation records, and other records pertaining to the project will be maintained.

1.7.2 Field Records

Field records generally consist of field notebooks with numbered pages, equipment maintenance and calibration forms, chain-of-custody forms, general field procedures, drilling and well construction forms, etc. All records will be written in indelible ink.

All information pertinent to a field survey and/or sampling event will be recorded in a bound log book. Entries in the log book must include at least the following:

A. Purpose of sampling (e.g., tank pull, site characterization, etc.).

B. Location of sampling including tank number, facility ID number, and name of site.

C. Name and address of field contact.

D. Name(s) of persons conducting the activity.

E. Equipment calibration

F. Documentation for generation of quality control samples.

G. Number and volume of samples taken.

H. Description of sampling points.

I. Date and time of collection.

J. Sample identification number(s).

K. Laboratory used.

L. References such as maps or photographs of the sampling site and Wyoming State Plane coordinates of well locations.

M. Field observations.

N. Documentation of all deviations from procedural documents and the quality assurance plan.

O. Any field measurements made such as pH, conductivity, temperature, etc.

P. Weather conditions.

Q. Equipment decontamination.

Additional documentation needed for low-flow or other pump sampling include:

A. Pump placement (relative to well screen position and static water level).

B. Initial static water level.

C. Initial pumping rate.

D. Drawdown measurements.

E. Stabilized pumping water level.

F. Final pumping rate.

G. Water quality indicators and turbidity measurements.

H. Times for all measurements.

Generally, sufficient information will be recorded so that someone can reconstruct the entire sampling event from the field log without relying on the collector's memory.

All documentation errors shall be corrected by drawing a single line through the error so it remains legible and shall be initialed by the responsible individual, along with the date and time of change. The correction shall be written adjacent to the error.

1.7.3 Analysis Records

Calibration documentation for sampling, measuring, and test equipment used during activities affecting quality shall be maintained. Such documentation will include a description of the calibrations performed and the standards used. Calibration curves and charts associated with sample analysis shall be signed and dated and filed in the project record file.

All information used in calculations shall be recorded in order to enable reconstruction of the final result at a later date. This information may include weight or volume of sample used, percent dry weight for solids, extract volume, dilution factor used, and blank- or background-correction protocols followed.

Results of assessment activities will be documented. In cases where assessment activities result in the finding of deficiencies, the nature of the deficiencies as well as the corresponding response actions will be documented.

1.7.4 Deliverables

Project/site-specific deliverables, including required reports and milestones, are specified in the scope of work attached to the consultant's contract or amendment for the specific project. Analytical data and other deliverables (e.g., remedial action plan, operation and maintenance reports, plans/specifications, as-built drawings, etc.) are uploaded by the consultant to the STP's GIS database.

2.0 DATA GENERATION AND ACQUISITION

Sampling procedures must be completed in accordance with this QAPP, the project/site-specific SAP, the consultant's scope of work attached to the contract or amendment, and STP Guidance Document No. 7.

2.1 Sampling Process Design

Project/site-specific SAPs must include the following as appropriate:

A. Design of the sampling network and rationale for the design,

B. Types and number of samples required,

C. Sample locations and frequencies,

D. Project activity schedules,

E. Sample matrices,

F. Identifies sources of variability and how this variability should be reconciled with project information, and

G. Measurement parameters of interest.

If planned sampling points become inaccessible, the STP's consultant will contact the STP Project Manager. The consultant and STP Project Manager will determine whether or not continued sampling is needed. If continued sampling is needed, the consultant and STP Project Manager will determine the best approach for establishing a new sampling point.

The STP assumes that all data collected are critical. If data are not critical, funds are not spent to collect the data.

2.1.1 Sampling Points

Sampling points will vary depending on the site. In general, soil sampling begins at the tank or former tank basin and steps out, down gradient, until field data indicate the edge of the plume has been identified. Up-gradient and side-gradient samples are also taken as necessary to delineate the plume and collect samples for background analyses. Select boreholes are completed as monitoring wells to delineate the groundwater plume. Sampling locations may be limited due to structures, product lines, utilities, etc. located on the site. Sampling points are generally determined in the field as sample collection progresses. Sampling points must be noted in the field on the site map.

2.1.2 Sampling Frequencies

Frequency of sample collection will vary depending on the site. The frequency of sample collection is generally determined in the field as sample collection progresses.

2.1.3 Grab Sample

Grab samples are typically collected for STP work. A grab sample is one taken from only one point at one particular time or may be defined as a discrete aliquot representative of a specific location at a given point in time. The sample is collected all at once and at one particular point in the sample medium. The representativeness of such samples is defined by the nature of the materials being sampled.

2.1.4 Composite Sample

Composite samples may be collected for STP work. A composite sample combines a number of discrete samples collected from a body of material into a single, homogenized sample for the purpose of analysis. The objective of composite soil sampling is to represent the average conditions in the sampled body of material.

2.2 Sampling Methods

Project/site-specific SAPs must provide detailed information on the following:

A. Consultant's Standard Operating Procedures (SOPs) to be used, SOP date, and options or modifications to be taken, if any;

B. Equipment required and how the equipment will be deployed, stored, operated to avoid contamination, and ensure maintenance of raw data or data averages;

C. Selection and preparation of sample containers, sample volumes, preservation methods, and maximum holding times to sample extraction and/or analysis, which will be in accordance with the required EPA method for each sample;

D. Sampling methods;

E. Decontamination procedures; and

F. Identifies actions to be taken when problems occur, individuals responsible for corrective action, and documentation of problem/corrective action taken.

2.2.1 Equipment

Prior to any sampling event, the necessary equipment must be gathered. The equipment, instrumentation, and supplies at the sampling site shall be specified in the project/site-specific SAP and must be appropriate to accomplish the activities planned. Sampling vessels will be cleaned prior to sample collection.

2.2.2 Sample Preservation, Containers, and Holding Times

Complete and unequivocal preservation of samples is a practical impossibility. Regardless of the nature of the sample, complete stability for every constituent can never be achieved. At best, preservation techniques can only retard the chemical and biological changes that inevitably continue after the sample is removed from the parent source. The changes that take place in a sample are either chemical or biological. In the former case, certain changes occur in the chemical structure of the constituents that are a function of physical conditions. Metal cations may precipitate as hydroxides or form complexes with other constituents, cations or anions may change valence states under certain reducing or oxidizing conditions, or other constituents may dissolve or

volatilize with the passage of time. Metal cations, such as iron and lead, may also adsorb onto surfaces (glass, plastic, quartz, etc.). Biological changes taking place in a sample may change the valence of an element or a radical to a different valence. Soluble constituents may be converted to organically bound materials in cell structures, or cell lysis may result in release of cellular material into solution. The well known nitrogen and phosphorus cycles are examples of biological influence on sample composition. Therefore, as a general rule, it is best to analyze the samples as soon as possible after collection. This is especially true when the analyte concentration is expected to be in the low μg/L range.

Methods of preservation are relatively limited and are intended generally to: (1) retard biological action, (2) retard hydrolysis of chemical/compounds and complexes, (3) reduce volatility of constituents, and (4) reduce absorption effects. Preservation methods are generally limited to pH control, chemical addition, refrigeration, and freezing.

Sample containers and preservatives will be provided by the A2LA laboratory chosen to complete the analyses. Holding times shall be as specified for the analyte and EPA method.

2.2.3 Soil Sampling Methods

2.2.3.1 Field Screening

Soil samples for field screening shall be collected every 5 feet, at zones of obvious contamination, or at other intervals specified in the project/site-specific SAP. Field screening samples shall also be taken at the water table. Samples taken for field screening shall not be submitted to the laboratory for analyses. Soil samples shall be collected in advance of the drill bit or auger. Samples shall not be taken from auger flights. A photoionization detector (PID) or flame ionization detector (FID) shall be used for field screening.

Procedure

1. Fill a sealable, new plastic bag with soil from the sampler, and seal the bag. Break up the sample and gently shake the bag once or twice.

2. Allow 10-15 minutes to elapse for headspace development. If ambient temperatures are below 32 degrees Fahrenheit, place the bag in a heated building or vehicle.

3. Calibrate the PID/FID according to the manufacturer's instructions. Calibration must be done daily and more often if conditions warrant.

4. Unseal a portion of the bag and quickly slip the PID/FID probe into the bag or insert the probe directly through the bag. Record the maximum meter response, which should occur in the first 5 seconds.

5. Reusable jars may be used in lieu of plastic bags. Cover the jar with aluminum foil and insert the probe through the foil after headspace development. Jars must be decontaminated and checked for residual vapors prior to each use.

When field screening is complete for a borehole or surface soil area, the sample that corresponds to the highest headspace reading is prepared for laboratory analysis. If field screening showed no elevated headspace reading, the sample collected at or near the water table is sent to the laboratory for analysis.

2.2.3.2 Surface Soil

Surface soil sample methods can be used for samples taken at the ground surface or the bottom or sidewalls of an excavation. A sampling trowel or scoop is typically used.

A garden-variety trowel looks like a small shovel. The blade is usually about 7 by 13 cm (3 by 5 in.) with a sharp tip. A laboratory scoop is similar to the trowel, but the blade is usually more curved and has a closed upper end to permit the containment of material. Scoops are available from a variety of sources and available in several sizes. Stainless steel or polypropylene scoops with 7 by 15 cm (2 3/4 by 6 in.) blades are preferred. A trowel can be bought from hardware stores; the scoop can be bought from laboratory supply houses.

Procedure

1. At random locations, take small, equal portions of sample from the surface or near the surface of the material to be sampled. Samples for analyses of volatile organic compounds (VOCs) shall be collected first to minimize volatilization.

2. Place the sample in a suitable container and fill as much as possible to reduce headspace.

3. Cap the container, attach the label and seal, and place in a cooler packed with ice to maintain a temperature of less than 4 degrees Celsius.

4. Complete the record in the field log book, the sample analysis request sheet, and chain-of-custody record in accordance with the sample custody procedures outlined in this document.

2.2.3.3 Subsurface Soil

Subsurface soil sampling is usually performed using a truck-mounted, rotary-type drilling rig equipped with a drive head for drilling and sampling. This system consists of an auger, a series of extensions, a "T" handle, and a thin-wall tube sampler.

Prior to mobilization, the drill rig and associated equipment are thoroughly cleaned. Drilling shall begin in the area of least contamination and proceed to the most contaminated areas of the site (if

known). Rig and equipment decontamination must be done between sites when drilling remediation wells and between wells when drilling monitoring wells.

Subsurface soil sampling methods vary depending on site conditions and may include thin-walled tubes (Shelby tubes), split-spoon samplers, rotary coring split-barrel samplers, California samplers, continuous auger coring, or direct push. The anticipated method and procedure to be used will be stated in the project/site-specific SAP.

Samples will be transferred from the sampling device directly to appropriate containers, sealed, labeled, and placed in a cooler packed with ice.

2.2.4 Groundwater

New or existing monitoring wells are used to collect groundwater samples. Prior to sampling, the depth to product and groundwater are measured. The total depth of the well is also measured. These depths are recorded on a sampling form or in the field book. Depths are measured to the nearest 100th of a foot using a water-level probe or oil/water interface probe if free product is expected. Measurements are taken from a permanent reference point on the top of the well casing (usually marked on the north side of the well).

2.2.4.1 Well-Purge Sampling

A minimum of three well casing volumes is purged from the well prior to sampling. If a well is purged dry, complete evacuation of the well is sufficient prior to sampling. Field parameters are collected using appropriate equipment and include pH, specific conductance, temperature, dissolved oxygen, and oxygen reduction potential. Sampling may not be completed within 48-hours of well development.

Equipment is decontaminated between wells. Sampling shall begin with the least contaminated well if such information is known.

Groundwater samples are collected using disposable polyethylene bailers. If the well was purged using low flow techniques, samples can be collected from the tubing used during purging. All samples are transferred to the laboratory-supplied collection vials or bottles with as little agitation and headspace as possible. Preservatives are included in the vials or bottles provided by the laboratory. Samples are properly labeled and placed on ice in a cooler.

2.2.4.2 Low-Flow Sampling

Low-flow sampling may be used in accordance with ASTM D6771-02 (or its most recent version), "Standard Practice for Low-Flow Purging and Sampling for Wells and Devices Used for Ground-Water Quality Investigations." The technique is designed to allow the collection of representative groundwater samples from the formation surrounding the screened section of the monitoring well. A bladder or submersible pump is placed within the screened section and all water pumped is monitored for a number of chemical and physical parameters using a flow cell and field

instrumentation. (Peristaltic and other suction-lift pumps shall not be used because they may cause loss of VOCs, degassing, and redox and pH changes. A peristaltic pump may be used if the only sample to be collected is for the analysis of DRO.) Water levels will also be checked to ensure that drawdown is kept to a minimum. Sampling commences when the measured parameters have stabilized and turbidity is at an acceptable and constant level.

2.2.4.3 No-Purge Sampling

No-purge sampling may be used in lieu of traditional and low-flow sampling methods. No-purge sampling is defined in API Research Bulletin No. 12 dated October 2000 as sampling groundwater from a well without any removal of water from the well prior to sampling. No-purge sampling involves collecting a sample, typically by carefully lowering a bailer or similar sampling device into the water table and allowing it to fill with minimal disturbance of the water column, without prior purging of the well. There are currently several different methods of no-purge sampling including, but not limited to: Snap, Hydrasleeve and Gore Sorber. Manufacturer's approved procedures must be followed when using no-purge samplers.

2.2.5 Decontamination Procedures

Preventing or minimizing cross contamination in sampled media and in samples is important for preventing the introduction of error into sampling results and for the protection of on-site personnel. Decontamination of sampling equipment may be performed at the location where sampling occurs, prior to going to the sampling site, or in designated areas near the sampling site. The cleaning steps described below contain general cleaning procedures. The decontamination method, the materials, solvents, and type of water to be used will be specified in the project/site-specific SAP. The SAP will also identify the disposal procedures for decontamination by-products.

Field Sampling Equipment Cleaning Procedures:

1. Wash all containers and samplers with a non-phosphate detergent solution (e.g., liquinox or alconox).

2. Rinse containers and samplers several times with tap water.

3. Rinse containers and samplers with distilled water.

4. Air dry or dry the containers and samplers with a stream of warm, dry air.

5. Following decontamination, samplers shall be wrapped in aluminum foil. The sampler shall remain in this wrapping until it is needed.

An acid rinse step is required if metals are present on-site. (Note: when sampling for metals, chromic acid shall not be used to clean glassware, especially if chromium is to be included in the analytical scheme. Chromic acid shall not be used with plastic bottles.)

Items that have been exposed to petroleum products shall be wiped with an absorbent cloth, rinsed with an organic solvent such as petroleum naphtha or trichloroethane, and washed as above.

2.3 Sample Handling and Custody

Maximum hold times from sample collection to extraction and/or analysis is defined by the EPA analytical method being used. EPA methods are defined in the project/site-specific SAP and STP Guidance Document #7.

Sample custody includes procedures taken to prove possession and traceability of a sample from the time the sample is taken until it is analyzed. Sample custody consists of two components: 1) written documentation of the actual sampling, and 2) physical custody of the official sample after it has been obtained.

To have an effective sample custody or chain-of-custody program, each monitoring/sampling activity must be governed by established procedures that can be used to prove possession and traceability of a sample.

A sample is considered to be in the custody of the responsible person (field custodian) if:

A. It is in his or her actual physical possession, or

B. It is in his or her view after being in his or her physical possession, or

C. While it is locked in a tamper-proof container or storage area, or

D. It is placed with a common carrier or the U.S. mail.

The following sample custody procedures are required to establish, maintain, and document sample possession.

2.3.1 Field Custody Procedures during Collection of Samples/Field Investigation

Quality assurance must be stressed in the collection of all samples. State funds are spent to remediate sites based largely on sample data. Therefore, all data collected using state funds must be validated.

As few people as possible shall handle samples. The field sampler is personally responsible for the care and custody of the samples collected until they are transferred or properly dispatched.

To document that the proper handling procedures have been implemented, as a minimum, the following will be incorporated in the collection and transfer of samples.

A. Whenever samples are split with another party or government agency, it is noted in the field log. The note indicates with whom the samples are being split and shall be signed by both the sampler and recipient. If the sample split is refused, this will be noted and signed by both parties. If a representative is unavailable during the field sampling activities, but a request is made for a split sample to be delivered to a specified location, the field log shall contain a statement that the samples were delivered to the designated location at the designated time.

B. After collection, a sample label will be placed on each sample container. Labels must be legible and filled out in ballpoint (waterproof ink) pen. The labels must include, at a minimum, the following information:

1. Location/description of location where sample was collected;

2. Date and time of collection;

3. Collector's sample number, which uniquely identifies the sample; and

4. Name of sample collector.

Each sample will be stored in an ice chest or other suitable container.

C. The field sampler is responsible for the proper care and custody of collected samples until personally transported to the laboratory or transferred to a common carrier for shipment to the laboratory.

2.3.2 Transfer of Custody and Shipment

A. When the possession of samples is transferred in the field from one person to another, this transfer must be documented on the chain-of-custody form. This documentation is in the form of the transferee signing, dating, and recording the time of transfer. Additionally, signatures are required from the individuals assuming custody of the sample. The entire procedure must be repeated each time a change in custody is made. If subsequent custody transfers require the use of more than one chain-of-custody form, the forms shall be numbered consecutively. If samples are to be sent by common carrier, the common carrier's receipt number and/or receipt shall be retained as part of the permanent chain-of-custody documentation. Samples that are to be shipped shall be sealed or locked so that any evidence of tampering may be readily detected.

B. When a sample is shipped to the laboratory, it must be packaged in a proper shipping container to avoid leakage or breakage. It is recommended that samples requiring refrigeration be packed with reusable plastic packs. A cooler with ice may be used as long as the container is capable of maintaining the prescribed temperature range and it is constructed to avoid leakage and breakage. The sampler completes a chain-of-custody form for all samples in the cooler, places the form in a water-tight plastic bag, and places it inside the cooler with the samples.

C. If the samples are mailed, they must be sent by registered mail. The package may also be placed with a common carrier, such as a bus company, airline, or freight company. In any case, all receipts must be retained and attached to the sample tag or other permanent record after the samples arrive at their destination.

D. When transfer of custody takes place, it is the responsibility of the sampler to ensure the integrity of the samples. This includes making sure all samples are accounted for, properly marked, sealed, and documented.

E. The field sampler is responsible for personally transporting or arranging for the shipment of samples to the laboratory. Transfer of custody of samples between field personnel and laboratory personnel authorized to receive the sample (often referred to as the laboratory sample custodian) will be accomplished by the use of the chain-of-custody form.

F. The field portion of the chain-of-custody form must be completed by the person collecting the sample and shall include most of the pertinent information noted in the logbook. (The information on the form intended to be completed by laboratory personnel includes the date and time of sample receipt and the signature of the person receiving the sample.)

G. Upon delivery of the samples to the laboratory, the laboratory sample control supervisor or designee will verify the number of samples and their identification, and inspect the seal on the cooler to ensure that it has not been tampered with. If it has not been disturbed, the cooler is opened and the chain-of-custody form is removed and signed. Field custody problems identified by laboratory personnel will be immediately relayed by the laboratory director to the program quality assurance representative for corrective action and/or resampling.

2.3.3 Laboratory Handling

Laboratory handling procedures are outlined in the "R211 – Specific Requirements: Wyoming Storage Tank Remediation Testing Laboratory Accreditation Program" document developed by A2LA.

2.4 Analytical Methods

All laboratories performing work for the STP must be accredited by A2LA for the Wyoming Storage Tank Program. Acceptance criteria, quality control procedures, specific method performance criteria, method validation, sample disposal procedures, and corrective action are defined by A2LA during the accreditation process. Requirements are outlined in the "R211 – Specific Requirements: Wyoming Storage Tank Remediation Testing Laboratory Accreditation Program" document developed by A2LA.

Analytical methods requirements shall be as defined in the most recent version of STP Guidance Document #7, "Sampling and Laboratory Analytical Requirements and Remediation Standards" and the project-specific scope of work attached to the consultant's contract or amendment. Laboratory turn-around times shall be as specified for the method being used.

The project/site-specific SAP shall include:

A. Analyses required to evaluate remediation system wastewater disposal options (e.g., WYPDES permit, industrial pretreatment permit, etc.) or other project-specific analyses needed.

B. Acceptance criteria, quality control procedures, and corrective actions for these project/site-specific analyses.

C. Identification of all Standard Operating Procedures (SOPs) to be used on the project with the date and options or modifications to be taken.

D. Field equipment or instrumentation needed.

E. Identification of procedures to follow when failures occur and the individual responsible for corrective action and documentation.

F. Sample disposal procedures.

2.5 Quality Control

The A2LA accreditation program discusses quality control procedures associated with each analysis and measurement method used. All laboratories accredited by A2LA for the Wyoming Storage Tank Program must adhere to standards set by A2LA and identified in the "R211 – Specific Requirements: Wyoming Storage Tank Remediation Testing Laboratory Accreditation Program" document developed by A2LA.

Duplicate (blind) samples, field blanks, trip blanks, and equipment blanks shall be collected at the frequency shown in the most recent version of STP Guidance Document #7. Additional quality control requirements are identified in the project/site-specific SAPs prepared by the consultant, including but not limited to:

A. Identifying what will be done when control limits are exceeded and how effectiveness of control actions will be determined and documented, and

B. Identifying procedures and formulas for calculating applicable quality control statistics (precision, bias, outliers, and missing data).

2.5.1 Field Quality Control Checks

The integrity of the samples is ensured by preparing one or more of the following control samples. Control samples are quality control (QC) samples that are introduced into a process to monitor the performance of the system. The QA/QC samples and frequencies described below are consistent with the RCRA Ground Water Monitoring Technical Enforcement Guidance Document (TEGD) and SW-846.

A. Trip Blank - Fill one of each type of sample bottle with an organic or aqueous solution free of any analytes of interest, transport to the site, handle like a sample and return to the laboratory for the same analyses as the environmental samples. This sample set remains sealed until analysis. One trip blank shall be collected per sampling event or with each analytical batch, with a minimum of one per 20 samples.

B. Equipment Blank (Rinsate Blank) - To ensure decontamination is properly completed, an aqueous or organic solution free of any analytes of interest is poured through the sampling equipment, transferred to sample bottles, and sent to the laboratory for analysis. One equipment blank is collected for each 10 percent or fraction thereof of daily non-disposable bailer use and/or one equipment blank for each type of disposable bailer used (one time only).

C. Blind Duplicate - To ensure laboratory accuracy, two separate samples are collected in the field from the same source at the same time. The sets are labeled with different nomenclature. One blind duplicate shall be collected for every day or with each analytical batch, with a minimum of 1 per 20 samples.

D. Field Duplicate - To document the precision of the sampling process, independent samples are collected as close as possible to the same point in space and time. These are two separate samples taken from the same source, stored in separate containers, and analyzed independently. These duplicates are useful in documenting the precision of the sampling process. One sample shall be collected for each day of groundwater sampling.

E. Field Blank - To ensure reagent integrity and check environmental contamination, an aqueous or organic solution free of any analytes of interest is transported to the field, transferred to the sample containers, and preserved. One field blank shall be collected per analytical batch with a minimum of 1 per 20 samples.

Field blanks, trip blanks, and equipment blanks are not required for non-VOC analyses.

2.5.2 Laboratory Quality Control Checks

A2LA certified laboratories are used for all STP projects. All laboratory quality control checks as specified in the Wyoming STP Accreditation Program (R211 – Specific Requirements: Wyoming Storage Tank Remediation Testing Laboratory Accreditation Program) will be followed.

2.6 Instrument/Equipment Testing, Inspection, and Maintenance

Instruments and equipment will be tested, inspected and maintained in accordance with manufacturer's recommendations. Instruments and equipment to be used during field sampling will be examined prior to taking the instrument/equipment to the field and each day prior to use to certify that they are in operating condition. This includes checking the manufacturer's operating manual and the instructions for each instrument to ensure that all maintenance requirements are being observed. Field notes from previous sampling trips will be reviewed so that the notations on

any prior equipment problems are not overlooked and all necessary repairs to equipment have been carried out.

A spare electrode will be sent with each pH meter to be used for field measurements. Two thermometers will be sent to sampling locations where measurement of temperature is required, including those locations where a specific conductance probe/thermometer is required.

The project/site-specific SAP shall identify individuals responsible for instrument/equipment testing, inspection, and maintenance. The SAP shall indicate how deficiencies found will be resolved, re-inspections performed, and effectiveness of corrective action. The SAP shall identify how deficiency resolution will be documented.

Spare parts for all equipment the consultant proposes to use on any project/site shall be maintained at a location determined by the consultant. Spare parts needed to insure project time schedules are met shall be available on site.

Laboratory instruments and equipment will be test, inspected, and maintained by the laboratory in accordance with the "R211 – Specific Requirements: Wyoming Storage Tank Remediation Testing Laboratory Accreditation Program" document prepared by A2LA. The A2LA procedures will be followed to resolved and document deficiencies in the laboratory.

2.6.1 Preventative Maintenance

Preventative maintenance is an orderly program for preventing failure of equipment during use. The main objective of the preventative maintenance program is to increase system reliability, thus decreasing down time and increasing data completeness.

Preventative maintenance of the equipment is the responsibility of the individual using the equipment. The preventative maintenance program shall consist of, at a minimum, the following:

A. Clean all sampling equipment thoroughly as soon as possible after using. Check all samplers for worn or broken parts before storing and again before taking into the field. Replace any broken or worn parts as needed.

B. Clean and check all safety equipment after using.

C. Check all equipment again before conducting field sampling activities for damage, wear, weak batteries, etc.

2.7 Instrument/Equipment Calibration and Frequency

Instruments and equipment shall be calibrated prior to each use or on a scheduled, periodic basis. Project/site-specific SAPs will discuss how calibration shall be conducted using certified equipment and/or standards with known valid relationships to nationally recognized performance standards for all equipment proposed to be used on the project/site. (If no such nationally

recognized standards exist, the SAP will document the basis for the calibration.) These discussions will provide calibration specifics that clearly depict the expectations (e.g., control limits, standards, and frequency) of the field operations. The calibrations performed and the standards used will be recorded in the field notebook. The project/site-specific SAP will identify how deficiencies will be resolved and documented.

2.7.1 Field Instruments/Equipment

Instruments and equipment used to gather, generate, or measure environmental data will be calibrated at the intervals specified by the manufacturer or more frequently if conditions dictate.

2.7.2 Laboratory Equipment

Requirements specified by A2LA for the Wyoming Storage Tank Program Accreditation (R211 – Specific Requirements: Wyoming Storage Tank Remediation Testing Laboratory Accreditation Program) process will be followed for laboratory equipment calibration and deficiency resolution.

2.8 Inspection/Acceptance of Supplies and Consumables

The project/site-specific SAP will describe how and by whom supplies and consumables are inspected and accepted for use on the project by the consultant. The acceptance criteria will also be described. Laboratory inspection and acceptance of supplies and consumables shall be in accordance with the "R211 – Specific Requirements: Wyoming Storage Tank Remediation Testing Laboratory Accreditation Program" document developed by A2LA.

2.9 Non-Direct Measurements

Data required for project implementation or decision making obtained from non-measurement sources are defined in the project/site-specific scope of work attached to the consultant's contract or amendment. These are project specific and may include previous reports or data obtained for the site. Existing project/site data, if available, are used by the consultant for informational purposes and to determine where data are missing. This information may be used to design the sampling network. All existing data are acceptable for use for the specific project; however, the consultant will determine the usefulness of the data.

2.10 Data Management

All data are managed by the consultant in accordance with the project/site-specific SAP. Data, reports, and other deliverables required to be uploaded to the STP GIS are identified in the project scope of work attached to the consultant's contract or amendment. Analytical and field measurement uploads are done through the STP electronic data deliverable (EDD) uploader (attached). Reports, as-builts, plans/specifications, and other document uploads are done through the GIS's project documents loader. Each consultant has designated an individual or individuals to complete the uploads. These individuals are data management, GIS specialists, or project managers/engineers who complete the work for the STP.

Data within the STP GIS are on the state's servers and backed up nightly. Data are retained permanently. Data is retrieved by STP Project Managers through access to the GIS. Hardware and software compatibility is ensured by WDEQ's internet technology staff and the state's electronic technology services group.

Laboratory data are managed in accordance with the "R211 – Specific Requirements: Wyoming Storage Tank Remediation Testing Laboratory Accreditation Program" document developed by A2LA. Laboratory data are submitted to the STP's consultants for uploading to the STP GIS. The laboratory will assign qualified individuals to manage data.

3.0 ASSESSMENT AND OVERSIGHT

3.1 Assessment and Response Actions

Performance and system audits of both field and laboratory activities will be conducted to verify that sampling and analyses are performed in accordance with the procedures established in the project/site-specific SAP, STP guidance documents, and the project scope of work.

3.1.1 Internal Assessment

Personnel performing field and laboratory activities are responsible for continually monitoring individual compliance with the QAPP. The project/site-specific SAP will:

A. Identify the consultant's internal assessment procedures (number, frequency, and assessment activities, with dates for completion);

B. Identify individuals responsible for conducting assessments and their authority to stop work;

C. Describe how and to whom the assessment information will be reported; and

D. Identify how corrective action will be addressed, verified, and documented.

3.1.2 Onsite Evaluation

Field Activities

Internal audits of field activities (sampling conducted by STP personnel) will be completed by the project manager. The audits will include examination of field sampling records, field instrument operating and calibration records, sample collection, handling and packaging in compliance with the established procedures, maintenance of QA procedures, chain of custody, etc.

Field documents pertaining to sample identification and control will be examined for completeness and accuracy. Field notebooks will be reviewed to ensure that all entries are dated and signed and

the contents are legible and contain accurate and inclusive documentation of project activities. Besides completeness, the review shall involve interpretation and evaluation of the field records to detect problems affecting the representativeness of environmental samples and identify any anomalous field test data. The reviewer shall document the sample validity and identify the environmental data associated with any poor or incorrect field work, as well as evaluate and document the impact of anomalous field measurement results on the associated environmental data.

External audits/review of the environmental data collection activities conducted by STP consultants shall be completed by the STP project manager in accordance with the project/site-specific SAP. The project/site-specific SAP will identify the consultant's internal audit procedures.

Laboratory Activities

Laboratory evaluations shall be conducted in accordance with A2LA's requirements for the Wyoming Storage Tank Program accreditation process ("R211 – Specific Requirements: Wyoming Storage Tank Remediation Testing Laboratory Accreditation Program"). Corrective action will be taken whenever data are determined unacceptable by comparison to pre-established quality control limits. Corrective actions will be the responsibility of the project manager or, in the case of laboratory error, A2LA.

3.1.3 Corrective Action

Corrective action will, in general, consist of the following:

A. Review of raw data and calculations.

B. Review of procedures to determine that appropriate sample collection and analytical methods were followed.

C. Review of instrumentation operation, calibration, and maintenance.

D. Other action as deemed necessary by A2LA.

As a result of the above, corrective action may be identified and will be pursued as necessary. This action may include:

A. Preparation of new standards and reagents.

B. Reanalysis of the sample or samples.

C. Recalibration and restandardization of equipment.

D. Resampling if possible.

E. Additional staff training.

F. Performing additional decontamination of equipment.

G. Other action as deemed necessary by A2LA.

Each corrective action will be documented with a description of the deficiency and corrective action taken, as well as the person(s) responsible for implementing the corrective action.

3.2 Reports to Management

Immediately following any internal or external on-site evaluation or upon receipt of the results of any performance evaluation, a report shall be submitted to the QAR that includes the results of the assessments and the plan for correcting identified deficiencies. A2LA submits reports after on-site laboratory evaluations. The STP consultant will submit reports to the STP Project Manager for submittal to the QAR.

4.0 DATA VALIDATION AND USABILITY

4.1 Data Review, Verification, and Validation

Validation will be accomplished by the consultant completing the work by comparing the contents of the data packages and QA/QC results to the requirements contained in the project/site-specific SAP. This includes a comparison of the quality control check results as well as an assessment of the laboratory analysis processes such as holding times and instrument calibration. Laboratory results will be assessed for compliance with required precision, accuracy, completeness, and sensitivity.

4.2 Verification and Validation Methods

4.2.1 Data Collection

The procedures describing how results shall be computed from field measurements and how to review and validate these data will be specified in the project/site-specific SAP. The procedures shall include all formulas used to calculate results and procedures used to independently verify that field measurement results are correct. If data quality criteria are not met, the data are not acceptable.

Data validation and integrity during data collection are the responsibility of the STP project manager for work completed by the STP and the consultant's project manager for work completed under contract. The project/site-specific SAP will identify issue resolution process and methods and individuals responsible for conveying the results to the STP Project Manager and/or design engineer.

4.2.2 Laboratory Operations

The procedures describing how to review and validate the laboratory operations data shall be as required by A2LA's Wyoming Storage Tank Program accreditation process ("R211 – Specific Requirements: Wyoming Storage Tank Remediation Testing Laboratory Accreditation Program").

4.3 Reconciliation with User Requirements

Throughout the life of the project, consultant deliverables are required at various milestones as described in the scope of work attached to the consultant's contract or amendment. These deliverables include reports that analyze the data and recommendations for future work. The project/site-specific SAP will describe the procedures used to evaluate validated data uncertainty. Results are reconciled with the project requirement at various stages in the process of completing the work. Reconciliation, issues identified and resolution, and limitation on the use of data (as applicable) are described in the various work products as they are produced.

END OF DOCUMENT

Attachments:

"R211 – Specific Requirements: Wyoming Storage Tank Remediation Testing Laboratory Accreditation Program"

STP Guidance Document #7, "Sampling and Laboratory Analytical Requirements and Remediation Standards"

STP EDD Uploader Form

STP Template Scope of Work for Consulting Services Procurement

R211 –

SPECIFIC REQUIREMENTS:

WYOMING STORAGE TANK

REMEDIATION TESTING

LABORATORY ACCREDITATION

PROGRAM

August 2014

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1. Introduction

This document describes the accreditation requirements applicable to the State of Wyoming, Department of Environmental Quality, Solid & Hazardous Waste Division (WDEQ/SHWD) Storage Tank Remediation (STR) Program Guidance Document #8. Laboratories that are not accredited through this program may not perform work for the WDEQ/SHWD STP.

This document details the requirements for accreditation and the parameters and methods on which accreditation will be granted. This requirements document will assure that laboratories performing analytical testing relating to the STR have the technical proficiency, competency, staffing, and management to properly perform analytical testing.

The International Organization for Standardization/International Electro-technical Commission (ISO/IEC) ISO/IEC 17025: 2005, the American Association for Laboratory Accreditation (A2LA) Environmental Program Requirements and State requirements form the basis for accrediting laboratories for the STR.

Scope A2LA will accredit environmental laboratories on an analyte-specific basis. Laboratories must be able to demonstrate that they are accredited by A2LA for compliance with the following parameters and one or more of the following test methods for each parameter:

Parameter	EPA Method Identification
Metals	
Cadmium	6010C, 7131A
Chromium (total, hexavalent, and trivalent)	6010C, 7196A
Lead	6010C, 7421
Purgeable Organics (volatiles)	
Benzene	5030B/8021B, 5030B/8260B or 8260C
Diisopropyl Ether	5030B/8021B, 5030B/8260B or 8260C
Ethyl benzene	5030B/8021B, 5030B/8260B or 8260C
Ethyl *tert*-Butyl Ether	5030B/8021B, 5030B/8260B or 8260C
Gasoline Range Organics C_6-C_{10}	5030B/8260B or 8260C, 8015C
Methyl *tert*-Butyl Ether	5030B/8021B, 5030B/8260B or 8260C
Naphthalene	5030B/8021B, 5030B/8260B or 8260C
tert-Amyl Methyl Ether	5030B/8021B, 5030B/8260B or 8260C
tert-Butyl Alcohol	5030B/8021B, 5030B/8260B or 8260C
Toluene	5030B/8021B, 5030B/8260B or 8260C
TPH(GRO)	8015C, 5030B/8260B or 8260C (C_6 to C_{10})
Xylenes, total	5030B/8021B, 5030B/8260B or 8260C
1,2-Xylene	5030B/8021B, 5030B/8260B or 8260C
1,3-Xylene	5030B/8021B, 5030B/8260B or 8260C
1,4-Xylene	5030B/8021B, 5030B/8260B or 8260C

1,2-Dichloroethane	5030B/8260B or 8260C
1,2-Dibromoethane	8011
Extractable Organics	
Diesel Range Organics C_{10}-C_{32}	8015C with 3630, 5030B/8270D with 3630
TPH(DRO)	8015C with 3630, 5030B/8270D (C_{10} to C_{32}) with 3630

The following requirements apply to the table above:

(a) When analyzing for dissolved cadmium, Method 6010B may be used, provided the detection limit is as low as the action level for groundwater samples and at least as low as the detection limit for the 7000 series for soils.
(b) When analyzing for benzene, ethylbenzene, naphthalene, toluene, and xylenes, Method 8021B may only be used during routine monitoring events.
(c) Constituent analysis of benzene, ethylbenzene, naphthalene, toluene, and xylenes by Method 8260B or 8260C are required for all subsurface investigation work, additional site assessments, and confirmation sampling for project closure.
(d) When analyzing groundwater for dissolved cadmium, dissolved chromium, and dissolved lead, samples that **cannot** be delivered to the laboratory within 48 hours must be filtered onsite with a 45 micron filter. **After** the samples have been filtered, add nitric acid onsite to lower the sample pH to <2. If the samples **can** be delivered to the laboratory within 48 hours, do **not** filter the samples or acidify the samples during onsite collection.

Assessors evaluate a laboratory for compliance with the United States Environmental Protection Agency (EPA) accepted methods. In addition, a laboratory must meet the minimum requirements specified in this document.

If the laboratory is a corporation, the corporation shall be registered with the Secretary of State, State of Wyoming, and shall be authorized to do business with the State of Wyoming.

2. Certification Requirements

To be certified by the STP to perform analytical testing relating to the Program, laboratories must show current accreditation by A2LA for the "Wyoming STR Program." Laboratories seeking accreditation for the STR program should contact A2LA.

Certification shall be valid for two (2) years from the date of accreditation by A2LA. Certification may be renewed with updated proof of accreditation from A2LA.

Certification may be revoked or suspended by the Program for any of the following:

(a) The applicant negligently, incompetently, recklessly, or intentionally violates any provision of these requirements or any state, federal, or local statute, regulation, or code or standard concerning the performance of analytical testing.

(b) The applicant obtains the certification through fraud or misrepresentations.

(c) The applicant knowingly or intentionally submits false information to contractors or the Program.

(d) The applicant loses its A2LA accreditation for one or more of the parameters and test methods specified in this requirement document (see Scope, above).

(e) The applicant receives an unsatisfactory contract performance review from the WDEQ Project Manager.

The WDEQ Director shall have the authority to suspend or revoke a certification. The WDEQ Director shall then cause a letter to be issued notifying the certified laboratory of the action.

3. General and Specific Criteria

The general criteria for accreditation are contained in ISO/IEC 17025:2005. All provisions of the general criteria shall apply.

Specific criteria are an elaboration on or interpretation of the general criteria plus those requirements of accreditation applicable to a certain field of testing, matrix type, testing technology, type of test, or specific test. The specific criteria applicable to the Environmental Field of Testing and Wyoming STR requirements are presented in the following sections. The numbering system for each section below corresponds to the requirement sections of ISO/IEC 17025:2005.

4. Management Requirements

4.1 Organization

(No Additions)

4.2 Quality System

(No Additions)

4.3 Document Control

(No Additions)

4.4 Review of Requests, Tenders and Contracts

(No Additions)

4.5 Subcontracting of Tests and Calibrations

(No Additions)

4.6 Purchasing Services and Supplies

(No Additions)

4.7 Service to the Client

(No Additions)

4.8 Complaints

(No Additions)

4.9 Control of Nonconforming Testing

(No Additions)

4.10 Improvement

(No Additions)

4.11 Corrective Action

4E.11.1 The laboratory shall document, investigate, and take corrective action for all episodes where QC data show an out-of-control situation. The laboratory shall keep records of all out-of-control events, the determined cause(s), and corrective actions taken. All reported data from an out-of-control event shall be appropriately qualified.

4.12 Preventive Action

(No Additions)

4.13 Control of Records

The laboratory shall establish and maintain a records system ensuring that:

4E.13.1 All observations and calculations are recorded in a permanent manner (such as laboratory notebooks, pro-forma work sheets, or magnetic media) at the time they are made and that the units of measurement in which observations are recorded are stated.

4E.13.2 Original records are uniquely identified and traceable to the test items to which they refer and to any test reports based upon them.

4E.13.3 Records are traceable, retrievable, and legible and include sufficient information and explanation such that they can be readily interpreted by staff other than those responsible for their generation.

4E.13.4 Records contain sufficient information to permit identification of possible sources of error and to permit, where feasible and necessary, satisfactory repetition of the test under the original conditions.

4E.13.5 Records contain sufficient details of any significant departures from test specifications or other specified procedures including authorizations for such departures.

4E.13.6 Records are checked for data transcription or calculation errors and the checks are documented.

4E.13.7 Records identify the person or persons responsible for their creation and the date of such creation and for the person(s) checking data transcriptions and calculations and the date of such checking.

4E.13.8 Corrections or amendments to test records are made in a manner that does not obliterate the original data and are signed or initialed and dated by the person responsible.

4E.13.9 A list of all staff documenting their initials and/or signatures as used in documents such as logbooks shall be maintained.

4E.13.10 Test records shall be protected from loss, damage, misuse, or deterioration and shall be retained for an appropriate period in a manner that permits retrieval when required. Test records that are created and/or retained on magnetic media (e.g., computer disks) or photographic media (e.g., microfiche) shall be stored in a manner that protects them from the hazards that degrade such media. Provision shall be made for the printing of such records when required.

Note: Appropriate records retention periods are based upon the laboratory's various types of work and its legal and contractual obligations.

4.14 Internal Audits

(No Additions)

4.15 Management Reviews

(No Additions)

5. Technical Requirements

5.1 General

(No Additions)

5.2 Personnel

5E.2.1 Technical Manager. The technical manager (however named) shall possess a 4-year college degree from an accredited educational institution in chemistry or a related science or equivalent and have at least 3 years of non-academic laboratory experience. The technical manager shall be on-site at least 50% of the time.

5E.2.2 Quality Manager. The quality manager (however named) shall possess a 4-year college degree from an accredited educational institution in a basic or applied science or equivalent and have at least 1 year of non-academic laboratory experience and training in statistics. Alternatively, the quality manager can have a college degree in other than the basic or applied sciences, with at least 4 years of non-academic analytical chemistry experience and training in statistics. The technical manager may also function as the quality manager so long as he/she does not act in the position as the sample analyst/technician analyzing the samples or act as the immediate supervisor of the analyst/technician involved with the analysis of the samples. The quality manager may be employed by the laboratory on a part-time basis or as a consultant.

5E.2.3 Senior Technical Staff. Persons in each senior technical position shall have a bachelor's degree in a relevant scientific field or equivalent experience. At least one year of non-academic experience in relevant analysis is required. Successful training in specific methods used in the laboratory shall be verified and documented as performance evaluations using reference/control materials of the matrices of concern. Proficiency testing results must be documented.

Persons filling the following job functions must meet the associated minimum experience and training requirements:

5E.2.3.1 Inductively coupled plasma-emission (ICP) spectroscopy: One year experience with satisfactory completion of a short course on ICP or an equivalent in-house training course.

5E.2.3.2 Flameless atomic absorption spectroscopy: One year with satisfactory completion of a short

course on graphite furnace atomic absorption (GFAA) or an equivalent in-house training course.

5E.2.3.3 Flame atomic absorption (FLAA) spectroscopy: One year with satisfactory completion of a short course on FLAA or an equivalent in-house training course.

5E.2.3.4 X-ray fluorescence (XRF) spectroscopy: One year with satisfactory completion of a short course on XRF or an equivalent in-house training course.

5E.2.3.5 Gas chromatography: One year with satisfactory completion of a short course on basic GC or an equivalent in-house training course.

5E.2.3.6 Mass spectrometry: One year with satisfactory completion of a vendor's training course, professional sponsored short course, or equivalent in-house training course.

5E.2.3.7 Mass spectra interpretation: One year with satisfactory completion of a vendor's training course, professional sponsored short course, or equivalent in-house training course.

5E.2.3.8 General chemistry and instrumentation: Six months.

5E.2.3.9 Field testing: Six months.

5E.2.3.10 Sample collection: Six months.

5E.2.4 Analyst/Technician. Analysts/technicians shall have completed a training course (or an equivalent in-house course) in relevant analyses and have demonstrated ability to produce reliable results through accurate analysis of reference materials (RMs), proficiency testing samples, or in-house quality control samples. Their performance must be documented. Junior staff (non-degreed personnel with less than 3 years relevant experience) must work under the direct supervision of the technical manager, or under the supervision of a senior technical person described above, or under the instruction of an analyst/technician who has performed successfully over a period of three years in the relevant analyses using the same technologies being applied for the analysis of environmental samples.

5E.2.5 Minimum Level of Experience Required for Independent Operation.

5E.2.5.1 Sample preparation: 3 months per method used.

5E.2.5.2 Routine sample analysis: 6 months per method used.

5E.2.6 Requirements during Training. Analyst/technicians in training may perform work on samples submitted for environmental analysis as long as the following conditions are met:

5E.2.6.1 They have demonstrated the ability to produce reliable results through accurate analysis of

RMs, proficiency testing samples or in-house quality control samples; and

5E.2.6.2 Their immediate supervisor or instructor is readily available in their work area when they are preparing and/or analyzing the samples.

5E.2.7 The laboratory shall have documented evidence contained in their training records of proficiency of all personnel for each test method or activity performed on the matrices of concern.

5.3 Accommodation and Environmental Conditions

5E.3.1 Quality Issues. In order to prevent contamination of samples or standards, the laboratory shall:

5E.3.1.1 Use distilled/demineralized water that is demonstrated to be free of interferants at applicable detection limits.

5E.3.1.2 Check and record the conductivity of distilled/demineralized water at least once a week using a calibrated conductivity meter that is external to the water system. The point of water collection shall be from a frequently used access point.

5E.3.1.3 Exhaust hoods shall be vented in such a manner to prevent cross contamination of samples and equipment. (Example: The hood outlet of the organic extraction laboratory should not be near the air intake for the volatile organic laboratory. Evidence can be obtained by examination of laboratory blanks for contamination.)

5E.3.1.4 Provide sample storage facilities that prevent cross contamination of samples with standards, solvents, or reagents. See section 11E4 of this criteria. (Evidence of compliance may be obtained through the examination of storage areas or through the use of laboratory storage blanks, travel/trip blanks, or other blanks stored with samples.)

5E.3.2 Laboratory Safety: Each laboratory shall have a safety and chemical hygiene plan (see OSHA rule 29 CFR 1910) as part of its standard operating procedure. Where safety practices are included as part of an approved method, the practices shall be strictly followed. While more specific safety criteria are not an aspect of this accreditation program, laboratory personnel should apply general and customary safety practices as a part of good laboratory procedures. The laboratory shall:

5E.3.2.1 Have toxic chemical handling areas consisting of impervious, non-reactive material covered with absorbent material.

5E.3.2.2 Provide exhaust hoods for personnel protection (see 29 CFR 1910.1450, Occupational Exposure to Toxic Substances in Laboratories and ANSI/AIHA Z9.5-1992, Standard for Laboratory Ventilation).

5E.3.2.3 Have procedures and facilities for handling material that may transmit infectious agents (see NIH 88-8395 or equivalent).

5E.3.2.4 Store reagents, corrosives, explosives, oxidants, and flammable solvents appropriately (see OSHA rule 29 CFR 1910.1450).

5E.3.3 Waste Disposal: Each laboratory shall have waste collection, storage, and disposal procedures and policies (reference: 40 CFR 261, 262, and 264) as part of its standard operating procedures. Where disposal practices are included as part of an approved method, these practices shall be strictly followed. While more specific disposal criteria are not an aspect of this accreditation program, the laboratory should apply appropriate federal, state, and local disposal practices as a part of good laboratory procedures.

5.4 Test Methods and Method Validation

The laboratory shall:

5E.4.1 Have documented procedures for making and controlling revisions to in-house SOPs (use revised SOPs only after written authorization by senior technical personnel).

5E.4.2 Have documented procedures for data collecting and reducing, reporting, and record keeping.

5E.4.3 Have documented method performance procedures to apply at appropriate levels of all measurement systems.

5E.4.4 Have documented procedures to verify test reports.

5E.4.5 Have documented procedures for correcting erroneously reported results.

5E.4.6 Prepare analytical standards at a frequency consistent with method requirements and good QC (frequency is a function of concentration and type of matrix; generally, the lower the concentration the less stable the standard).

5E.4.7 Specify the methods and do routine analyses for checking all solvents and reagents used for dilutions and extractions.

5E.4.8 SOPs for test methods shall supply or refer to information addressing the following areas:

Interferences	Instrument Calibration
Safety Considerations	Quality Control Procedures
Apparatus and Equipment	Detailed Step-by-Step Procedure

Reagents and Supplies
Sample Preservation and Storage
Sample Preparation
Sample Calculations
Method Performance Criteria (accuracy and precision)

5E.4.9 Acceptable Methodology. Procedures published by federal agencies (e.g., USEPA, NIOSH), nationally or internationally recognized technical authorities, or other validated procedures may be acceptable to use once the laboratory has demonstrated adequate performance with the method for each particular matrix. Alternative procedures and/or modifications of methods may be used if they have been EPA or State approved.

5E.4.10 Calibration range. Linear calibration ranges (or working calibration ranges) shall be established and routinely verified for each method.

5E.4.11 Method detection limits. Method detection limits (MDLs) shall be established and statistically verified at least annually where appropriate for each method and matrix of concern.

5E.4.11.1 For methods with stated MDLs, the laboratory shall demonstrate and document its ability to achieve such MDLs.

5E.4.11.2 MDLs shall be determined using procedures published or recognized by USEPA. An example of an acceptable recommended procedure is in 40 CFR Part 136, Appendix B.

5.5 Equipment

For analytical balances/pan balances:

5E.5.1 Analytical balances shall be capable of weighing to 0.1 mg.

5E.5.2 Records of balance calibration shall be kept covering at least the effective range of its use traceable to Class 2 or 3 (per ASTM E617) reference weights (formerly classified as Class S and S-1).

5E.5.3 Records showing functional/calibration checks for each day of use for analytical balances and monthly for pan balances shall be maintained. (Note: Criteria for the accuracy of balances must be established. ASTM E200-91 recommends an accuracy of 0.1% or less.)

5E.5.4 The balances shall be serviced and calibrated at least annually.
Please refer to P102 - A2LA Policy on Measurement Traceability.

5E.5.5 The reference weights shall be calibrated at least every five years.

For pH meters:

5E.5.6 The laboratory shall use a clean pH meter with appropriate electrode with scale graduations at least 0.1 pH units (calibrated to $\pm$ 0.1 pH units for each use period).

5E.5.7 Either a thermometer or a sensor for temperature measurement to make corrections for pH measurement or an automatic compensation device shall be in use.

5E.5.8 Either a magnetic, TFE-coated stirring bar or a mechanical bar with inert plastic-coated impeller shall be available.

5E.5.9 Records shall be kept showing daily, or before each use, calibration, whichever is less frequent. Calibration shall be performed with at least two buffers in the pH range expected in the samples.

5E.5.10 Aliquots of standard pH 4 & pH 7, or pH 7 & pH 10 shall be used only once.

For conductivity meter:

5E.5.11 A conductivity meter with an error not exceeding 1% or 1 μmhos/cm, whichever is greater, shall be in use.

5E.5.12 Records shall be kept to show a daily, or before each use, verification check, whichever is less frequent.

5E.5.13 Records shall be kept showing that the cell constant is determined annually.

For glassware:

5E.5.14 Glassware shall be cleaned in a manner appropriate for the analytical procedures for which it is used including protocols for: metals, ammonia, phosphorus, volatiles and semivolatiles. These cleaning procedures shall be documented.

For refrigerators:

5E.5.15 The bulb of the thermometer in each refrigerator shall be immersed in liquid.

5E.5.16 Thermometers shall be graduated in increments no larger than 1°C.

5E.5.17 Records shall be kept to show that refrigerator temperatures are maintained in the range of 2 - 5°C $\pm$ 1°C.

5E.5.18 Samples to be analyzed for volatile organic compounds (VOCs) shall be stored in separate refrigerators from all other samples.

For ovens:

5E.5.19 Thermometers shall be graduated in increments no larger than 1°C.

5E.5.20 If oven temperature cannot be read without opening the door, the bulb of the thermometer shall be immersed in a sand bath. (A second thermometer should be used to evaluate hysteresis of operation.)

5E.5.21 Oven temperatures shall be controlled and monitored (e.g., beginning and end of each use cycle) to meet applicable method requirements.

For microwave ovens:

5E.5.22 The calibration of the power available for heating shall be documented at least weekly in order to determine that the microwave has not started to degrade and that absolute power settings (watts) may be compared from one microwave to another. (EPA 600/8-91/213; NTIS PB92-114172)

For hot plates:

5E.5.23 Monitor temperature at the center of the hot plate where appropriate and document results. (Note: An uncovered beaker containing 50 ml of a liquid such as an oil located in the center of the hot plate can be used to estimate the temperature.)

For incubators/water baths:

5E.5.24 Method specific temperature requirements shall be controlled and monitored during the course of a test and appropriate records maintained to assure compliance.

For thermometers:

5E.5.25 The laboratory shall have access to a NIST-traceable thermometer.

5E.5.26 The calibration (correction factors) of working liquid-in-glass thermometers shall be checked at least annually against a NIST-traceable certified thermometer.

5E.5.27 The calibration (correction factors) of dial-type thermometers shall be checked at least quarterly against a NIST-traceable thermometer.

5E.5.28 The NIST-traceable thermometer(s) shall be calibrated at least every five years.

For autopipetors/dilutors:

5E.5.29 Apparatus having sufficient sensitivity for the application shall be in use.

5E.5.30 Records shall be kept showing delivery volumes are checked gravimetrically, as appropriate, each month of use.

5.6 Measurement Traceability

The laboratory shall:

5E.6.1 Use quality control materials and calibration standards that are traceable to appropriate national/international measurement standards, where available.

5E.6.2 Document the frequency, conditions, and standards used to establish calibration of all analytical/testing methodology.

5E.6.3 Verify and document all working standards versus primary (reference) standards where available.

5E.6.4 Document the traceability of the specific calibration, calibration check, control, or reference standards, samples, or mixtures of such standards or samples used to establish or verify the validity of the analytical measurement.

5E.6.5 Label reference materials/reagents with concentrations, date of preparation, expiration date, and the identity of the person preparing the reagent.

5E.6.6 Refrain from using any material beyond the specified expiration date unless documented procedures have been followed for assigning a revised expiration date.

5E.6.7 Have standards preparation documentation such as a preparations record book.

5E.6.8 Instrument performance checks shall be carried out before use for analysis of samples. Such checks shall include, as appropriate, evaluation of instrument sensitivity, noise levels and absorbance/emission levels versus historical values. Acceptance criteria shall be stated.

5E.6.9 Standard curves shall be prepared to adequately cover the expected concentration ranges of the samples using a minimum of three data points for each analyte and one blank, unless otherwise specified by the method employed. Acceptance criteria shall be stated. If acceptance criteria are not met, the problem must be resolved before generating reportable data.

5E.6.10 Field testing devices shall be calibrated as required by the testing procedure. Acceptance criteria shall be stated. In the absence of a requirement in the testing procedure, calibration

shall be in accordance with the manufacturer's specification. Calibration records shall be maintained.

5.7 Sampling

(No Additions)

5.8 Handling of Test Items

The laboratory shall:

5E.8.1 Have adequate written procedures for receipt, storage, and processing of samples (including, as applicable, trip and field blanks) to ensure that holding times are met;

5E.8.2 Give samples an unambiguous sample identification when logged.

5E.8.3 Maintain a permanent record for sample log-in data.

5E.8.4 Store samples in such a way as to maintain their identity, integrity, stability, and concentration.

5E.8.5 Maintain sample preservation records.

5E.8.6 Follow appropriate documented chain-of-custody procedures, when required.

5E.8.7 Document failure of sample collector to use appropriate containers, preservatives, packaging, and incorrect documentation and labeling upon receipt of samples.

5E.8.8 Samples disposal must meet waste disposal criteria as applicable.

5.9 Assuring the Quality of Results

5E.9.1 Quality Control (QC) Procedures. The laboratory shall comply with the quality control (QC) procedures required by applicable federal or state environmental or public health agencies when testing for specific analytes. The laboratory shall have QC procedures (SOPs) specific to each test technology addressing, as appropriate, the use of:

5E.9.1.1 Reagent/method blank analyses;

5E.9.1.2 Trip blanks and field blanks;

5E.9.1.3 Replicate/duplicate analyses;

5E.9.1.4 Spiked sample analysis;

5E.9.1.5 Blind samples;

5E.9.1.6 Surrogate standards;

5E.9.1.7 Laboratory control samples (LCSs);

5E.9.1.8 Control charts or the equivalent (e.g., quality control database);

5E.9.1.9 Calibration standards, blanks, and calibration devices (e.g., electronic conductivity meter, NIST-traceable thermometer);

5E.9.1.10 Reference material samples; and

5E.9.1.11 Internal standards.

5E.9.2 Quality Control Practices.

5E.9.2.1 The laboratory shall continually evaluate its performance (system process control) for each method and matrix that includes the determination of accuracy and precision.

5E.9.2.2 Supervisory personnel shall conduct a documented review of the data calculations and QC results.

5E.9.2.3 Deviations or deficiencies in QC shall be reported to management and such reports shall be documented. QC data shall be retrievable for all analytical results.

5E.9.2.4 Method detection limits (MDLs) shall be determined and documented.

Note: Confirmation of MDLs shall be done as appropriate or as required by the method.

5E.9.3 Acceptance Limits. Acceptable performance limits for analytical instrumentation and each method shall be documented based upon the continuing statistical evaluation of data generated by the analysis of quality control samples, unless specific minimum acceptance limits are established by the method.

5E.9.4 Where applicable, the following minimum QC shall be practiced in the laboratory:

For Inorganics/ Classical Chemistry:

5E.9.4.1 One calibration check standard and associated blank in 20 samples tested; the lab should repeat analysis of all affected samples if the calibration check standard is outside $\pm$ 10% of expected value unless the method specifies otherwise (broader acceptance ranges must be fully justified

and documented).

5E.9.4.2 One reagent, method, or digestion blank (carried through preparation) in 20 (or per batch).

5E.9.4.3 One matrix spike in 20 (or per batch).

5E.9.4.4 One duplicate or matrix spiked duplicate in 20 (or per batch).

5E.9.4.5 One laboratory control sample in 20 (or per batch).

Note 1: Analysis of a low concentration or near MDL (2 to 3 times MDL) standard with each batch of 20 samples or less is recommended to assess analytical system performance near the MDL (required in CLP SOWs for metals when client needs results near MDL).

Note 2: A batch includes up to 20 samples plus the attendant QC samples unless otherwise specified.

For Organics:

5E.9.4.6 One calibration check standard in 20 samples (or method-specific frequency) inside established control limits; if any are outside the limits, repeat analysis of all affected samples.

5E.9.4.7 One reagent, method, or preparation blank (carried through preparation) in 20 (or per batch).

5E.9.4.8 One matrix spike in 20 (or per batch).

5E.9.4.9 One duplicate or matrix spike duplicate in 20 (or per batch).

5E.9.4.10 Internal or external standards and surrogates (where available) shall be used for all samples.

5E.9.4.11 As required by the method, one laboratory control sample (consists of a representative matrix spiked with a reference standard containing the target analytes) in 20 (or per batch).

Note: Analysis of a spiked blank water or soil (LCS)(sodium sulfate or silica sand for organics) that is subjected to ALL extractions and cleanups with each batch of 20 samples or less is recommended to evaluate analytical system performance (CLP Statement of Work (SOW) requires analysis of an LCS).

5E.9.5 The laboratory shall establish control limits for all the above types of QC samples and be able to explain and document the basis for such established limits.

5E.9.6 Control Charts. Control charts or control data shall be used to track laboratory performance with the associated acceptance limits for each matrix and to evaluate instrument performance.

5.10 Reporting the Results

(No Additions)

PROFICIENCY TESTING (PERFORMANCE EVALUATION) REQUIREMENTS

Please refer to R103 – General Requirements: Proficiency Testing for ISO/IEC 17025 Laboratories and the associated Annex (R103a).

APPENDIX A

ACRONYMS AND GLOSSARY OF TERMS ASSOCIATED WITH THE PROGRAM

ACRONYMS

AA Atomic Absorption or Automated Analysis (wet chemical)
AAS Atomic Absorption Spectrometry (see FLAA and GFAA)
ANSI American National Standards Institute
AOAC Int. Association of Official Analytical Chemists International
ASTM American Society for Testing and Materials
ASTPHLD Association of State and Territorial Public Health Laboratory Directors
AWWA American Water Works Association
C Celsius (temperature unit)
CCB Continuing Calibration Blank
CCV Continuing Calibration Verification
CERCLA Comprehensive Environmental Response, Compensation & Liability Act
CDC Centers for Disease Control
CFR Code of Federal Regulations
CRADA Cooperative Research and Development Agreement
CLP Contract Laboratory Program
CRM Certified Reference Material
EDL Estimated Detection Limit
EMPC Estimated Maximum (Possible) Concentration used for dioxin and furans analyses
EPA Environmental Protection Agency (see also USEPA)
EQL Estimated Quantitation Limit
FIFRA Federal Insecticide, Fungicide and Rodenticide Act
FLAA Direct Flame Aspiration Atomic Absorption Spectrometry
GFAA Graphite Furnace Atomic Absorption Spectrometry
GLP Good Laboratory Practices (TSCA and FIFRA)
HPLC High Performance Liquid Chromatography
IC Ion Chromatography
ICB Initial Calibration Blank
ICP-AES Inductively Coupled Plasma Atomic Emission Spectrometry
ICP/MS Inductively Coupled Plasma-Mass Spectrometry
ICV Initial Calibration Verification
ICS Interference Check Standard
IDL Instrument Detection Limit
IEC International Electrotechnical Commission
IMVL Interlaboratory Method Validation Study
ISO International Organization for Standardization
LCS Laboratory Control Sample
LOQ Limit of Quantitation

LSA	Laboratory Systems Audit
MBAS	Methylene Blue Active Substances
MCL	Maximum Contaminant Level
MDL	Method Detection Limit
MOU	Memorandum of Understanding
NIOSH	National Institute for Occupational Safety and Health
NIST	National Institute of Standards and Technology
NTIS	National Technical Information Service
OSW	Office of Solid Waste (USEPA)
PCBs	Polychlorinated biphenyls
PE	Performance Evaluation
PM	Preventive Maintenance
PT	Proficiency Testing
PQL	Practical Quantitation Limit
QA	Quality Assurance
QAMS	Quality Assurance Management Staff
QAPjP	Quality Assurance Project Plan
QAPP	Quality Assurance Program Plan
QC	Quality Control
QM	Quality Manual
RCRA	Resource Conservation and Recovery Act
RE	Relative Error
RPD	Relative Percent Difference
SAP	Sampling and Analysis Plan
SARA	Superfund Amendments and Re-authorizations Act of 1986
SM	Standard Methods for the Examination of Water and Wastewater
SOP	Standard Operating Procedure
SRM	Standard Reference Material (produced by NIST)
SW	Solid Waste (usually as part of SW846, an EPA RCRA methods document)
TCLP	Toxicity Characteristic Leaching Procedure
TFE	Tetraflouroethylene (Teflon or equivalent)
TOC	Total Organic Carbon
TOX	Total Organic Halides
TQM	Total Quality Management
TSCA	Toxic Substances Control Act
USEPA	United States Environmental Protection Agency (see also EPA)
WP	Water Pollution
WS	Water Supply
XRF	X-Ray Fluorescence

GLOSSARY

Accreditation: A formal recognition that an organization (e.g., laboratory) is competent to carry out specific tasks (e.g., tests) or specific types of tasks. See also Certification.

Acceptance limits: Data quality limits specified for analytical method performance.

Accuracy: The closeness of agreement between a test result and an accepted reference value. The term accuracy, when applied to a set of observed values, will be a combination of a random component and of a common systematic error or bias component. Since in routine use, random components and bias components cannot be completely separated, the reported "accuracy" must be interpreted as a combination of these two components. See Precision and Bias.

Aliquot: See Subsample

Assessment: The process of obtaining information on an entity to evaluate its conformance or non-conformance with specified criteria. An assessment generally includes or is intended to mean an on-site visit of the entity.

Assessor: An individual who carries out some or all functions related to laboratory assessment (auditor is a common synonym).

Batch: A quantity of material produced or processed in one operation, considered to be a uniform, discrete unit.

Bias: The difference between the population mean of the test results and an accepted reference value. Bias is a systematic error as contrasted with a random error. There may be one or more systematic error components contributing to the bias.

Blank, Analytical: See Blank, Digestion.

Blank, Calibration: See Blank, Initial Calibration and Blank, Continuing Calibration blank.

Blank, Continuing calibration (CCB): A standard solution which contains no analyte and is used to verify blank response and freedom from carryover, analyzed after the CCV and after the Interference Check Standard (ICS).

Blank, Digestion: See Blank, Method.

Blank, Method: A mixture of all reagents used for the extraction or digestion of the matrix to evaluate the process for contamination from the laboratory. This blank will be run through the entire method.

Blank, Field: A sample of media carried to the sampling site, exposed to the sampling conditions (e.g., bottle caps removed), returned to the laboratory, treated as an environmental sample, and carried through

all steps of the analysis in order to evaluate possible site contamination sources such as airborne contaminants.

Blank, Laboratory: See Blank, Method.

Blank, Matrix: A sample of the matrix without the analytes of interest that goes through the complete analysis including digestion.

Blank, Initial calibration (ICB): A standard solution that contains no analyte and is used for initial calibration and zeroing instrument response.

Blank, Reagent: See Blank, Method.

Blank, Rinseate: A sample of a "used" cleaning fluid rinse solution, also called an equipment blank (e.g., a final rinse of the device used to collect environmental samples) used in rinsing collection media and equipment prior to use to monitor possible cross contamination.

Blank, Spiked Reagent: A specified amount of Reagent Blank fortified with a known mass of the target analyte(s), usually to determine the recovery efficiency of the method.

Blank, Trip: A sample of media taken from the laboratory to the sampling site and returned to the laboratory unopened, to evaluate the integrity of the sample container and its preparation.

Blind sample: A subsample submitted for analysis with a composition and identity known to the submitter but unknown to the analyst and used to test the analyst's or laboratory's proficiency in the execution of the measurement process.

Calibrate: To determine, by measurement or comparison with a standard, the correct value of each scale reading on a meter or other device, or the correct value for each setting of a control knob. The levels of the calibration standards should bracket the range of planned measurements. See Calibration curve.

Calibration-check: See Calibration verification.

Calibration-check standard: See Calibration verification.

Calibration curve: The graphical relationship between the known values for a series of calibration standards and instrument responses.

Calibration drift: The difference between the instrument response and a reference value after a period of operation without recalibration. See Continuing calibration verification.

Calibration standard:	A substance or reference material used to calibrate an instrument (often called a calibrant).
Calibration solution:	See Calibration standard.
Calibration verification:	See Initial or continuing calibration verification.
Certification:	A procedure by which a third party gives written assurance that a product, process, or service conforms to specified requirements. See also Accreditation.
Certified Reference Material (CRM):	A reference material that has one or more of its property values established by a technically valid procedure and is accompanied by or traceable to a certificate or other documentation issued by a certifying body. See Certification and Reference material.
Chain of custody:	An unbroken trail of accountability that ensures the physical security of samples, data, and records.
Check sample:	An uncontaminated sample matrix spiked with known amounts of analytes, usually from the same source as the calibration standards, to establish the stability of the analytical system or to assess the performance of all or a portion of the measurement system. See also Quality control sample.
Continuing calibration verification (CCV):	A standard solution (or set of solutions) used to verify freedom of excessive instrumental drift with the concentration near mid-range of linear curve.
Control chart:	A graph of some measurements plotted over time or sequence of sampling, together with control limit(s) and, usually, a central line and warning limit(s).
Control sample:	See Laboratory control sample.
Corrective action:	Action taken to correct a deficiency noted in an assessment. See Deficiency and Assessment.
Deficiency:	A failure to comply with one of the requirements of the program usually noted during an assessment. See Assessment.
Duplicate analyses:	The analyses or measurements of the variable of interest performed identically on duplicate samples.
Duplicate samples:	Two samples taken from and representative of the same population and independently carried through all steps of the sampling and analytical procedures in an identical manner. Laboratory duplicates are used to assess variance of sub-sampling and analysis. Field duplicate samples are used to assess variance of the total method including sampling and analysis.

Field sample:	A sample collected and delivered to the laboratory for analysis.
Initial calibration verification (ICV):	A standard solution (or set of solutions) used to verify calibration standard levels whose concentration of analyte is near mid-range of linear curve and is made from a stock solution having a different manufacturer or manufacturer lot identification than the calibration standards.
Instrument maintenance log:	A chronological record of preventive and emergency maintenance performed on an analytical instrument. The logs include record of calls, service technician summaries, records of calibration etc.
Interference check standard (ICS):	A standard solution (or set of solutions) used to verify accurate analyte response in the presence of possible interferences from other analytes present in samples.
Internal standard:	A standard added to a test portion of a sample in a known amount and carried through the entire demonstration procedure as a reference for calibration and controlling the precision and bias of the applied analytical method.
Intralaboratory precision:	A measure of the method/sample specific analytical variation within a laboratory, usually given as the standard deviation estimated from the results of duplicate analyses.
Laboratory control sample (LCS):	A reference material with an established concentration obtained from a source independent of the instrument calibration and traceable to an appropriate national/international measurement standard or other certified reference material.
Laboratory sample:	An aliqout or sub-sample of a field sample upon which laboratory analyses are made and results gathered.
Lot:	A set of samples submitted together for laboratory analysis which can be treated as one or more batches.
Matrix:	The component or substrate which contains the analyte(s) of interest.
Matrix spike:	An aliquot of sample spiked with a known concentration of target analyte(s) prior to sample preparation and analysis in order to document the bias of a method in a given sample matrix.
Matrix spike duplicate:	Intralaboratory split samples spiked with identical concentrations of target analyte(s) prior to sample preparation and analysis in order to document the precision and bias of the method in a given sample matrix.

Method performance: A general term used to document the characteristics of a method. These characteristics usually include method detection limits, linearity, precision, accuracy and bias.

Method detection limit (MDL): The minimum concentration of an analyte that, in a given matrix and with a specific method, can be identified, measured and reported with 99% confidence that the analyte concentration is greater than zero.

Mobile laboratory: A mobile laboratory is a self-contained, mobile facility that moves under its own power or is conveyed on a trailer, and does not remain at a site for more than two years.

NLLAP requirements: Requirements specified by the EPA National Lead Laboratory Accreditation Program (NLLAP) in order to be accredited for lead analysis in paint, soil and dust matrices by an EPA-recognized laboratory accreditation organization such as A2LA.

Precision: The closeness of agreement between test results obtained under prescribed conditions. Precision is usually expressed as standard deviation, variance, or range, in either absolute or relative terms.

Primary standard: A substance or device with a property or value that is unquestionably accepted (within specified limits) in establishing the value of the same or related property of another substance or device.

Proficiency testing: Methods of checking laboratory testing performance by means of interlaboratory tests.

Quality assurance (QA): For laboratories, the activity of providing the evidence needed to establish confidence that laboratory data are of the requisite accuracy.

Quality control (QC): For laboratories, the process through which a laboratory measures its performance, compares its performance with standards and acts on any differences.

Quality system: For laboratories, the organization structure, responsibilities, procedures, processes and resources needed to ensure that laboratory services satisfy data requirements.

Quantitation Limits: The maximum or minimum levels or quantities of a target analyte that can be quantified with the certainty required by the data user.

Reference material: A material or substance, one or more properties of which are sufficiently well established to be used for the calibration of an apparatus, the assessment of a measurement method, or assigning values to materials.

Reference standard: See Reference material.

Relative percent difference: A term defined as:

$$RPD = \frac{|R_1 - R_2|}{\overline{R}} \times 100$$

where $|R_1 - R_2|$ represents the absolute difference in two values and $\overline{R}$ represents the average of the two values.

Replicate analyses: The analysis of the quantity (or analyte) of interest performed identically on two or more laboratory subsamples of the same field sample within a short time interval.

Run: A set of consecutive sample measurements.

Sample log: The document where sample identification, condition, etc is noted when samples arrive at the laboratory. The log is part of the sample tracking system. See Sample tracking.

Sample tracking: A system of following a sample from receipt at the laboratory, through sample processing and analysis, and to final reporting. The system includes unique numbering or bar coding labels and the use of a sample log.

Secondary standard: A standard whose value is based upon comparison with a primary standard.

Site blank: See Field blank.

Spiked matrix: See Spiked sample.

Spiked sample: A sample prepared by adding a known mass of target analyte to a specified amount of matrix sample for which an independent estimate of target analyte concentration is available, used, for example, to determine the effect of the matrix on a method's recovery efficiency.

Split samples: Two or more representative portions taken from a sample or subsample and analyzed by different analysts or laboratories used to replicate the measurement of the variable(s) of interest.

Standard addition: The procedure of adding known increments of the analyte of interest to a sample to cause increases in detection response to subsequently establish by extrapolation of the plotted responses the level of the analyte of interest present in the original sample.

Standard operating procedure (SOP): A written document that details the method of an operation, analysis, or action whose techniques and procedures are thoroughly prescribed and which is accepted as the method for performing a certain routine or repetitive task.

Standard reference material (SRM):	A certified reference material produced by the U.S. National Institute of Standards and Technology and characterized for absolute content independent of analytical method.
Stock solution:	A concentrated solution of analyte(s) or reagent(s) prepared and verified by prescribed procedure(s), and used for preparing working standards or standard solutions.
Stratification:	The division of a target population into subsets or strata which are internally more homogeneous with respect to the characteristic to be studied than the population as a whole.
Subsample:	A representative portion of a sample. A subsample may be taken from any laboratory or a field sample.
Surrogate:	An organic compound which is similar to the target analyte(s) in chemical composition and behavior in the analytical process, but which is not normally found in environmental samples.
Validation:	The process of substantiating specified performance criteria.
Working standard:	See Secondary standard

DOCUMENT REVISION HISTORY

Date	Description
July 1, 2001	Scope (page 3) modified to add alternative methods for metals and MTBE. General Criteria updated to reference ISO/IEC 17025. Specific Criteria numbering and order changed to match ISO/IEC 17025. Document Revision History section added. No other changes made.
July 28, 2003	Scope (page 4) modified to add Ethanol, Methyl *tert*-Butyl Ether, *tert*-Butyl Alcohol, Ethyl *tert*-Butyl Ether, Diisopropyl Ether, *tert*-Amyl Methyl Ether, Benzene, Ethylbenzene, Toluene, and Xylenes. Scope (page 4) modified to replace total metals with dissolved metals. Scope (page 4) modified to add an alternative method for TPH(GRO) Certification Requirements (page 4) Delete Supplement to the Scope. 5E.5.4 (page 11) Reference the A2LA Policy on Measurement Traceability and delete "by an authorized person and a certificate shall be provided and retained identifying traceability to an appropriate national/international measurement standards body, such as the National Institute of Standards and Technology (NIST)". 5E.5.12 (page 12) Deleted calibration and Add verification. Scope (page 4) Added additional requirements for Methods 6010B, 8021B, 8260B, and for the dissolved metals. Title (pages 1, 2, 3) modified to reflect the program's new name.
June 14, 2004	Scope (page 5) modified to update method changes for Dissolved Cadmium, Dissolved Chromium, Dissolved Lead, TPH-DRO, and TPH-GRO.
September 13, 2005	Updated to reference ISO 17025:2005

February 17, 2006	Revised the test methods and analytes per a conference call with LeRoy Feusner.
February 20, 2008	Revisions made by Karen Halvorsen, STR Program Manager, to update test methods and analytes (include silica gel cleanup step for DRO and remove ethanol from analyte list), change the program and division names to Storage Tank Program and Solid & Hazardous Waste Division, and make minor technical writing edits.
November 9, 2010	Revisions requested by WY STR Program Manager to add 1,2-Dichloroethane by 8260 and 1,2-Dibromoethane by 8011.
May 10, 2011	Revisions requested by WY STR Program Manager, Karen Halvorsen, to change quality control testing from 10 to 20 samples in section 5.9.4 and correct DRO to EPA 8270D.
August 13, 2014	Added option to use 8260C in addition to 8260B for all applicable analytes (pages 3 and 4).

SOLID & HAZARDOUS WASTE DIVISION
STORAGE TANK PROGRAM
GUIDANCE DOCUMENT #7

SUBJECT: SAMPLING AND LABORATORY ANALYTICAL REQUIREMENTS AND REMEDIATION STANDARDS

SCOPE: This document provides sampling and laboratory analytical requirements to insure that analyses conducted for Storage Tank Program (STP) projects are consistent throughout the program. This document also provides remediation standards for STP contaminants of concern (CoCs). As referenced in this document, "Chapter 17" refers to Water Quality Rules and Regulations, Chapter 17, Part J. If there are any conflicts between this document and any rule or regulation, the rule or regulation will prevail.

INTRODUCTION: This document provides laboratory analytical requirements for all work phases (i.e., subsurface investigation, additional site assessment completed as part of design, operation and maintenance, and closeout confirmation sampling) associated with STP remediation projects. The requirements in this document should be included in any Sampling and Analysis Plan (SAP) or minimum site assessment (MSA) work plan submitted to the STP.

Site owners completing MSAs should use this document to increase the likelihood of an MSA being approved by the STP, allowing a site to enter the program. This guidance may also be used for environmental audits where properties may have been impacted by an STP-eligible tank release.

1. STP Contaminants of Concern

STP CoCs in <u>both soil and groundwater</u> are benzene, ethylbenzene, toluene, and xylenes (BETX); total petroleum hydrocarbons (TPH) as gasoline range organics (GRO) and as diesel range organics (DRO); and naphthalene.

Additional CoCs in <u>groundwater</u> may include (see Table 3 for applicability) methyl *tert*-butyl ether (MTBE); *tert*-butyl alcohol (TBA); ethyl *tert*-butyl ether (ETBE); diisopropyl ether (DIPE); *tert*-amyl methyl ether (TAME); 1,2-dibromoethane or ethylene dibromide (EDB); 1,2-dichloroethane (1,2-DCA); dissolved lead (Pb); dissolved cadmium (Cd); and dissolved chromium (Cr). Sampling and analyses for EDB and 1,2-DCA are not necessary if it can be shown that no tanks were installed prior to 1996 and the site never contained a tank that stored racing fuel or aviation gasoline. Additional CoCs in <u>soil</u> are total Pb, total Cd, and Cr.

The majority of STP remediation projects involve petroleum products. When regulated hazardous substances are encountered in an STP remediation project, contact the STP Project Manager for assistance with monitoring and analytical requirements.

Minimum Site Assessment Contaminants of Concern. During an MSA, at all tank sites, soil and groundwater must be analyzed for BETX, TPH-DRO, and naphthalene. At fuel tank sites, soil and groundwater must also be analyzed for TPH-GRO. Groundwater must be analyzed for EDB and 1,2-DCA unless it can be shown that no tanks were installed prior to 1996 and the site never contained a tank that stored racing fuel or aviation gasoline. At used oil tank sites, soil samples must be analyzed for Total TOX. Laboratory methods for these CoCs are provided in this document. Analyses of soil and groundwater for other CoCs discussed in this document are not required during an MSA.

2. Remediation Standards

Contaminants must be decreased to acceptable levels for protection of human health and the environment before a contaminated site can be closed.

Groundwater. Remediation standards for CoCs in groundwater include U.S. Environmental Protection Agency (EPA) maximum contaminant levels (MCLs) for drinking water. Where an MCL does not exist for a CoC found in groundwater, a state drinking water equivalent level (DWEL) has been calculated using Chapter 17. Action levels have also been established for TPH-GRO and TPH-DRO. MCLs, DWELs, and action levels for CoCs in groundwater are provided in this guidance document. If a contaminant other than a CoC is found in groundwater, and an MCL does not exist for the contaminant, a DWEL must be calculated using Chapter 17.

Soil. With the exception of TPH-DRO, soil restoration levels are site specific. A risk assessment must be completed to determine contaminant remediation levels in soil that are protective of human health. Chapter 17 provides requirements for calculating site-specific remediation levels in soil.

Chapter 17 Calculations. When a DWEL or soil restoration level must be calculated, the equations in Chapter 17 will be used. A spreadsheet has been developed in Microsoft Excel based on Chapter 17 equations that can be used to calculate acceptable contaminant levels. The spreadsheet can be found on the STP website at http://deq.state.wy.us/shwd/stp and clicking on the Guidance Document link. The spreadsheet is in the Guidance Document #7 link. Attachment B of this document provides constants to be used in the Chapter 17 equations. Attachment B also contains DWELs and default soil remediation standards for select contaminants that may be found at STP sites.

GUIDELINES:

1. Laboratory General Requirements

All laboratories analyzing samples and providing data that will be submitted to the STP must be accredited by the American Association of Laboratory Accreditation (A2LA) for the Wyoming Program. A list of laboratories currently accredited by A2LA for the Wyoming Program can be found on the STP website: http://deq.state.wy.us/shwd/stp and clicking on the "Prequalified Contractors" link.

Laboratory data and quality assurance/quality control (QA/QC) reports for STP remediation projects shall be uploaded to the STP GIS database using the Electronic Data Submittals (EDS) template found on the STP website: http://deq.state.wy.us/shwd/stp and clicking on the "Electronic Data Submittal" link. Data must be uploaded within 30 days of receipt of the sample for analyses.

New sample containers, coolers, and all equipment necessary for sampling and shipping samples shall be supplied by the party collecting the samples or the laboratory.

2. Sampling General Requirements

When the STP is paying for laboratory work through consultant or contractor remediation contracts, analyses shall be completed only for those contaminants listed in this document. The STP will not pay for additional analyses completed, unless specifically requested

and approved by the STP. The STP will not pay costs associated with broken sample containers, missed hold times, or other mishandling of samples.

Additional soil or groundwater analyses may be required to allow evaluation of soil remediation or disposal options. The consultant or contractor under contract with the STP for remediation projects shall determine additional soil or groundwater analyses required and present those to the STP during cost negotiations.

The STP does not pay for analyses when performed as part of an MSA completed by a site owner.

3. QA/QC

SAPs and work plans shall include sample preservation and handling protocol, chain-of-custody control, analytical procedures, field and laboratory QA/QC protocol. The STP Quality Assurance Project Plan shall be followed. QA/QC protocol shall include:

A. Samples must be collected and contained such that they are never in contact with any material incompatible with QA/QC procedures.

B. Handling procedures must be carefully established and followed. Proper chain-of-custody procedures must be followed. All chain-of-custody forms shall be submitted with the applicable report (e.g., remedial action plan, MSA report, closure report, etc.).

C. Trip Blank. Fill one of each type of sample bottle with an organic or aqueous solution free of any analytes of interest, transport to the site, handle like a sample, and return to the laboratory for the same analyses as the environmental samples. This sample set remains sealed until analysis. One trip blank shall be collected per sampling event or with each analytical batch, with a minimum of 1 per 20 samples.

D. Equipment Blank (Rinsate Blank). To ensure decontamination is properly completed, an aqueous or organic solution free of any analytes of interest is poured through the sampling equipment, transferred to sample bottle, and sent to the laboratory for analysis. One equipment blank is collected for each 10 percent or fraction thereof of daily non-disposable bailer use and/or one equipment blank for each type of disposable bailer used (one time only).

E. Blind Duplicate. To ensure laboratory accuracy, two separate samples are collected in the field from the same source at the same time. The sets are labeled with different nomenclature. One blind duplicate shall be collected for every day or with each analytical batch, with a minimum of 1 per 20 samples.

F. Field Duplicate. To document the precision of the sampling process, independent samples are collected as close as possible to the same point in space and time. They are two separate samples taken from the same source, stored in separate containers, and analyzed independently. These duplicates are useful in documenting the precision of the sampling process. One sample shall be collected for each day of groundwater sampling.

G. Field Blank. To ensure reagent integrity and check environmental contamination, an aqueous or organic solution free of any analytes of interest is transported to the field, transferred to the sample containers, and preserved. One field blank shall be collected per analytical batch with a minimum of 1 per 20 samples.

H. Field blanks, trip blanks, and equipment blanks are not required for non-VOC analyses.

I. Surrogate recovery shall be reported as part of the QA/QC.

4. Soil Sampling and Analyses

A. Former fuel tank sites

The most heavily contaminated soil sample collected (based on field instrument readings) from **all borings** at former fuel tank sites shall be properly preserved and submitted for laboratory analyses of total petroleum hydrocarbon gasoline range organics (TPH-GRO); total petroleum hydrocarbon diesel range organics (TPH-DRO); benzene, ethylbenzene, toluene, xylenes (BETX) (report constituents separately); and naphthalene.

The most heavily contaminated soil sample collected (based on field instrument readings) from **all borings within the tank excavation** at former fuel tank sites shall also be analyzed for total lead.

At least one soil sample shall be collected and analyzed for total organic carbon (TOC) from each storage tank site. This sample must be collected from an uncontaminated borehole, preferably upgradient of the tank basin.

B. Former used oil tank sites

The most heavily contaminated soil sample collected (based on field instrument readings) from **all borings** at former used oil tank sites shall be properly preserved and submitted for laboratory analyses of TPH-DRO, BETX (report constituents separately), and naphthalene.

The most heavily contaminated soil sample collected (based on field instrument readings) from **all borings within the tank excavation** at former used oil tank sites shall also be analyzed for total lead, total cadmium, chromium (total, hexavalent, and trivalent concentrations) and Total TOX.

At least one soil sample shall be collected and analyzed for total organic carbon (TOC) from each storage tank site. This sample must be collected from an uncontaminated borehole, preferably upgradient of the tank basin

C. The required analytical methods for soil samples are specified in Table 1 on the following page.

TABLE 1
ANALYTICAL METHODS FOR SOIL SAMPLES

Product	Constituent	EPA Method
Fuel Tanks	BETX	5035/8021B or 5035/8260B or 8260C
	Total Organic Carbon	415 for soil
	Total Lead	3020A/7421 or 6010C
	TPH-DRO (see note 2)	8015C or 8270D; C_{10} - C_{32}
	TPH-GRO	8015C or 5035/8260B or 8260C; C_6 - C_{10}
	Naphthalene	5035/8021B or 5035/8260B or 8260C
Used Oil Tanks	BETX	5035/8021B or 5035/8260B or 8260C
	Total Organic Carbon	415 for soil
	TPH-DRO (see note 2)	8015C or 8270D; C_{10} - C_{32}
	Naphthalene	5035/8021B or 5035/8260B or 8260C
	Total Lead	3020A/7421 or 6010C
	Total Cadmium	3020A/7131A or 6010C
	Total Chromium – total, hexavalent, trivalent	6010C for total; 3060A/7196A for hexavalent; trivalent as difference between total and hexavalent
	TOX	9023

Table 1 Notes:

BETX = benzene, ethylbenzene, toluene, xylenes (report constituents separately)
C_6 - C_{32} = carbon atom range
DRO = diesel range organics
EPA = Environmental Protection Agency
GRO = gasoline range organics
TPH = total petroleum hydrocarbons

1. Detection levels are EPA-method specific. Notification is required for all constituents detected above the detection level.
2. Silica gel cleanup is not required for soil samples; however, the STP Project Manager may request silica gel cleanup for any sample at any time.
3. Laboratory procedure must have a detection limit of 0.1 mg/L. If the TOX analytical concentration is above the detection limit, further analysis is required using EPA method 8260 or 8260C.

5. Soil Remediation Standards

Sections 38, 40, and 41 of Chapter 17 provide rules for remediation of contaminated soil at storage tank sites. Site-specific data should be obtained, and the procedures in Chapter 17 should be followed to calculate cleanup levels at the site. See Attachment B to this document for CoC chemical properties that should be used in Chapter 17 calculations. When using Chapter 17 to calculate soil cleanup levels, physical, chemical, and toxicological data needed for the equations must be taken from one of the following sources in the order indicated:

1. EPA, Region IX, Preliminary Remediation Goals Database (www.epa.gov/region9/waste/sfund/prg/index.html

2. EPA Integrated Risk Information System (IRIS) (www.epa.gov/iris/subst/index.html)

3. EPA Health Effects Assessment Summary Tables (HEAST)

4. EPA/State environmental agency final written guidance documents, reports, or databases

Soil remediation standards for STP CoCs are provided in Table 2.

TABLE 2
SOIL REMEDIATION STANDARDS

Product	Constituent	Remediation Standard
Fuel Tanks	BETX	Site Specific
	Total Organic Carbon	Site Specific
	Total Lead	Site Specific
	TPH-DRO	>2300 mg/kg
	TPH-GRO	Site Specific
	Naphthalene	Site Specific
Used Oil Tanks	BETX	Site Specific
	Total Organic Carbon	Site Specific
	TPH-DRO	>2300 mg/kg
	Naphthalene	Site Specific
	Total Lead	Site Specific
	Total Cadmium	Site Specific
	Chromium – total, hexavalent, trivalent	Site Specific for total only; report hexavalent and trivalent concentrations
	TOX Constituents	Site Specific (See Note 3)

Table 2 Notes:

BETX = benzene, ethylbenzene, toluene, xylenes (report constituents separately)
C_6 - C_{32} = carbon atom range
DRO = diesel range organics
EPA = Environmental Protection Agency
GRO = gasoline range organics
mg/kg = milligrams per kilogram
TPH = total petroleum hydrocarbons

1. Site-specific soil clean-up levels for organic compounds (except TPH-GRO) and metals are determined from an environmental fate and transport risk assessment model contained in the Wyoming Water

Quality Rules and Regulations, Chapter 17, Storage Tanks, Sections 40 and 41.

2. Site-specific soil clean-up levels for TPH-GRO are determined from graphs (Attachment A) using average thickness of the contaminated zone and average distance between the bottom of the contaminated zone and the top of the seasonally high groundwater table.
3. If the Total TOX exceeds the detection limit, further analysis is required to determine the presence of individual halogenated organic constituents. A site-specific remediation standard shall be calculated for all individual halogenated organic constituents detected.

6. Groundwater Sampling and Analyses

All wells without free product on the water table shall be sampled and analyzed. All wells with free product shall not be sampled; however, the free product thickness (to within 0.1 feet) and water levels (to within 0.01 feet) shall be measured and recorded. The analytical detection limit for each EPA analysis method for each constituent analyzed must be reported.

To remove polar nonhydrocarbon compounds (compounds from sources other than petroleum), the STP requires that the laboratory include a silica gel cleanup step when analyzing groundwater samples for TPH-DRO. If TPH-DRO is the only constituent found in groundwater, the STP project manager may have the well(s) resampled using a peristaltic pump or other low-flow sampling method. Low-flow sampling may reduce influence by nondissolved particle entrainment on the TPH-DRO analyses.

During STP remediation projects, the consultant shall sample existing private water wells, as requested by the STP Project Manager. The private water well sample(s) shall be analyzed for TPH-DRO, TPH-GRO, BETX, naphthalene, and initially methyl *tert*-butyl ether (MTBE), EDB, and 1,2-DCA. Analytical methods to be used shall be those shown in Table 3.

A. Former fuel tank sites

All groundwater samples collected from wells at former fuel tank sites shall be properly preserved and submitted for laboratory analyses of TPH-GRO, TPH-DRO, BETX (report constituents separately), naphthalene, MTBE, tert-butyl alcohol (TBA), ethyl tert-butyl ether (ETBE), diisopropyl ether (DIPE), and tert-amyl methyl ether (TAME).

All groundwater samples collected from wells **within tank excavations** at former fuel tank sites shall also be analyzed for dissolved lead.

During an MSA or subsurface investigation, all groundwater samples collected from wells within tank excavations and the three wells downgradient of the tank excavation with the highest concentrations of BETX shall be analyzed for EDB and 1,2-DCA. If EDB or 1,2-DCA is not found during initial site assessment, sampling for the constituent during future phases of the work is not necessary.

B. Former used oil tank sites

All groundwater samples collected from wells at former used oil tank sites shall be properly preserved and submitted for laboratory analyses of TPH-DRO, BETX (report constituents separately), and naphthalene.

All groundwater samples collected from wells **within tank excavations** at former used oil tank sites shall also be analyzed for dissolved lead, dissolved cadmium, and dissolved chromium (total, hexavalent, and trivalent concentrations).

C. The required analytical methods for groundwater samples are specified in Table 3.

TABLE 3 (SEE TABLE NOTES NEXT PAGE)
ANALYTICAL METHODS FOR GROUNDWATER SAMPLES

Product	Constituent	EPA Method
Fuel Tanks	Benzene	5030B/8021B or 5030B/8260B or 8260C
	Ethylbenzene	5030B/8021B or 5030B/8260B or 8260C
	Toluene	5030B/8021B or 5030B/8260B or 8260C
	Xylenes	5030B/8021B or 5030B/8260B or 8260C
	Methyl *tert*-Butyl Ether (MTBE)	5030B/8021B or 5030B/8260B or 8260C
	tert-Butyl Alcohol (TBA)	5030B/8021B or 5030B/8260B or 8260C
	Ethyl *tert*-Butyl Ether (ETBE)	5030B/8021B or 5030B/8260B or 8260C
	Diisopropyl Ether (DIPE)	5030B/8021B or 5030B/8260B or 8260C
	tert-Amyl Methyl Ether (TAME)	5030B/8021B or 5030B/8260B or 8260C
	TPH-GRO	8015C or 5030B/8260B or 8260C; C_6 - C_{10}
	TPH-DRO (see notes 4 and 5)	8015C with silica gel cleanup or 8270D with silica gel cleanup; C_{10} - C_{32}
	Naphthalene	5030B/8021B or 5030B/8260B or 8260C
	Dissolved Lead	3020A/7421 or 6010C
	1,2-dibromoethane or ethylene dibromide (EDB)	8011 (see note 6)
	1,2-dichloroethane (1,2-DCA)	8260B or 8260C
Used Oil Tanks	Benzene	5030B/8021B or 5030B/8260B or 8260C
	Ethylbenzene	5030B/8021B or 5030B/8260B or 8260C
	Toluene	5030B/8021B or 5030B/8260B or 8260C

	Xylenes	5030B/8021B or 5030B/8260B or 8260C
	TPH-DRO (see notes 4 and 5)	8015C, with silica gel cleanup or 8270D with silica gel cleanup; C_{10} - C_{32}
	Naphthalene	5030B/8021B or 5030B/8260B or 8260C
	Dissolved Lead	3020A/7421 or 6010C
	Dissolved Cadmium	3020A/7131A or 6010C
	Dissolved Chromium; total, hexavalent, and trivalent	6010C for total; 7196A for hexavalent; trivalent as the difference between total and hexavalent concentrations

Table 3 Notes:

C_6 - C_{32} = carbon atom range
DRO = diesel range organics
GRO = gasoline range organics
TPH = total petroleum hydrocarbons

1. Benzene, ethylbenzene, toluene, and xylenes analyses by 8260B or 8260C are required for all subsurface investigation work, additional site assessment, and confirmation sampling for project closure. Analyses by 8021B may only be used during routine monitoring events.
2. Samples collected for metal analyses, with the exception of hexavalent chromium, must be filtered on site with a 45 micron filter unless the samples can be delivered to the laboratory within 48 hours. Add nitric acid on site to lower the sample pH to <2 **after** the samples have been filtered. Samples collected for hexavalent chromium analysis must be unfiltered, not acidified and delivered to the laboratory within 24 hours of collection.
3. Detection levels are EPA-method specific. Notification is required for all constituents detected above the detection level.
4. Silica gel cleanup for TPH-DRO analyses must be specified on the chain-of-custody. The lab may choose the silica gel cleanup method to use. Silica gel cleanup is only required when TPH-DRO is the only constituent above the cleanup level or when closing a site. The STP project manager may request the silica gel cleanup for any sample at any time.
5. Microextraction method 3511 should be used by the lab when possible. The method requires 40 ml VOA bottles, which saves time and money over using the 1 liter amber jars. The method also results in less lab waste.
6. Method 8011 protocol does not specify preservation (acidification) of groundwater samples. Preservation of samples may be necessary to prevent biodegradation if the samples are not continuously refrigerated after collection or if the samples are not analyzed within the 14-day holding time. Not all laboratories routinely conduct analyses using 8011, so laboratory capability and capacity should be confirmed during the planning stages. At sites where benzene is the primary risk driver, Method 8260B or 8260C may be appropriate to monitor the quality of groundwater during active remediation. Once the concentration of benzene is reduced to below the MCL, it is necessary to switch to Method 8011 (or 504.2 drinking water method) for monitoring the concentration of EDB to determine if additional remediation is required in order to reach the MCL for EDB. (Methods 8260B or 8260C do not detect EDB to the MCL).

7. Groundwater Remediation Standards

Chapter 17, Section 39, states that STP remediation actions will protect groundwater to the most stringent of federal primacy MCLs, DWELs, or the standards found in Wyoming Water Quality Rules and Regulations, Chapters 1 and 8. For STP CoCs, the most stringent level will be MCLs or DWELs because, with the exception of lead, Chapters 1 and 8 do not contain standards for STP CoCs.

There is no MCL for TPH, nor is it appropriate to calculate a DWEL for TPH, as TPH is not a specific chemical substance but rather a series of separate organic compounds. However, TPH as a large group of organic compounds has been found to exhibit some degree of toxicity. Therefore, TPH action levels (Table 4 on the following page) are tools that may assist in the determination of when a site is nearing cleanup or if a site is clean during a tank removal.

In the STP, TPH is based on fraction-specific petroleum hydrocarbons:

Gasoline Range Organics (GRO): C_6 through C_{10}
Diesel Range Organics (DRO): C_{10} through C_{32}

The action level for TPH-GRO concentration in groundwater is 7.3 milligrams/liter (mg/L). If naphthalene is detected above the DWEL (0.7 mg/L), the TPH-DRO action level is 1.1 mg/L. However, if naphthalene and BETX concentrations are below the respective DWEL and MCLs and free product is not present on the groundwater table, the TPH-DRO plus TPH-GRO concentration must be equal to or less than 10 mg/L (sheen criteria). These values for TPH have been calculated based on protection of groundwater to drinking water standards.

STP remediation standards (MCLs, DWELs, EPA advisory levels, and action levels) as of the date of this document are provided in Table 4 (see next page). Current MCLs can be found on the EPA's website at www.epa.gov.

TABLE 4
GROUNDWATER REMEDIATION STANDARDS

PRODUCT	CONSTITUENT	MCL	DWEL	ACTION LEVEL
Fuel Tanks	Benzene	0.005	--	--
	Ethylbenzene	0.7	--	--
	Toluene	1.0	--	--
	Xylenes	10	--	--
	Naphthalene	--	0.7*	--
	Methyl *tert*-Butyl Ether (MTBE)	--	0.04	--
	tert-Butyl Alcohol (TBA)	--	0.22	--
	Ethyl *tert*-Butyl Ether (ETBE)	--	0.19	--
	Diisopropyl Ether (DIPE)	--	1.2	--
	tert-Amyl Methyl Ether (TAME)	--	0.128	--
	TPH-GRO (C_6 - C_{10})	--	--	7.3**
	TPH-DRO (C_{10} – C_{32})	--	--	1.1**
	Dissolved Lead	0.015	--	--
	1,2-dibromoethane or ethylene dibromide (EDB)	0.00005	--	--
	1,2-dichloroethane (1,2-DCA)	0.005	--	--
Used Oil Tanks	Benzene	0.005	--	--
	Ethylbenzene	0.7	--	--
	Toluene	1.0	--	--
	Xylenes	10	--	--
	Naphthalene	--	0.7*	--
	TPH-GRO (C_6 - C_{10})	--	--	7.3**
	TPH-DRO (C_{10} – C_{32})	--	--	1.1**
	Dissolved Lead	0.015	--	--
	Dissolved Cadmium	0.005	--	--
	Dissolved Chromium; total, hexavalent, and trivalent	>0.1 for total; report hexavalent and trivalent concentrations	--	--

Table 4 Notes:

All values are in milligrams per liter (mg/L)
TPH-GRO – Total petroleum hydrocarbon as gasoline range organics
TPH-DRO – Total petroleum hydrocarbon as diesel range organic
C_6 - C_{32} = carbon atom range
* EPA Health Advisory Level (2006)
** If naphthalene is detected above the DWEL (0.7 mg/L), the TPH-DRO action level is 1.1 mg/L. However, if naphthalene and BETX concentrations are below the respective DWEL and MCLs and free product is not present on the groundwater table, the TPH-DRO **plus** TPH-GRO concentration must be equal to or less than 10 mg/L (sheen criteria).

8. Vapor Hazards Evaluation

Chapter 17, Section 42, requires an evaluation of explosive atmospheres caused by leaking storage tanks. The STP action levels shown in Table 5 are 25 percent of the lower explosive level for the contaminant.

TABLE 5
EXPLOSIVE ATMOSPHERE ACTION LEVELS

CONTAMINANT	LOWER EXPLOSIVE LEVEL (%)	UPPER EXPLOSIVE LEVEL (%)	STP ACTION LEVEL (%)
Benzene	1.3	7.9	0.32 (3200 ppmv)
Diesel Fuel	1.3	7.5	0.32 (3200 ppmv)
Ethylbenzene	1	6.7	0.25 (2500 ppmv)
Fuel Oils	0.6	7.5	0.15 (1500 ppmv)
Gasoline	1.2	7.6	0.30 (3000 ppmv)
Jet Fuel (JP-4)	1.3	8	0.32 (3200 ppmv)
Toluene	1.2	7.1	0.30 (3000 ppmv)
Xylenes	1	7	0.25 (2500 ppmv)

Table 5 Notes:
% percent
ppmv – parts per million by volume

If assessment reveals that an acute or chronic vapor intrusion exposure may be a concern (e.g., plume has migrated or is suspected to have migrated under or near buildings or along preferential pathways) at the site or adjacent properties, the possibility of vapor intrusion to buildings, sewer lines, etc. shall be assessed. There are two main concerns with vapor intrusion. The first is the potential for vapors to accumulate and become a volatile explosion hazard. This is most common in sewer lines, sumps, and other confined subsurface places. The second concern is for affects to human health from vapors in homes, schools, and work places. At a minimum the following tasks shall be performed to evaluate the potential for vapor intrusion impacts:

A. Survey the immediate area at each site and interview residents and workers to determine if vapors have been detected.

B. Use an instrument capable of detecting hazardous vapors to assess potentially hazardous (explosive) spaces such as sewer lines, sumps, utility corridors, etc. Indoor air monitoring shall be performed as necessary to quantify reports of odors or potential vapor exposures.

C. The potential for vapors to affect human health from dissolved phase plumes or LNAPL plumes must be evaluated. Several guidance documents (e.g., ITRC Vapor

Intrusion Guide, 2007; EPA OSWER Draft Guidance for Vapor Intrusion to Indoor Air Pathway from Groundwater and Soils, 2002) exist that provide steps for evaluating this pathway.

An indoor air monitoring sampling schedule shall be determined if appropriate.

Following the construction of any active subsurface remediation system that has the potential to liberate or move petroleum vapors from source areas (e.g., air sparge), a follow up vapor intrusion evaluation shall be required using the same procedures as the initial evaluation. This is intended to ensure the active system has not caused a vapor intrusion problem.

9. Indoor Air Quality

Indoor air quality must be considered at STP sites in accordance with Chapter 17, Section 42(b). Table 6 provides indoor air quality standards and action levels calculated in accordance with Chapter 17.

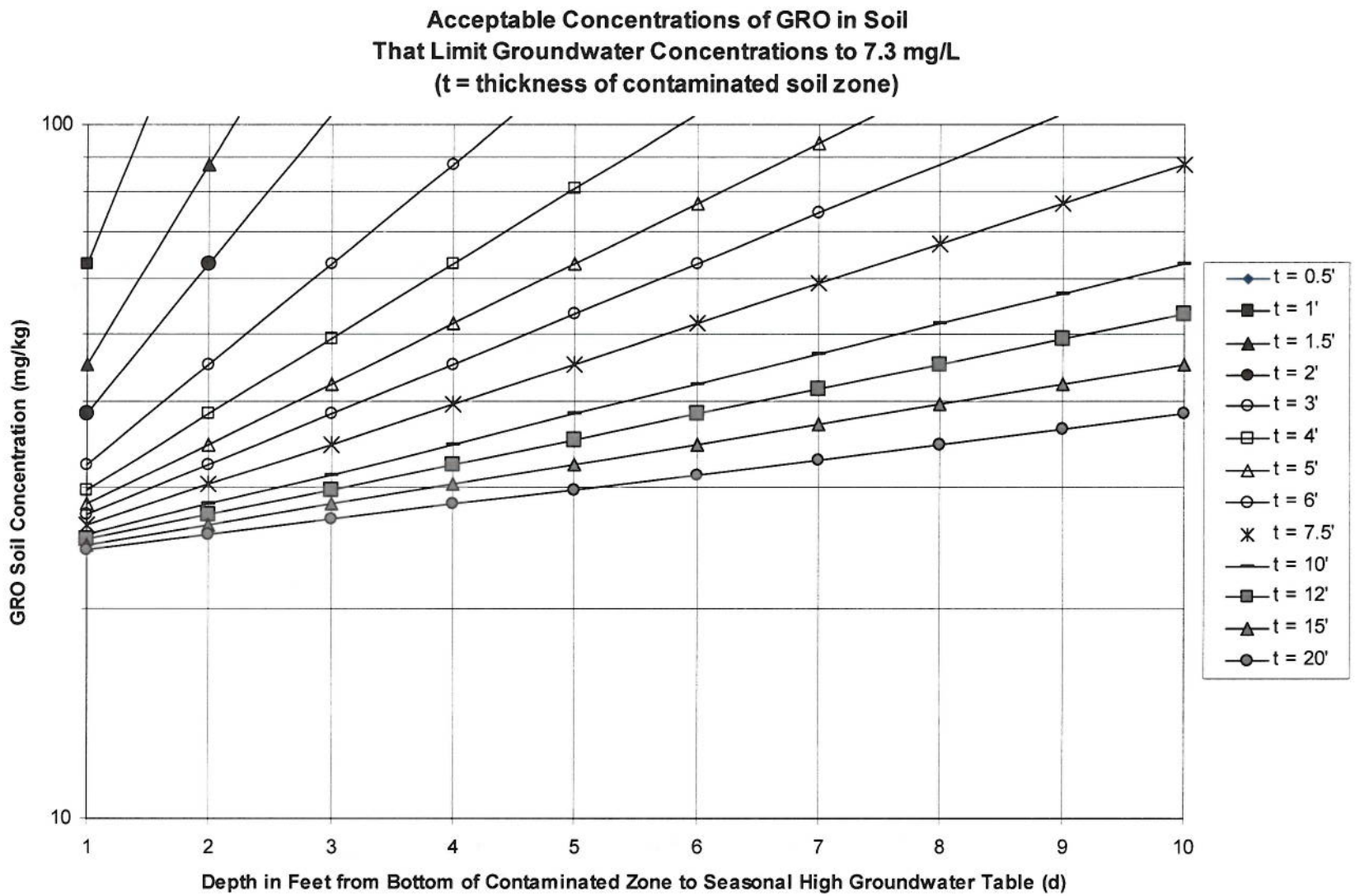
TABLE 6
INDOOR AIR QUALITY STANDARDS AND ACTION LEVELS

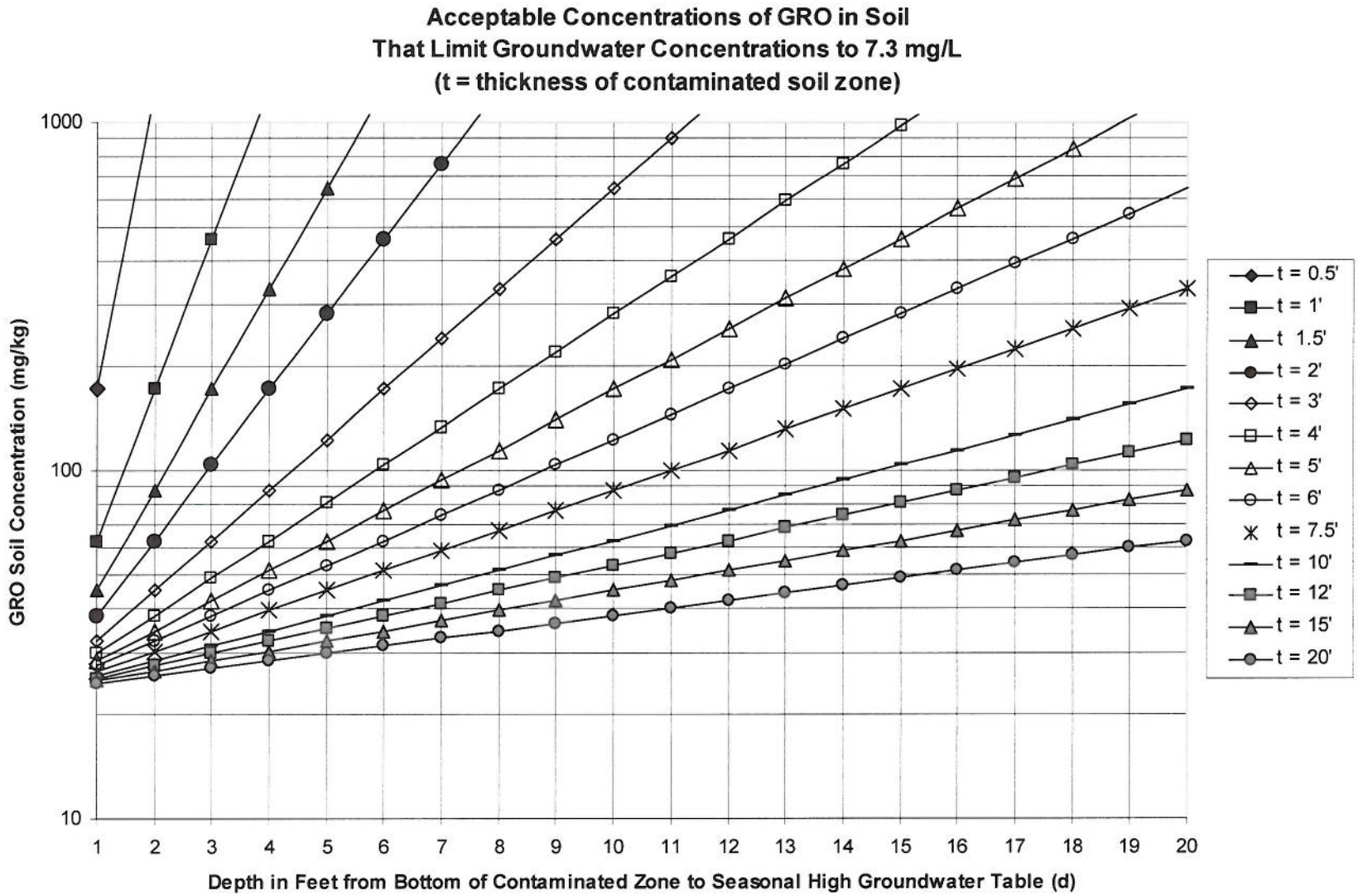
COMPOUND	WY OSHA OCCUPATIONAL STANDARD	ACTION LEVEL
Benzene	3,200	0.38
Ethylbenzene	435,000	1400
Hexane	1,800,000	270
Methyl *tert*-butyl ether (MTBE)	N/A	0.01
Toluene	377,000	530

Table 6 Notes:
WY OSHA – Wyoming Occupational Safety and Health Administration
All values are in micrograms per cubic meter at 25°Celcius and 760 millimeters mercury.

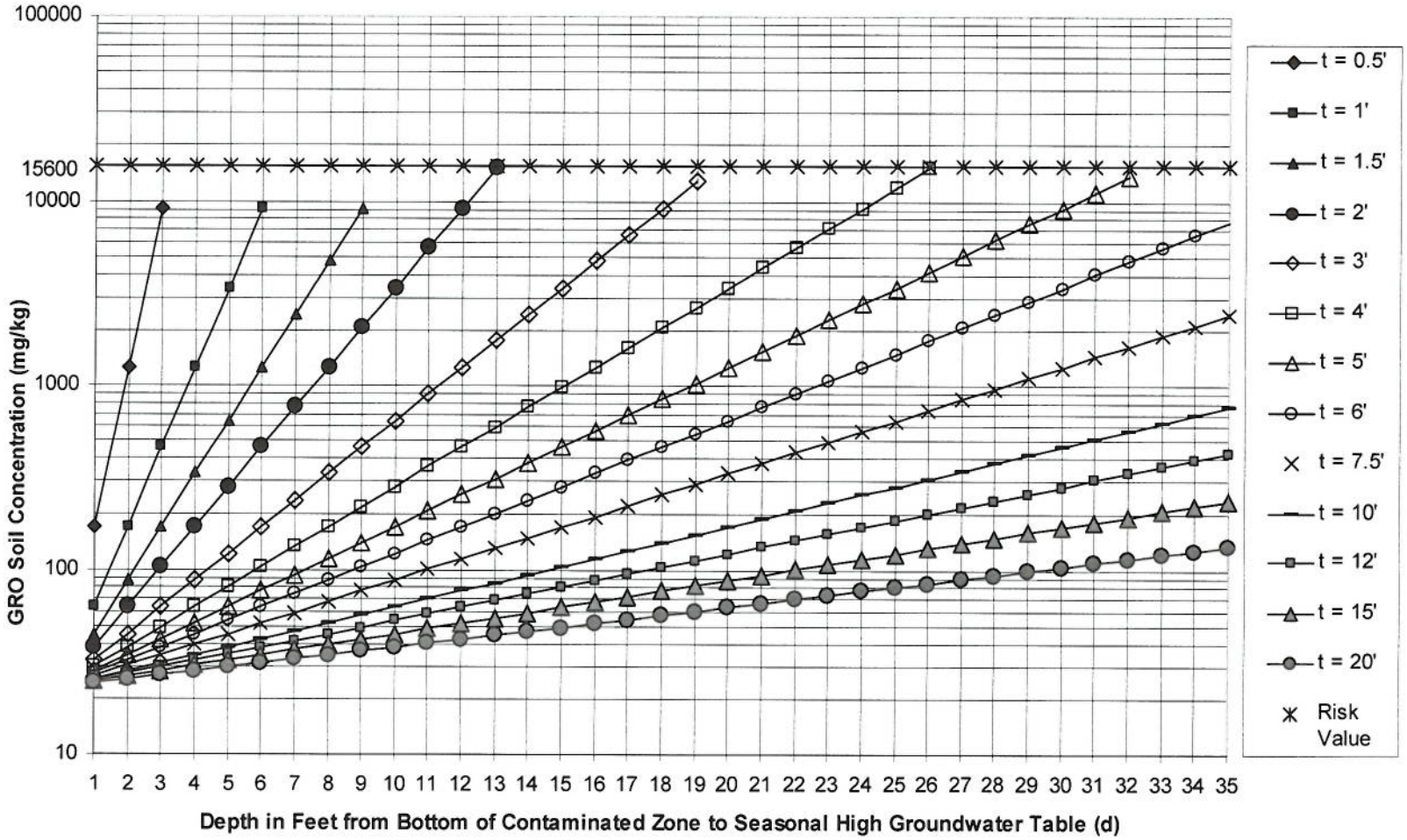
ATTACHMENT A

TPH-GRO GRAPHS

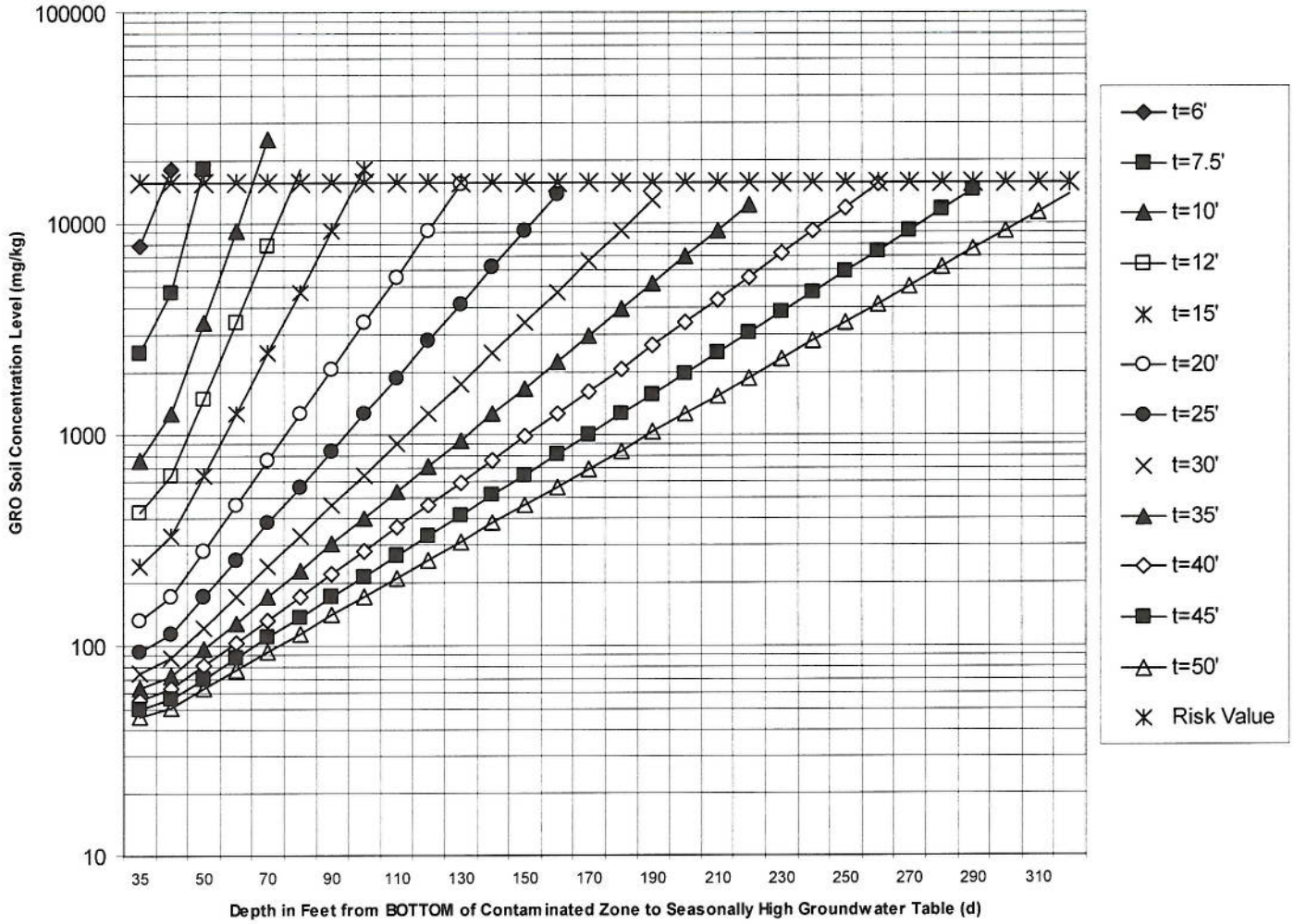

Acceptable Concentrations of GRO in Soil
That Limit Groundwater Concentrations to 7.3 mg/L
(t = thickness of contaminated soil zone)
GRO Soil Concentration (mg/kg)
100
10
1
2
3
4
5
6
7
8
9
10
Depth in Feet from Bottom of Contaminated Zone to Seasonal High Groundwater Table (d)
t = 0.5'
t = 1'
t = 1.5'
t = 2'
t = 3'
t = 4'
t = 5'
t = 6'
t = 7.5'
t = 10'
t = 12'
t = 15'
t = 20'


Acceptable Concentrations of GRO in Soil
That Limit Groundwater Concentrations to 7.3 mg/L
(t = thickness of contaminated soil zone)
GRO Soil Concentration (mg/kg)
1000
100
10
1
2
3
4
5
6
7
8
9
10
11
12
13
14
15
16
17
18
19
20
Depth in Feet from Bottom of Contaminated Zone to Seasonal High Groundwater Table (d)
t = 0.5'
t = 1'
t 1.5'
t = 2'
t = 3'
t = 4'
t = 5'
t = 6'
t = 7.5'
t = 10'
t = 12'
t = 15'
t = 20'

Acceptable Concentrations of GRO in Soil
That Limit Groundwater Concentrations to 7.3 mg/L
(t = thickness of contaminated soil zone)



Acceptable Concentrations of GRO in Soil That Limit Groundwater Concentrations to 7.3 mg/L
(t= thickness of contaminated soil zone)



ATTACHMENT B

CHAPTER 17 CALCULATIONS

INTRODUCTION: Attachment B provides constants used in Chapter 17 calculations for select constituents. Attachment B also provides DWELs for select constituents and default soil remediation standards when site-specific information cannot be attained. **Prior to using default soil remediation standards, consult the STP district office.**

1. Precipitation

Average annual precipitation data can be obtained from the National Weather Service or a published precipitation map of Wyoming.

2. Drinking Water Equivalent Levels

Drinking water equivalent levels (DWELs) for STP CoCs are provided in this guidance document. Table B-1 provides DWELs for select constituents (not CoCs) that may have been stored in a storage tank. DWELs shown in Table B-1 were calculated using the equations in Chapter 17.

TABLE B-1
DWELS FOR SELECTED CONSTITUENTS

COMPOUND	DWEL (mg/L)	COMPOUND	DWEL (mg/L)
Acenaphthene	2.2	Ethylene glycol	73
Anthracene	73	Fluoranthene	1.5
Bis(2-ethylhexyl)phthalate	0.0061	Fluorene	1.5
Butylbenzylphthalate	7.3	Hexane	401
Chrysene	0.012	Methanol	18
Dibutylphthalate	3.7	Propylene glycol	18
Diethylphthalate	29	1,2,4-Trimethylbenzene	1.8
Dioctylphthalate	1.5	1,3,5-Trimethylbenzene	1.8

DWEL – Drinking Water Equivalent Level
mg/L – milligrams per liter

3. Default Soil Remediation Standards

If site-specific soil data are not available, default soil remediation standards in Table B-2 for STP CoCs may be used only after consultation with the STP district office. Table B-3 contains default soil remediation standards for other contaminants that may be found at storage tank sites. The values in Tables B-2 and B-3 were calculated using the methods in Chapter 17.

TABLE B-2
DEFAULT SOIL REMEDIATION STANDARDS
FOR STP CONTAMINANTS OF CONCERN

CONTAMINANT	HUMAN EXPOSURE	SOIL SATURATION	MIGRATION POTENTIAL TO GROUNDWATER
Benzene	5.7E-01	3.8E+02	1.8E+01
Cadmium	3.9E+01	nc	1.2E+01
Chromium (hexavalent)*	3.0E+01	nc	1.7E+00
Chromium (trivalent)*	1.2E+05	nc	5.2E+05
Chromium (total)*	2.1E+02	nc	nc
Ethylbenzene	1.3E+03	9.0E+01	nc
Lead*	4.0E+02	nc	1.8E+00
Naphthalene	nc	6.5E+01	nc
Toluene	4.8E+02	1.8E+02	1.9E+04
TPH-DRO	2.3E+03	nc	nc
TPH-GRO	1.6E+04	nc	See Section 11
Xylenes	1.8E+02	9.2E+01	5.8E+06

Notes:

All values in milligrams per kilogram.
nc – not calculated due to insufficient physiochemical parameter data, or the calculated concentration was greater than pure product in soil.
* EPA non-standard method applied.
If laboratory cannot analyze to the levels in Table B-2, the laboratory detection limit shall be the cleanup concentration.

TABLE B-3 DEFAULT SOIL CLEANUP LEVELS FOR SELECT COMPOUNDS			
	DEFAULT SOIL CLEANUP CONCENTRATIONS		
CHEMICAL COMPOUND	HUMAN EXPOSURE mg/kg	SOIL SATURATION mg/kg	MIGRATION POTENTIAL TO GROUNDWATER mg/kg
Acenaphthene	1.1E+03	4.4E+01	nc
Anthracene	2.1E+04	1.0E+00	nc
Benzo(a)pyrene	8.7E-02	1.6E+00	nc
Bis (2-ethylhexyl) phthalate	4.6E+01	5.1E+03	nc
Chrysene	8.2E+01	6.4E-01	nc
Dibutylphthalate	7.7E+03	3.9E+01	nc
Diethylphthalate	5.6E+04	4.3E+02	3.0E+03
Diisopropyl ether (DIPE)	2.7E+03	3.3E+02	nc
Dioctylphthalate	3.1E+03	1.7E+03	nc
Ethyl *tert*-butyl ether (ETBE)	4.2E+03	1.7E+04	nc
Ethylene dibromide (EDB)	2.0E-02	6.4E+02	5.5E-06
Ethylene glycol	1.6E+05	nc	6.0E+01
Fluoranthene	3.0E+03	2.3E+01	nc
Fluorene	2.5E+03	2.7E+01	nc
Hexane	9.6E+01	3.7E+01	nc
Methyl *tert*-butyl ether (MTBE)	3.8E+01	1.7E+04	4.9E-02
Propylene glycol	3.9E+04	nc	Nc
1,2,4-Trimethylbenzene	3.0E+01	1.00E+00	nc
1,3,5-Trimethylbenzene	1.3E+01	5.00E+01	nc

Notes:

- mg/kg – milligrams per kilogram
- nc – Not calculated due to insufficient physiochemical parameter data, or because the calculated concentration was greater than pure product in soil.
- If laboratory cannot analyze to the levels in Table B-3, the detection limit shall become the cleanup level.

4. Chemical Properties

Table B-4 contains chemical properties for STP CoCs that should be used in the calculations required by Chapter 17. Table B-5 contains chemical properties for other contaminants that may be found at STP site.

TABLE B-4
CHEMICAL PROPERTIES FOR
STP CONTAMINANTS OF CONCERN

CONTAMINANT	K_{oc} (mL/gm)	D_i (cm^2/s)	D_w (cm^2/s)	S (mg/L)	H′ (no units)
Benzene	5.9E+01	8.8E-02	9.8E-06	1.8E+03	2.3E-01
Diisopropyl ether (DIPE)	1.9E+01	7.4E-02	8.0E-06	2.0E+03	2.0E-01
Ethylbenzene	3.6E+02	7.5E-02	7.8E-06	1.7E+02	3.2E-01
Ethyl *tert*-butyl ether (ETBE)	4.0E+01	7.4E-02	8.0E-06	1.0E+05	1.1E-01
Methyl *tert*-butyl ether (MTBE)	6.0E+00	8.0E-02	1.0E-05	1.5E+05	2.4E-02
Naphthalene	2.0E+03	5.9E-02	7.5E-06	3.1E+01	2.0E-02
tert-Amyl methyl ether (TAME)	4.0E+01	7.4E-02	8.0E-06	2.6E+03	8.1E-02
tert-Butyl alcohol (TBA or Butanol)	2.3E+00	9.0E-02	1.0E-05	1.0E+06	5.0E-04
Toluene	1.8E+02	8.7E-02	8.6E-06	5.3E+02	2.7E-01
Xylenes	4.1E+02	7.8E-02	7.8E-06	1.6E+02	3.0E-01

Notes:

K_{oc} = Organic carbon partition coefficient. Note: When K_{oc} values cannot be located in a technical source, the following equations may be used to calculate K_{oc} using published K_{ow}, or solubility values, for a particular chemical contaminant.

$$\log K_{oc} = 1.06(\log K_{ow}) - 0.68$$

$$\log K_{oc} = -0.55(\log S) + 3.64 \text{ (Solubility, S, in mg/L)}$$

D_i = Diffusivity in air (25°C)
D_w = Diffusivity in water (25°C)
S = Solubility in water (20-25°C)
H′ = Dimensionless Henry's Law Constant (Henry's Law Constant*41) @ 25°C
mL/gm – milliliters per gram
cm^2/s – centimeters squared per second
mg/L – milligrams per liter
C – degrees Celsius

TABLE B-5 CHEMICAL PROPERTIES FOR CONTAMINANTS (OTHER THAN CoCs) THAT MAY BE FOUND AT STP SITES					
COMPOUND	**K_{oc} (mL/gm)**	**D_i (cm^2/s)**	**D_w (cm^2/s)**	**S (mg/L)**	**H´ (unit less)**
Acenaphthene	4.9E+03	4.2E-02	7.7E-06	4.2E+00	6.4E-03
Anthracene	2.4E+04	3.2E-02	7.7E-06	4.3E-02	2.7E-03
Benzo(*a*)pyrene	1.0E+06	4.3E-02	9.0E-06	1.6E-03	4.6E-05
Bis(2-ethylhexyl) phthalate	1.5E+07	3.5E-02	3.7E-06	3.4E-01	4.2E-06
Chrysene	4.0E+05	2.5E-02	6.2E-06	1.6E-03	3.9E-03
Dibutylphthalate	3.4E+04	4.4E-02	7.9E-06	1.1E+01	3.9E-08
Diethylphthalate	2.9E+02	2.6E-02	6.4E-06	1.1E+03	1.9E-05
Dioctylphthalate	8.3E+07	1.5E-02	3.6E-06	2.0E-02	2.7E-03
Ethylene dibromide	4.4E+01	7.3E-02	8.1E-06	4.2E+03	2.7E-02
Ethylene glycol	7.6E-03	unavailable	unavailable	miscible	2.5E-06
Fluoranthene	1.1E+05	3.0E-02	6.4E-06	2.1E-01	6.6E-04
Fluorene	1.4E+04	3.6E-02	7.9E-06	2.0E+00	2.6E-03
Hexane	8.9E+02	2.0E-01	7.8E-06	1.8E+01	5.0E+00
1,2,4-Trimethylbenzene	3.7E+03	7.5E-02	7.1E-06	2.6E-01	2.3E-01
1,3,5-Trimethylbenzene	8.2E+02	7.5E-02	7.1E-06	5.0E+01	3.2E-01

Notes:

K_{oc} = Organic carbon partition coefficient. Note: When K_{oc} values cannot be located in a technical source, the following equations may be used to calculate K_{oc} using published K_{ow}, or solubility values, for a particular chemical contaminant.

$\log K_{oc} = 1.06(\log K_{ow}) - 0.68$

$\log K_{oc} = -0.55(\log S) + 3.64$ (Solubility, S, in mg/L)

D_i = Diffusivity in air (25°C)
D_w = Diffusivity in water (25°C)
S = Solubility in water (20-25°C)
H´ = Dimensionless Henry's Law Constant (Henry's Law Constant*41) @ 25°C
mL/gm – milliliters per gram
cm^2/s – centimeters squared per second
mg/L – milligrams per liter
C – degrees Celsius

5. Metals

Remediation standards for metals in soil are directly affected by soil pH. The average pH in Wyoming soils is 7.8. Table B-6 presents soil metal adsorption coefficients for metals commonly found at STP sites.

TABLE B-6
STP METALS OF CONCERN
K_d VALUES, SOIL pH 7.8

Metal	K_d (mL/gm)
Cadmium	1,900
Chromium (trivalent)	4,300,000
Chromium (hexavalent)	14
Lead	100

Notes:
Source: EPA Soil Screening Guidance, OSWER 9355.4-23
K_d – Soil metal adsorption coefficient
mL/gm – milliliters per gram

6. Default Soil Properties

Table B-7 provides default bulk soil densities and volumetric moisture values that should be used when site-specific field data are not available. Site-specific data should be determined by laboratory analyses where possible.

TABLE B-7
STP DEFAULT SOIL PROPERTIES

SOIL TEXTURE	BULK SOIL DENSITY (ρ_b), gm/cm^3	VOLUMETRIC MOISTURE (Θ) AT FIELD CAPACITY, mL/cm^3
Sand	1.65	0.062
Sandy loam	1.55	0.19
Loam	1.4	0.232
Sandy clay loam	1.5	0.244
Clay loam	1.35	0.31
Sandy clay	1.45	0.321
Silty loam	1.35	0.284
Silty clay loam	1.3	0.342
Silty clay	1.25	0.371
Clay	1.25	0.378

Notes:

Source: USDA, Natural Resources Conservation Service
gm/cm^3 – grams per cubic meter
mL/cm^3 – milliliters per cubic meter

7. Half-Life Values

Table B-8 provides half-life values for select STP CoCs in soil and must be used when calculating the biodegradation rate constant, k. Table B-9 provides half-life values for other contaminants that may be present in soil at STP sites.

TABLE B-8
HALF-LIFE FOR SELECT STP CONTAMINANTS OF CONCERN IN SOIL

CONTAMINANT	SOIL HALF-LIFE ($T_{½}$) (YEARS)
Benzene	0.04
Ethylbenzene	0.03
Methyl *tert*-butyl ether (MTBE)	0.5
Naphthalene	0.13
tert-Butyl alcohol (TBA or Butanol)	0.6
Toluene	0.06
Xylenes	0.08

Source: Handbook of Environmental Degradation Fates

TABLE B-9
HALF-LIFE FOR SELECTED CONTAMINANTS IN SOIL

CONTAMINANT	SOIL HALF-LIFE ($T_{½}$) YEARS	CONTAMINANT	SOIL HALF-LIFE ($T_{½}$) YEARS
Acenaphthene	0.28	Ethylene dibromide	0.5
Anthracene	1.3	Ethylene glycol	0.03
Benzo(*a*)pyrene	1.4	Fluoranthene	1.2
Bis(2-ethylhexyl)phthalate	0.06	Fluorene	0.2
Chrysene	2.7	Methanol	0.02
Dibutyl phthalate	0.06	*tert*-Butyl alcohol (TBA or Butanol)	0.6
Diethylphthalate	0.15	1,2,4-Trimethylbenzene	0.08
Dioctyl phthalate	0.08		

Source: Handbook of Environmental Degradation Fates

TABLE 1: FLUID LEVEL SUBMITTAL (TEMPLATE)
WDEQ/STP GIS APPLICATION

Site	Facility ID	Well ID	Date Measured	Depth to LNAPL	Depth to Water	Measuring Point Elevation	Total Depth Gauged	Specific Gravity	Vacuum

TABLE 2: ANALYTICAL AND FIELD DATA SUBMITTAL (TEMPLATE)
WDEQ/STP GIS APPLICATION

Site	Facility ID	Well ID	Sample Type Code	Start Depth	End Depth	Date Sampled	Analyte	CAS No	Result	Limit	Qualified	Units	Method	Matrix

TABLE 3: NEW SAMPLE LOCATIONS SUBMITTAL (TEMPLATE)
WDEQ/STP GIS APPLICATION

Project	Design Engineer	Site	Facility ID	Well ID	Location Type	Longitude	Latitude	Accuracy	Surface Elevation	Top of Casing/Measuring Point Elevation	Permit	Total Well Depth	Screened Interval

APPENDIX A
SCOPE OF WORK
PROFESSIONAL SERVICES FOR
[NAME] STP REMEDIATION PROJECT

1. **Summary Scope of Work**

A. GIS Uploads

B. Subsurface Investigation (SSI)/Additional Site Assessment Tasks (0907.05)

(i) SSI/Additional Site Assessment Management

(ii) Review Project Files and Reports

(iii) Research Public Records and Conduct Site Owner Interviews

(iv) Secure Permits and Third Party Access Agreements

(v) Prepare Additional Site Assessment Plan

(vi) Planning Meeting

(vii) Additional Site Assessment Field Work

(viii) Project-Specific Subsurface Investigations Tasks

C. Design Tasks (0906.01)

(i) Design Management

(ii) Pilot Testing

(iii) Remedial Action Plan

(iv) Construction and Equipment Plans and Specifications

(v) Project-Specific Design Tasks

D. Construction Oversight Tasks (0906.02)

(i) Construction Oversight Management

(ii) Construction and Equipment Bid Assistance

(iii) Construction Oversight

(iv) Operation and Maintenance Manual and Equipment Startup

(v) Project-Specific Construction Management and Overview Tasks

E. Operation and Maintenance (O&M) and Monitoring Tasks (0907.06)

(i) O&M Management

(ii) O&M

(iii) Data Evaluation and Annual Reports

(iv) Post-Remediation Verification Sampling and Testing

(v) Site Remediation Completion Reports

(vi) Project-Specific O&M and Monitoring Tasks

F. Project Closeout Tasks (0907.07)

(i) Closeout Management

(ii) Site Closeout Plans

(iii) Closeout Bidding and Administration

(iv) Closeout Contractor Oversight

(v) Final Site Closeout Reports

(vi) Public Meeting

(vii) Project-Specific Closeout Tasks

G. Additional Work Due to Unknown Conditions

2. <u>Detailed Scope of Work</u>

A. GIS Upload Requirements

(i) General Information

(a) The STP webportal shall be used to upload site location data, analytical data, fluid level data, documents, and site mapping to the STP GIS. Site location, analytical, and fluid level data shall be uploaded to the Load Data page. STP-required documents and shapefiles for remediation system mapping shall be uploaded through the STP webportal's Project Documents page. Consultants that have the ability to convert AutoCAD drawings to Shapefiles, must do so and complete the required uploads.

(b) Consultants that do not have the capability to convert AutoCAD drawings to shapefiles may submit AutoCAD files that conform to paragraph (iii)(c) below to the STP for

conversion. AutoCAD files submitted that do not meet the specification below will be sent back to the consultant for revising and resubmittal. Revisions shall be made at no additional cost to the STP.

(ii) Data Uploads

All location, analytical, and fluid level data gathered through the life of the project shall be uploaded to the STP GIS using the Electronic Data Submittal (EDS) form available on the STP website and the STP webportal's Data Load page. Data shall be uploaded as soon as it is available and has been validated by the consultant.

(iii) Report and Drawing Uploads. Reports and drawings shall be uploaded using the STP webportal's Project Documents page. Required report and drawing GIS submittals are:

(a) Subsurface Investigation Phase: Sampling and Analysis Plan submitted as a PDF document. All groundwater and soil data collected during the SSI phase.

(b) Design Phase: RAP, construction and equipment plans and specifications. Upload the RAP as one, combined PDF document (do not upload analytical appendices). Upload the construction and equipment specifications as one combined PDF document for each contract (e.g., Site Construction and Equipment Supply). Do not upload WDEQ's front-end boiler plate document.

(c) Construction Oversight Phase: As-built drawings. Upload drawings depicting site plans and system layouts in GIS shapefile format, or submit drawings to the STP in AutoCAD format (if conversion to shapefiles cannot be completed). Upload a complete DWF file for the plans, including schematics, building layouts, well details, etc. If submitting AutoCAD drawings, each AutoCAD drawing shall be in State Plane, UTM, or latitude/longitude. All site plans will preferably be located within Model Space of one AutoCAD file. If uploading shapefiles, shapefiles shall be projected in North American Datum (NAD) 83, latitude-longitude, degrees. For AutoCAD drawings, remediation-specific entities shall exist on one of the following layers (as appropriate for the specific entity); for shapefiles, remediation-specific entities shall be included in separate shapefiles corresponding to the following layers:

Utilities

Utility_Water
Utility_StormSewer
Utility_SanitarySewer
Utility_Phone
Utility_Fiber
Utility_Gas
Utility_Electric_Over
Utility_Electric_Buried
Utility_Other

Structures

Structure_EquipBuild
Structure_Building
Structure_TankBasin

Structure_AST
Structure_PumpIsland

Areas

Pavement_Asphalt
Pavement_Gravel
Pavement_Concrete
Area_Excavation

Pipe

Pipe_SVE
Pipe_HorizSVE
Pipe_Sparge
Pipe_GWE
Pipe_Electric
Pipe_MPVE
Pipe_VER
Pipe_Discharge

Wells

Well_Monitor
Well_SVE
Well_Sparge
Well_GWE
Well_MPVE
Well_VER
Well_SoilBoring

Text

Text

(d) O&M Phase: O&M reports and site remediation completion reports. Upload each report as one, combined PDF document including text, tables, figures, and appendices (except analytical data).

(e) Closeout Phase. Closeout letters to property owners, final site closure reports/letters. Upload each closeout letter as a PDF document. Upload each report as one, combined PDF document (except analytical data).

Do not include analytical data (including QA/QC data) that are contained in reports as appendices when reports are uploaded. All analytical data must be submitted as it becomes available as specified above.

Do not upload photos. Provide digital photos to the STP Project Manager.

B. Subsurface Investigation (SSI)/Additional Site Assessment Tasks (0907.05)

(i) SSI/Additional Site Assessment Management

Note that all data collected during the SSI should be included in the final Remedial Action Plan (see task B(v) below). A separate SSI report should not be prepared or uploaded to the GIS.

(a) Non-resident engineering firms must register the project with the Department of Revenue (DOR). Resident engineering firms that will be using non-resident subcontractors for the subsurface investigation portion of the project must register the project with DOR. If a resident engineering firm's subcontractor uses non-resident subcontractors, the project must be registered with DOR. Registration must be done within 15 days of starting the project. Department of Revenue will send the ENGINEER a packet of information. Engineering firms that must register the project (as identified above) are required to post a 4% bond for the SSI portion of the contract. In lieu of a bond, a letter of credit may be acceptable to DOR. The cost for the bond or letter of reference should be included in the SSI management task. ENGINEER must withhold 4% of non-resident subcontractors' payments until the bond is released by DOR. At the completion of the subsurface investigation, ENGINEER shall notify DOR. Department of Revenue will issue affidavits to the non-resident subcontractors. The ENGINEER shall release the 4% withholding upon notification from DOR. At that time, DOR will release the ENGINEER's bond. System modifications during O&M that require construction-related activities (e.g., trenching or dig and haul work) must also be registered with DOR. A 4% bond will be required for construction-related activities during O&M. Please contact the Department of Revenue (307) 777-7961 if you have any questions.

(b) Project Management Plan

(1) Within 15 calendar days of receipt of the Notice to Proceed, the ENGINEER will prepare and submit a Project Management Plan to WDEQ for review and approval. The plan shall include an organizational chart and description of key personnel responsibilities. The plan shall list the project director, project manager, project engineer and geologist, key field personnel, subcontractors, and equipment. Additionally, the plan shall address:

(A) The approach for minimizing waste generation, handling, and disposal throughout the life of the project.

(B) The approach for water, energy, and fuel conservation throughout the life of the project. Consideration for the use of renewable energy.

(C) Recycling approach.

(2) Personnel experience summaries and/or resumes shall be provided. Certificates of completion of initial OSHA Hazardous Waste Site Worker Training, annual refresher training, and supervisory training (as appropriate) shall be provided for each person proposed for work on the sites. Key personnel identified in the Proposal should remain with the project for its duration. Replacement of key personnel will be allowed with written approval by WDEQ. WDEQ reserves the right to reject any or all personnel the ENGINEER proposes. In the event WDEQ does not approve proposed project personnel, the ENGINEER shall promptly provide replacement personnel meeting WDEQ approval.

(c) Task Schedule and Cash Flow Projections. The ENGINEER shall prepare and submit for approval a graphic time schedule showing the tasks to be completed and the time in which they will be conducted and completed. This time schedule shall include provisions to graphically portray the actual time schedule of tasks completed for use in progress evaluation. The cash

flow projection will indicate the tasks or subtasks to be completed under each payment request. The time schedule, task schedule, and cash flow projection shall be updated and submitted with each pay request. Anticipated budget and/or schedule overruns and a recovery plan shall be included with each pay request. The ENGINEER shall notify the WDEQ Project Manager when a task goes over budget and provide justification for the overage. Failure by the ENGINEER to submit an updated time schedule, task schedule, and cash flow projection with each pay request will result in delays in processing payments.

(d) Project Health and Safety Plan. Within 15 calendar days of receipt of the Notice to Proceed, the ENGINEER shall submit a project-specific Health and Safety Plan (HASP).

(1) A project HASP must be developed by the ENGINEER and reviewed by WDEQ before work begins. Review of the ENGINEER's HASP shall not imply WDEQ's acceptance or approval of the plan. The HASP must address hazards likely to be encountered at the sites and establish policies and procedures to protect workers and the public from the hazards. The plan will also provide measures to minimize the possibility of accidents and injuries that may occur during normal activities or adverse weather conditions.

(2) Each on-site worker must be trained and in current compliance with health and safety provisions of 29 CFR Part 1910.120. Documentation shall be provided to verify compliance with this requirement. Workers that have not received required training or that lack training certificates will not be permitted to perform work at the sites.

(e) Sampling and Analysis Plan (SAP). The SAP shall include a Quality Assurance/Quality Control (QA/QC) Plan for sample collection and analysis. The plan shall be prepared in accordance with "STP Guidance Document #7 Analytical Requirements" found at http://deq.state.wy.us/shwd/stp by clicking on the "Guidance Documents" link. It is the ENGINEER's responsibility to ensure adequate QA/QC procedures are utilized in sample handling and analysis so that representative analytical results are obtained.

(1) This plan shall be submitted to the WDEQ Project Manager for review and approval.

(2) The laboratory that the ENGINEER proposes to use for analysis of environmental samples shall be indicated. Sample analyses must be completed by a laboratory accredited by the American Association for Laboratory Accreditation (A2LA) for the Wyoming Storage Tank Program. A list of these labs can be found on the STP's website: http://deq.state.wy.us/shwd/stp by clicking on the "Prequalified Contractors" link.

(3) Static water level and immiscible layers shall be measured prior to well purging and sampling. A minimum of three well casing volumes must be removed from the well prior to sampling, except when free product exists. If water samples are to be collected from wells containing free product, the purging/collection procedure must be approved by WDEQ before proceeding. Low yielding wells can be evacuated to dryness. Samples are not to be taken until wells have totally recovered. Samples are not to be taken within 48 hours of well development. Samples collected from the bottom of the aquifer, if specifically requested, must be collected in a manner that will not allow the sample collected, nor the inside of the sample container, to come into contact with groundwater above the sample depth.

(4) Low-flow sampling may be used at wells conducive to the technique. Low-flow sampling techniques must follow ASTM D 6771-02, "Standard Practice for Low-Flow Purging and Sampling for Wells and Devices Used for Ground-Water Quality Investigations." In accordance with ASTM D6771-02, peristaltic and other suction-lift pumps may not be used for low-flow sampling unless DRO is the only analysis that will be completed. No-flow sampling, such as "Hydrasleeve," may be used provided collection protocols are described in the SAP.

(5) All handling procedures must be carefully established and followed. Samples must be cooled to 4°C for transportation to the laboratory. Proper chain-of-custody procedures must be followed. Field blanks, duplicate samples, laboratory spikes, etc. will be utilized as part of the QA/QC program. The ENGINEER must supply all chain-of-custody reports and lab reports, including QA/QC reports, to WDEQ in the Remedial Action Plan or applicable routine report.

(6) In addition to groundwater analyses required in STP Guidance Document #7, analyses may be required to evaluate remediation system wastewater disposal options (e.g., WYPDES permit or industrial pretreatment permit). The ENGINEER shall determine additional water analyses required for wastewater disposal options and present those to WDEQ.

(7) Monitored Natural Attenuation Parameters.

(A) The ENGINEER shall collect groundwater samples and have the samples analyzed for monitored natural attenuation (MNA) parameters at all sites where MNA is the proposed remedial action. The groundwater samples are to be collected only from equally spaced groundwater monitoring wells along, or very near, the centerline of down-gradient groundwater contaminant plumes and immediately up gradient of the leaking tank source in an uncontaminated groundwater monitoring well. A2LA laboratory certification is **not** required for MNA indicator parameters in groundwater.

(B) The MNA parameters and EPA methods are the same for fuel and waste oil tank sites and are specified in the following table:

ANALYTICAL METHODS FOR MNA INDICATOR PARAMETERS IN GROUNDWATER

CONSTITUENT	EPA METHOD*
Dissolved Iron (Fe^{+2})**	3020A/7381 or 6010C
Total Iron (Fe^{+3})	3020A/7381 or 6010C
Nitrate (NO^{-3})	353.2
Sulfate (SO^{-4})	375.2
Sulfide (S^{-2})***	376.2
Total Manganese (Mn^{+2})	3020A/7361 or 6010C
Methane (CH_4)***	3810
Total Alkalinity	310
pH	On site
Dissolved Oxygen	On site

*Detection levels are EPA-method specific. Notification is required for all constituents detected above the detection level.

** **Dissolved** iron samples must be collected and shipped in an air-tight amber glass container with no head space. If the sample cannot be delivered to the laboratory within 48 hours, the sample must be filtered on site with a 45 micron filter. Add nitric acid to lower the sample pH to <2 **after** sample is filtered on site. If the sample can be delivered to the laboratory within 48 hours, there is no need to filter the sample on site. **Do not** acidify the sample during on-site collection.

*** Methane and Sulfide samples must be collected and shipped in an air-tight glass container with no head space.

(8) Ethanol-Blended Fuel Release Sites. The ENGINEER shall refer to STP Guidance Document 16 for sampling requirements at ethanol-blended fuel release sites. The ENGINEER shall work with the STP project manager to determine the appropriate site-specific requirements.

(f) Sage Grouse Coordination/Activities. If Work will be conducted outside of an obvious city/town limit and not in a previously disturbed area, the ENGINEER shall immediately notify the STP Project Manager. If WDEQ determines that the work is in a Sage Grouse Core Area and/or within 2 miles of an occupied lek, the ENGINEER shall consult with Wyoming Game & Fish Department (WGFD) and follow all steps on the STP's Sage Grouse Checklist. The STP Project Manager will provide the ENGINEER with the WGFD contact information. Consultation includes running an analysis tool called Density Disturbance Calculation Tool (DDCT). The ENGINEER will be responsible for running the DDCT tool. The tool can be found at:

http://wgfd.wyo.gov/web2011/Departments/Wildlife/pdfs/SAGEGROUSE_DENSITYTOOL0002017.pdf

A copy of all information provided to WGFD by the ENGINEER must be given to the STP Project Manager. WGFD will coordinate with the STP Project Manager, and all protective stipulations and mitigation measures will be provided to the ENGINEER. All protective stipulations and mitigation measures must be included in the ENGINEER's plans/specifications and other work products. Lead time from WGFD may be substantial. ENGINEER should notify the STP Project Manager as soon as possible if it appears drilling or other activities will be required outside of a city/town limit and a disturbed area. Sage grouse habitat mitigation and consultation with WGFD is an on-going activity throughout the life of this project.

(g) Threatened and Endangered Species Survey

(1) Site Survey Report. The ENGINEER may be required to furnish services for a site-specific authoritative survey of threatened and endangered plant and animal species at or near the proposed remediation sites. The survey shall satisfy the requirements of the Endangered Species Act (Act) and shall include those species that are federally listed in accordance with the Act, and those that are presently candidate species for listing under the Act. A one-page report will be prepared for each site surveyed. All reports shall be submitted within 90 days after receipt of the Notice to Proceed. Each report, at a minimum, will include: 1) county name and legal description of properties or areas, 2) species observed, 3) a brief description of habitats, 4) a comment on the suitability of the site for the species that may reasonably be expected in the area, 5) photographs, and 6) an overview and recommendations for avoidance.

(2) Mitigation or Avoidance Report. The ENGINEER shall provide recommendations for mitigation or avoidance of adverse impacts on threatened and endangered species, per the requirements of the Act. Three copies of these recommendations shall be submitted to WDEQ with the final system design.

(h) Cultural Resources Inventory

(1) Cultural Resources Inventory Report. The ENGINEER may be required to conduct or commission an inventory of the cultural resources that may be affected by the proposed remediation design at each site within the project. Such inventories shall be conducted by a qualified professional. All cultural resource reports shall be submitted within 90 days after receipt of the Notice to Proceed. The report, at a minimum, shall include: 1) an inventory of the cultural resources present on each site in the form of completed WyCP forms, which can be found at http://wyoshpo.state.wy.us, 2) a map of the project area, 3) maps of each site showing the location of all cultural features, artifact concentrations, and plan views of proposed remediation system locations, 4) photographs of all cultural features that will be affected by the proposed remediation systems, and 5) and overview and recommendations for avoidance. Two copies of the report shall be submitted to WDEQ.

(2) Mitigation or Avoidance Report. Three copies of a plan to mitigate the adverse affects of the remediation systems on any of the sites determined eligible for the National Register of Historic Places shall be submitted to WDEQ with the final system design. This could include marking off areas to be avoided by construction activities due to the existence of cultural resources.

(ii) Review Project Files and Reports

Identified source sites and known affected third party sites where additional assessment may be required are provided in Attachment A-1.

(a) Review WDEQ Files and Reports. The ENGINEER shall review all available documentation to determine the areas where additional information must be obtained to fully define the extent of contamination and to complete design of remediation systems.

The ENGINEER shall review all information available in the WDEQ project files for each site and prepare brief site descriptions and site maps for each site. The ENGINEER shall identify the size, number, and condition of removed, abandoned, and existing tanks; suspected release date and contaminants; findings of previous investigations (if any); location(s) of previously installed monitoring wells (if any); location(s) of potentially affected third party site owners; and other pertinent site characterization information. All files must be reviewed in the district office where the work is being performed by contacting the WDEQ Project Manager. Files cannot be removed from the district office. Within 30 days of the Notice to Proceed, the ENGINEER shall provide a letter report to the WDEQ Project Manager summarizing the findings of the file review.

Reports of subsurface investigations or conditions generated by WDEQ, or on behalf of WDEQ, are available to the ENGINEER in the WDEQ district office for the purpose of study and planning only. Any records of such investigations that are included in these documents are advisory only. These reports are not part of this Contract and are furnished solely for the convenience of the ENGINEER. WDEQ assumes no responsibility for the sufficiency or accuracy of previous investigations or existing reports, the records thereof, or the interpretations set forth therein. There is no warranty or guarantee, either express or implied, that the conditions are as indicated by previous investigations or reports thereof, or that unforeseen developments will not occur, or that materials other than, or in proportions different from, those indicated will not be encountered.

(b) Locate Previously Installed Monitoring Wells. The ENGINEER shall locate previously installed monitoring wells using a metal detector, survey coordinates, or other methods. The ENGINEER shall identify the number and location of previously installed wells for each site and describe any needed repairs. All previously installed monitoring wells shall be shown on the site maps.

(c) Identify Potentially Affected Third Party Site Owners. The ENGINEER shall identify potentially affected third party site owners resulting from the review of available files and reports. The ENGINEER shall identify the site owner's name, address, telephone number, and property legal description for each potentially affected third party site.

(iii) Research Public Records and Conduct Site Owner Interviews

(a) Research Public Records. Within 30 days of the Notice to Proceed, the ENGINEER shall provide a letter report to the WDEQ Project Manager summarizing the findings of the research. The ENGINEER shall use a qualified person to research the records of the Courthouse and the County Assessor's Office where the work will be performed for each of the source sites and identified potentially affected third party sites. The third party site owner's name, address, telephone number, and property legal description shall be provided in the report.

(b) Interviews. Within 30 days of the Notice to Proceed, the ENGINEER shall provide a letter report to the WDEQ Project Manager summarizing the findings of the interviews. The ENGINEER shall interview site owners and operators to confirm property ownership and

obtain pertinent site information (e.g., confirming current and past ownership). The ENGINEER will prepare questions for interviews that can be conducted in person, by telephone, or by letter. These questions shall be phrased to obtain as much pertinent information as possible without creating animosity between the ENGINEER and the person being interviewed. The ENGINEER shall ask these questions, however, the person being interviewed is under no obligation to answer the questions. When no answers or incomplete answers are provided, the interview can be considered complete as long as the ENGINEER has made a reasonable effort to obtain information and all information obtained has been recorded in writing.

(iv) Secure Permits and Third Party Access Agreements

(a) Secure Required Permits. The ENGINEER shall provide all required permits to the WDEQ Project Manager within 60 days of the Notice to Proceed and prior to initiating any site activities. These permits may include, but are not limited to, Utility Licenses from the Wyoming Department of Transportation, and any permits or licenses required from a municipality, county, state, or federal agency.

(b) Secure Third Party Access Agreements. The ENGINEER shall provide signed access agreements to the WDEQ Project Manager within 60 days of the Notice to Proceed. WDEQ will provide the ENGINEER with the Standard Access Agreement form. The ENGINEER shall obtain a signed access agreement from all potentially affected third party site owners.

(1) As work progresses and third party affected sites are identified, the ENGINEER shall determine property ownership and obtain signed access agreements from those property owners. For purposes of proposal and cost estimates, the ENGINEER should assume 10 third party affected sites will be identified.

(2) If the ENGINEER cannot obtain an access agreement from any property owner, the ENGINEER shall immediately notify the WDEQ Project Manager.

(c) Grantor Approval of Remediation Wells, Piping, Equipment and Appurtenances on Grantor's Property. The ENGINEER shall secure a signed "Grantor Approval of Remediation Wells, Piping, Equipment and Appurtenances on Grantor's Property" agreement whenever wells, piping, equipment, or appurtenances are to be placed on a source site or third party site.

(v) Prepare Additional Site Assessment Plan

(a) If additional site condition information is necessary as a result of the evaluation of existing data, an Additional Site Assessment Plan shall be prepared. This plan shall be submitted to WDEQ for review at least fifteen (15) calendar days prior to the start of the assessment work.

(1) The Additional Site Assessment Plan shall be structured to provide the following minimum information: 1) source of contamination present, 2) contamination characteristics, 3) extent and degree of contamination, 4) age of contamination, and 5) facts and circumstances relating to the release. Data will be identified that are needed to support design of an appropriate remedial action program. Sampling activities will be consistent with the requirements stated above for the SAP.

(2) The plan shall define how the additional information will be collected, analyzed, and incorporated into the Remedial Action Plan (RAP). The ENGINEER shall coordinate soil and groundwater remediation objectives with WDEQ and evaluate existing data relative to those objectives.

(b) After receiving signed access agreements, the ENGINEER shall confirm the validity of the site descriptions, prepared as part of the file review, by completing field reconnaissance at all sites. Field reconnaissance shall include identifying the presence of overhead utilities and observable underground utilities.

(c) Site maps shall be prepared showing the location of the former tanks and pertinent features (including overhead utilities).

(vi) Planning Meeting. The ENGINEER shall meet with the STP Project Manager at the WDEQ District Office to present the information in the Additional Site Assessment Plan. The ENGINEER is responsible for providing a complete analysis of available data and the need for additional information. WDEQ shall evaluate the information presented at the meeting and request changes, as necessary. No work presented in the Plan shall commence until WDEQ has approved the information presented at this meeting and until requested changes have been made by the ENGINEER. Any remobilization costs, costs for additional subsurface analysis, or other costs for work needed because of incomplete field effort will be the ENGINEER's responsibility.

(vii) Additional Site Assessment Field Work

The ENGINEER shall conduct additional site assessment identified in the Additional Site Assessment Plan and approved by WDEQ. The ENGINEER is responsible for the types, quantities, and locations of all subsurface investigation methods necessary for the ENGINEER to provide complete system designs. The results from the additional site assessment shall be presented in the Remedial Action Plan.

The ENGINEER shall devise a numbering scheme that will tie sample locations, sample types (e.g., soil, water), sample numbers, boreholes, wells, pits, laboratory reports, and data presentations (e.g., maps, tables, figures, appendices) together.

Drilling and analytical testing for the additional assessment will be completed by the ENGINEER or a contractor under contract with the ENGINEER. The ENGINEER is responsible for the execution of this contract whether the work is completed by the ENGINEER's subcontractor or by the ENGINEER.

The ENGINEER is responsible for providing adequate high-visibility barricades, flares, lanterns, signs, flaggers, and pre-warning devices to alert motorists and pedestrians of hazardous conditions. These measures shall be in accordance with the current issue of the Manual of Uniform Traffic Control Devices for Streets and Highways (published by the U.S. Department of Transportation), the Wyoming Department of Transportation Manual on Traffic Control for Roadway Work Operations, and in accordance with the regulations of any local municipal authority. The ENGINEER shall coordinate its traffic safety plan with the appropriate jurisdictional authority.

(a) Locate and Clear Utilities.

(1) The ENGINEER shall be responsible for locating and clearing utilities where subsurface investigation work will be completed. Locations of all existing underground utilities within the project sites shall be horizontally and vertically located to the fullest extent possible and clearly labeled as to size and type on the site maps. The underground utilities shall be tied to an established horizontal control survey marker whenever feasible (e.g., Wyoming Department of Transportation Highway Right-of-Way Marker, State Plane Coordinates Monument, etc.). Any subsurface utility damaged by Engineer or Contractor shall be repaired at no cost to WDEQ.

(2) At sites where impressed current corrosion protection systems are operating the ENGINEER shall be responsible for locating and marking, on the ground, the corrosion protection components before site work begins. Corrosion protection components shall be shown on the plans. ENGINEER shall have a WDEQ-licensed cathodic protection system tester inspect and test the system prior to the start of any SSI site work and again after SSI site work is completed. ENGINEER is advised that lead time for a licensed tester to be on site may take up to two (2) months or longer. Owner or operator shall be notified by the ENGINEER at least seven (7) days in advance of the testing. Testing shall not be completed more than one (1) month in advance of drilling or other intrusive work nor later than one (1) month after drilling or other intrusive work is complete.

(b) Locate Private Wells. The ENGINEER shall locate all private wells within the vicinity of each site and include a list of the wells and all related information in the Remedial Action Plan. Information provided shall include type of well, completion date, depth, casing type, present or past use, and available completion data.

(c) Install Soil Borings

(1) Boreholes shall be drilled by the ENGINEER at locations and to depths agreed to during planning meetings. At least one boring shall be located in tank excavations or immediately down gradient. Drilling shall continue radially outward until soil samples collected at the groundwater table do not show hydrocarbon contamination by field instrument. Drilling shall continue vertically downward to a depth of 5 feet below the lowest expected level of the groundwater table.

(A) Hollow Stem Auger Drilling. Hollow stem auger is the preferred drilling method. The ENGINEER is responsible for selecting hollow stem augering equipment capable of completing holes to the necessary depths, given the expected subsurface conditions. Alternate drilling methods will be authorized only after demonstration that all attempts to utilize hollow stem augering have been exhausted through extensive documentation of inability to advance auger and/or inability to reach target depth.

(B) Solid Stem Auger Drilling. If site conditions are favorable, solid stem auger drilling may be used for subsurface investigation holes at the ENGINEER's risk and discretion. WDEQ will assume no responsibility for failed solid stem auger boreholes. Any redrilling of boreholes necessitated by the use of solid stem augers will be at the ENGINEER's expense.

(C) Direct Push. Direct push or punch methods (i.e., geoprobe, hydropunch, etc.) may be used where conditions are favorable and at the ENGINEER's risk and discretion. WDEQ will assume no responsibility for failed direct push boreholes. Any redrilling of boreholes necessitated by the use of direct push methods will be at the ENGINEER's expense. If used, the direct push rig and equipment must be capable of collecting core samples, and the ENGINEER must be able to produce an accurate log of the subsurface conditions.

(D) Air Percussion Drilling. Air percussion drilling referenced herein refers to a technique where drilling and casing are completed simultaneously and the hole is lined with tubes as the drilling proceeds. Drill casing utilized for this type of drilling shall have an inside diameter of no less than 6.625 inches. A change of drilling method from hollow stem augering to air percussion will be made only with prior authorization from the WDEQ Project Manager. The ENGINEER will be required to demonstrate the unsuitability of hollow stem auger drilling by documented inability to advance boreholes to target depths even after attempting offsets. Slow rates of drilling and/or failure to attempt offsets will not be deemed sufficient documentation to justify change of drilling methods.

(2) All down-hole equipment shall be decontaminated between borings to minimize the risk of cross contamination. Decontamination water must be disposed of according to applicable rules and regulations. The ENGINEER shall provide WDEQ with the location to be used for water disposal.

(3) All soils from the boreholes shall be disposed of by the ENGINEER. If the soils do not have hydrocarbon contamination, they may be disposed of on the project site if approved by the site owner. If the soils are contaminated with hydrocarbons, they must be disposed of at a site approved by WDEQ Solid and Hazardous Waste Division. The ENGINEER shall obtain all permits and pay all costs associated with soil disposal. The ENGINEER will notify the WDEQ Project Manager of the disposal site.

(4) Soil samples will be collected using split spoon samplers or an alternative method approved by WDEQ. Samples will be collected continuously during installation of all borings in the tank basin or immediately down gradient of the tank basin and at 5-foot intervals during installation of all other borings. These samples shall be analyzed using a field instrument to determine the most heavily contaminated area of the contaminated zone in each boring. A sample from the most heavily contaminated area of the contaminated zone in each boring shall be submitted to the laboratory for analyses.

(5) Headspace monitoring for total volatile hydrocarbons will be conducted on each soil sample collected using a catalytic platinum filament (e.g., Tank Techtor, etc.) or PID (e.g., HNu, Photovac Tip, etc.) methodology.

(6) The ENGINEER shall provide an accurate log of each borehole. This documentation shall be provided by or under the direct supervision of a Wyoming licensed Professional Geologist. Soil samples shall be described in accordance with the Unified Soil Classification System, as specified in ASTM D 2488, unless another method is approved by WDEQ. The ENGINEER shall use the format shown on the Borehole Completion Diagram included in Appendix A of these Contract Documents. The log shall include the thickness of the contaminated zone and the distance between the bottom of the contaminated zone to the groundwater table.

(7) Each borehole not completed as a well shall be surveyed for both horizontal location and elevation (above mean sea level). This survey information is to be plotted on the coordinate base map provided in the Remedial Action Plan. The Wyoming State Plane Coordinate System (Wyo. Stat. § 34-25-101 through 108) shall be used when surveying and plotting the borehole locations. Surveys shall be conducted in accordance with Wyo. Stat. § 33-29-124 by a Wyoming Registered Professional Land Surveyor. Survey data shall be in feet. Location should also be provided in latitude/longitude to incorporate the borehole into the GIS.

(8) Borehole closure must be performed in accordance with Chapter 26, Wyoming Water Quality Rules and Regulations. A deviation may be permitted, however, for shallow boreholes that do not penetrate the groundwater table. These may be abandoned with the associated cuttings, if they are uncontaminated, and with a 2-foot bentonite plug on the upper 2 feet. All other boreholes must be abandoned with a bentonite slurry. Borings in paved areas or other public use areas shall be abandoned in accordance with the requirements of the jurisdiction having authority. The ENGINEER shall obtain WDEQ's approval prior to abandoning any borehole.

(9) Any redrilling of boreholes necessitated by the negligence or fault of the ENGINEER will be done at the ENGINEER's expense.

(d) Backhoe Excavation Test Pits. Backhoe test pits may be used in lieu of boreholes to examine the subsurface conditions and/or obtain representative samples. The location and size of the excavation shall be determined by the ENGINEER.

(1) The ENGINEER shall provide accurate documentation of the soil in the test pit. This documentation shall be provided by or under the direct supervision of a Wyoming licensed Professional Geologist. Soil samples shall be described in accordance with the Unified Soil Classification System as specified in ASTM D 2488, unless another method is approved by WDEQ.

(2) Each excavation and each sample collection point within each excavation shall be surveyed for both horizontal location and elevation (above mean sea level). This survey information is to be plotted on the coordinate base map provided in the Remedial Action Plan. The Wyoming State Plane Coordinate System (Wyo. Stat. § 34-25-101 through 108) shall be used when surveying and plotting the excavation locations. Surveys shall be conducted in accordance with Wyo. Stat. § 33-29-124 by a Wyoming Professional Land Surveyor. Survey data shall be in feet.

(e) Monitoring Wells

(1) Well Installation. Selected boreholes will be completed as monitoring wells at locations agreed to during planning meetings. Monitoring well permits for wells 4-inches or less in diameter are not required by the Wyoming State Engineer's Office or WDEQ.

(A) Monitoring well construction must satisfy the requirements of Chapter 26 of the Wyoming Water Quality Rules and Regulations and Part II, Chapters III, IV, V, and VI of the Wyoming State Engineer's Office Regulations and Instructions. The borehole diameter shall be at least 4 inches larger in diameter than the well casing diameter. All wells shall be constructed using 2-inch Schedule 40 PVC, or 4-inch Schedule 40 PVC if requested by WDEQ Project Manager, unless this material is found to be incompatible with conditions in the field. In this case an alternate well material shall be chosen by the ENGINEER and approved by WDEQ for the well construction.

(B) The casings shall meet the conditions provided in the Wyoming Water Quality Rules and Regulations Chapter 26. All well casing sections will be flush threaded. Under no circumstances are PVC glue or plastic welding solvents to be used to join casings. The casing will be fitted with a free draining, threaded bottom cap of the same material as the casing. The top of the casing will be fitted with a locking cap.

(C) The well screen shall be commercially manufactured plastic screen or slotted casing only, unless otherwise directed by the WDEQ Project Manager. Screen slot size will be chosen to be compatible with the granular pack. The screened interval shall extend at least 2 feet above the highest expected seasonal groundwater level and at least 5 feet below the lowest expected groundwater level. Any deviations from the specified screened interval must be approved by the WDEQ Project Manager. The screened interval shall intersect the water table of the uppermost aquifer. The granular pack around the screened interval will extend to 1 foot above the screen. The granular pack will be chosen for compatibility with the screen slot size and the geologic materials encountered to minimize the entrance of fine grained material into the well. The granular pack will be placed into the annular space in such a manner that no voids or bridging will occur.

(D) A seal of bentonite pellets or chips, 2 feet in thickness, shall be placed above the granular pack. The bentonite plug shall be hydrated for 24 hours prior to placing the surface seal. The annular space above the bentonite seal to within 1 foot of the surface shall be sealed with Portland cement or a sand-cement grout. The grout shall be placed into the annular space in such a manner that no voids or bridging will occur. The sealing material shall meet the conditions provided in the Wyoming Water Quality Rules and Regulations Chapter 26.

(E) Monitoring wells shall be completed with an 8-inch metal, flush-mounted, watertight well box with cover, unless an aboveground completion is requested by WDEQ. A traffic-rated well box shall be used. The well box will be set in place with concrete at the same time the upper foot of the annular space is completed. A bolted, flush-mount cover will be installed to minimize the potential for entry of fluids from the ground surface. A 2-inch diameter, non-corrodible pipe shall be installed inside the well box such that one opening is flush with the concrete inside the well box and the other opening extends at least 6 inches into native soils beneath the well box. The well box will be placed 2 inches above the existing ground surface in areas not subject to snow removal. The well box for monitoring wells in street or drive/parking areas subject to snow removal shall be placed 2 inches below the existing ground surface. A wire-mesh reinforced, 4000 psi concrete apron will be completed from the top of the well box to the ground surface and will be bonded to existing concrete or asphalt. Monitoring wells shall be permanently identified on top of the cover with the well number stamped into the metal.

(F) A watertight PVC well plug with lock shall be provided by the ENGINEER. The locks shall be Master Lock, Model 21, or approved equivalent. The locks shall be keyed as directed by the WDEQ Project Manager. The number shall not be on the lock.

(G) Monitoring well closure must be performed in accordance with Chapter 26, Wyoming Water Quality Rules and Regulations, and Part III, Chapter VI of the Wyoming State Engineer's Office Regulations and Instructions. Wells in paved areas or other public use areas shall be abandoned in accordance with the requirements of the jurisdiction having authority. The ENGINEER shall obtain the WDEQ's approval prior to abandoning any monitoring well.

(H) Any redrilling of boreholes caused by failure to reach the planned total depth, by careless drilling affecting samples, or for failure in the installation of well materials will be done at the ENGINEER's expense.

(I) Accurate as-built documentation of the well design and construction shall be provided by the ENGINEER. This documentation shall be provided by or under the direct supervision of a Wyoming licensed Professional Geologist or Professional Engineer.

(J) Each well shall be surveyed for both horizontal location and elevation (above mean sea level). A referenced water level measuring point to the nearest 0.01 foot shall be established and used at each monitoring well. The reference point shall be established as the north side, top of PVC casing. This survey information is to be plotted on the coordinate base map provided in the Remedial Action Plan. The Wyoming State Plane Coordinate System (Wyo. Stat. § 34-25-101 through 108) shall be used when surveying and plotting the well and borehole locations. Surveys shall be conducted in accordance with Wyo. Stat. § 33-29-124 by a Wyoming Registered Professional Land Surveyor. Survey data shall be in feet.

(2) The ENGINEER shall develop the well by overpumping, water surging, air surging, or jetting.

(A) A typical procedure is to develop the well by surging a minimum of 50 times with a 3-foot teflon bailer or surge block. At least 3 borehole volumes shall be removed after surging.

(B) At the completion of surging and purging, at least one water sample shall be collected and allowed to sit undisturbed for 10 minutes. Well development should settle the filter pack, alleviate bridging, and remove any fines from the pack and casing. If no appreciable sand or sediment accumulates, the well will be assumed to be adequately developed. If sand or sediment accumulates in appreciable quantities, the WDEQ Project Manager shall determine if further development is necessary.

(C) Wells with free product shall not be developed.

(D) The ENGINEER shall develop and sample wells within 10 days of well installation. The ENGINEER shall not sample wells within 48 hours of well development.

(3) Contaminated Water Disposal. Water that is collected during monitoring well development or sampling must be disposed of properly by the ENGINEER. If the water cannot be disposed of in the local sanitary sewer, the ENGINEER will propose a water disposal plan for approval by WDEQ. WDEQ will approve the water disposal plan before any contaminated water will be disposed.

(f) Geologic Cross-Sections

(1) Geologic cross-sections depicting lithologic relationships and lithologic continuity shall be developed. Geologic cross-sections shall include cross-section location maps.

(2) The specific plotting method shall be agreed to by WDEQ and the ENGINEER during the planning meeting. At least one geologic cross-section will be provided for each site. Cross-sections shall be completed by or under the direct supervision of a Wyoming licensed Professional Geologist and must be stamped by a Wyoming P.G. A complete reproducible set of each cross-section shall be included in the Remedial Action Plan. The ENGINEER may also provide cross-sections prepared from information found in earlier reports and investigations; however, the information must be verified for accuracy or a disclaimer attached.

(g) Potentiometric Surface and Iso-concentration Maps

(1) A potentiometric surface map shall be prepared for each of the project areas. Individual iso-concentration maps shall be prepared for free product, TPH, and each chemical compound with concentrations equal to or greater than the published STP action level. Iso-concentration maps will be developed only after discussion with the WDEQ Project Manager to determine their usefulness.

(2) Each iso-concentration map shall be provided in the Remedial Action Plan. Iso-concentration maps shall include data from all wells sampled; the format for this data presentation shall be clarified with the WDEQ Project Manager prior to development of the maps. The State Plane Coordinate System (Wyo. Stat. § 34-25-101 through 108) shall be used when surveying and plotting the well locations. Well coordinates and top of casing elevations shall be arranged by site and provided in tabular form.

(h) Characterize Free Product. Product samples will be collected and analyzed for source identification or when necessary to complete analysis of subsurface conditions. The necessity of this characterization, sampling protocol, and analytical method used shall be approved by WDEQ.

(i) Vapor Intrusion Determination.

(1) If assessment reveals that an acute or chronic vapor intrusion exposure may be a concern (e.g., plume has migrated or is suspected to have migrated under or near buildings or along preferential pathways) at the site or adjacent properties, ENGINEER shall assess the possibility of vapor intrusion to buildings, sewer lines, etc. There are two main concerns with vapor intrusion. The first is the potential for vapors to accumulate and become a volatile explosion hazard. This is most common in sewer lines, sumps, and other confined, subsurface, places. The second concern is for affects to human health from vapors in homes, schools, and work places. At a minimum the ENGINEER shall perform the following tasks to evaluate the potential for vapor intrusion impacts:

(A) The ENGINEER shall survey the immediate area at each site and interview residents and workers to determine if vapors have been detected.

(B) The ENGINEER shall use an instrument capable of detecting hazardous vapors to assess potentially hazardous (explosive) spaces such as sewer lines, sumps, utility corridors, etc. Indoor air monitoring will be performed as necessary to quantify reports of odors or potential vapor exposures.

(C) The potential for vapors to affect human health from dissolved phase plumes or LNAPL plumes must be evaluated. Several guidance documents (e.g., ITRC Vapor Intrusion Guide, 2007; EPA OSWER Draft Guidance for Vapor Intrusion to Indoor Air Pathway from Groundwater and Soils, 2002) exist that provide steps for evaluating this pathway.

(2) The vapor hazards evaluation and mitigation shall be completed in accordance with Chapter 17, Section 42, and STP Guidance Document No. 7. An indoor air monitoring and sampling schedule shall be determined by the ENGINEER and STP Project Manager if appropriate.

(3) Following the construction of any active subsurface

remediation system that has the potential to liberate or move petroleum vapors from source areas (e.g., air sparge), a follow up vapor intrusion evaluation will be required using the same procedures as the initial evaluation. This is intended to ensure the active system has not caused a vapor intrusion problem.

(viii) Project-Specific SSI Tasks. ***[PROJECT MANAGER TO INPUT ANY PROJECT-SPECIFIC ADDITIONAL SITE ASSESSMENT TASKS HERE. KEEP SAME FORMAT AS REST OF DOCUMENT. ADD TASKS TO RFP COST SCHEDULE IN ATTACHMENT B. IF THERE ARE NO PROJECT-SPECIFIC ADDITIONAL SITE ASSESSMENT TASKS, REMOVE THIS PARAGRAPH, REMOVE FROM THE OUTLINE IN SECTION 1, AND REMOVE FROM THE COST SCHEDULE IN ATTACHMENT B.]***

C. Design Tasks (0906.01)

(i) Design Management.

(a) If necessary to reflect current project status, the ENGINEER shall update the Project Management Plan, task schedule, cash flow projections, project Health and Safety Plan, and the Sample Collection and Analysis Plan. The time schedule, task schedule, and cash flow projections will be submitted with each pay request.

(b) If electrical service, gas service, telephone service, sewer disposal, etc. are required for operation of the proposed systems, the ENGINEER shall begin discussions with the provider as soon as information needed by the provider is available. The ENGINEER shall be responsible for providing information and drawings necessary for the provider in a timely manner such that connection of the various services can be completed prior to planned system startup. All utilities shall be in WDEQ's name and utility billing shall be through the WDEQ project manager. WDEQ will enter into contracts needed by the utility company; however, documentation, including but not limited to, drawings, plans, and specifications for the required service shall be provided by the ENGINEER to the utility company.

(ii) Pilot Testing

(a) The ENGINEER shall conduct preliminary evaluation of feasible remediation technologies for each site. The preliminary evaluation shall include, but is not limited to, remediation potential, constructability, cost, permit requirements, construction effects on site owner/operators, etc.

(b) The ENGINEER shall prepare a Pilot Test Work Plan for WDEQ review and approval. At a minimum the plan shall include the technologies proposed for pilot testing, the location(s) selected for pilot testing, the estimated cost of conducting the pilot test(s), the data to be obtained from the pilot test(s), and how the data will be used in the final selection and design of the remediation systems. This plan shall be approved by WDEQ prior to commencing work.

(c) The ENGINEER shall complete the pilot testing according to the WDEQ-approved Pilot Test Work Plan.

(d) The ENGINEER shall obtain well permits from the State Engineer's Office for all pilot test wells that extract groundwater. Permits are not required for 4-inch or less diameter monitoring wells. The pilot test well permits shall show WDEQ/SHWD/STP as the well owner. The well contact shall be the STP Project Manager **not the ENGINEER**.

(e) Prior to implementing an injection program on a site where a cathodic protection (CP) system (sacrificial anodes or impressed current) may be impacted as determined by the ENGINEER, a WDEQ-licensed cathodic protection system tester must test the CP system. The ENGINEER shall recommend the frequency of testing necessary to determine if the injection program is causing adverse impact to the tanks or CP system. If the CP system shows a failing test, the ENGINEER and CP tester must determine how to counteract the injection program to protect the tank(s). A CP system is considered effectively protecting a tank if the system test shows a reading of less than -850 millivolts (mv). When the injection program is complete, the CP tester must retest the system and make necessary adjustments. Required CP testing should be considered part of the pilot test injection program and associated costs shall be included in the ENGINEER'S cost estimates.

(f) The ENGINEER shall minimize waste generation during pilot testing. Pilot test procedures that have the potential to generate a non-media (filters, canisters, etc.) hazardous waste shall be approved by STP Project Manager prior to the ENGINEER implementing the procedure. The ENGINEER shall be responsible for proper disposal of all waste generated during pilot testing.

(iii) Remedial Action Plan (RAP)

(a) Draft RAP

(1) Preliminary Draft RAP. One copy of the Preliminary Draft RAP shall be submitted to the WDEQ Project Manager. At a minimum, the Preliminary Draft RAP shall provide a summary of the additional site assessment findings, ENGINEER's recommendations, and a preliminary remedial approach at the sites. The Preliminary Draft RAP should provide sufficient detail to allow WDEQ to evaluate the remedial approach proposed and further understand the scope of the Project. One copy of the Preliminary Draft RAP shall be provided within 60 days of the completion of the additional site assessment. The full Appendices need not be included with this copy. WDEQ will complete its review of the Preliminary Draft RAP within 15 working days of receipt. Depending on the nature and severity of WDEQ's comments, the ENGINEER may be called for an in-person meeting. The Preliminary Draft RAP shall be dated and clearly stamped **Draft - For Review Only**, or other similar language, so as to not construe it as a final document.

(2) Final Draft RAP. One copy of the Final Draft RAP shall be submitted to the WDEQ Project Manager. The Final Draft RAP shall be in final form and content and in the format specified below. One copy of the Final Draft RAP, including all Appendices, shall be provided within 60 days of WDEQ's acceptance of the Preliminary Draft RAP. The Final Draft RAP binder covers and inside title pages shall be dated and clearly stamped **Draft - For Review Only**, or other similar language, so as to not construe it as a final document. WDEQ will complete its review of the Final Draft RAP within 30 days of receipt. The ENGINEER shall be prepared to meet with WDEQ and discuss the content of the document. This meeting may either be in person or via teleconference, depending on the nature and severity of WDEQ's comments. Following completion of changes requested by WDEQ, the ENGINEER will prepare three complete copies of the Final Draft RAP, including Appendices, for WDEQ and distribution to public review locations. Each binder cover and inside title page shall be dated and clearly labeled, **Final Draft RAP for Public Review**. WDEQ will distribute the copies. The ENGINEER will provide single copies of summary site-specific information and maps from the Final Draft RAP for use in disseminating information to site owners/operators.

(b) Final RAP. The ENGINEER shall modify the Final Draft RAP in response to owner/operator concerns and public comments after obtaining WDEQ approval of the modifications. This modified draft will become the Final RAP. Within 10 days of WDEQ's approval of the modifications, the ENGINEER shall provide the WDEQ Project Manager with three copies of pages that were modified for insertion into the copies at WDEQ and the public review locations. Each copy of the Final RAP shall bear the original seals and signatures of the Engineer and Geologist of record for the Project as having responsibility for the content of the document.

(c) Remedial Action Plan Report Requirements and Guidelines. This section is intended to provide guidance for preparing a RAP for the Storage Tank Program (STP). The guidance describes major components and sections that should be contained in any RAP submitted to the STP. To allow faster review, the RAP must be organized as outlined below.

(1) Title Page. The title page should identify the site(s) for which the RAP is being prepared, the date the RAP was prepared or submitted, and the name of the consulting firm preparing the RAP.

(2) Table of Contents. The table of contents should be sufficiently detailed to facilitate rapid location of information contained in the RAP. In addition to identifying the major sections and subsections of text, the table of contents should include: 1) List of Appendices, 2) List of Tables, 3) List of Figures, and 4) List of Plates.

(3) Introduction. The introduction should familiarize the reader with the approaches and design criteria used in developing the RAP. At a minimum, this section should include: 1) summary of document content and layout, 2) index map that lists and shows the location of sites discussed in the RAP, 3) summary of methodology for sampling and choosing remedial technologies, and 4) description of criteria evaluated to choose appropriate remedial systems (e.g., technical, human health, environmental impact, institutional, and present worth cost criteria).

(4) Description of Subsurface Environmental Conditions. This section should describe the results of subsurface investigations undertaken to assess the nature and extent of contamination and to support selection and design of remediation systems. It may reference previously completed investigations, if applicable. As applicable, this section should address the following:

(A) Summary of Site History. Identify the sites using the WDEQ facility identification number, provide the date(s) when the release(s) was/were first known, the type of product released, and actions taken to date (e.g., free product removal, emergency response stabilization, other remedial responses). Present a chronological summary of conditions at each site or remedial area being evaluated, including: 1) description of the remedial area location and past/present use, 2) identification of known or potential sources of contamination, 3) description of circumstances leading to the release, 4) summary of acute and chronic risks, including the location of domestic wells and if contamination appears to extend underneath residential areas, 5) basis for known site conditions (e.g., borehole data, excavation, third party report, previous site information), and 6) description of the horizontal and vertical extent of contamination (including soil and groundwater plumes and the level of precision to which they have been measured).

(B) Sampling and Analysis of Groundwater and Soils. Describe the location and number of samples taken and the parameters tested. Summarize the methodology and results of subsurface investigations performed to confirm or refine results of initial

investigations or to enhance the development or choice of remediation. Describe the boring and sampling methodology for soils; and the methodology for drilling, installation, and utilization of groundwater monitoring wells. Describe sampling procedures, shipping methods for samples, name of laboratory that performed the analyses, and the analytical methods used. Explain the reasoning behind the choice of analytical methods, particularly if samples were analyzed using WDEQ-approved alternate methods. Describe the disposal method for contaminated soils and groundwater generated during well installation and development. Describe the differing layers of the soil column and the impact of soil conditions on the overall remediation effort. For example, if capillary fringe soil contamination is to be included with the groundwater remediation, the RAP should explain that capillary fringe soils data were included when delineating groundwater contamination plumes. Explain the numbering scheme used to tie the sample locations, sample numbers, laboratory report samples, etc. to each site. Present a brief summary of sampling and analytical results. Summarize the samples having concentrations above the analytical detection limit.

(5) Environmental Restoration Standards. Describe the methodology used for determining environmental restoration standards for both soil and groundwater. Explain how the proposed restoration standards will meet Water Quality Rules and Regulations Chapter 17. Clearly identify any EPA or WDEQ criteria adopted. If the standards for a particular contaminant vary based on location (e.g., different facilities within a multi-facility RAP, or different locations in the soil column), the reasons for the variation should be explained and justified. Specify the anticipated remediation time range necessary to achieve target cleanup levels at each site. Calculations should be provided to fully illustrate the parameters, analyses, and computations used.

(6) Description of Remediation Area Conditions. A summary description of remediation area conditions including those discussed below should be provided. This information could be displayed in table format.

(A) Risk characterization including acute hazards identified, acute hazard exposure pathways, chronic hazards identified, and chronic hazard exposure pathways.

(B) General characteristics including identified UST contributing sites, potential unidentified sources, active and inactive tanks, suspected contaminants present, vertical and horizontal extent of contamination, concentrations and distribution of contaminants throughout the soil profile, preferred pathways, acreage of remediation area, offsite land uses, site geology (evidence of sinkholes, fractures, lithologic units and/or rock types, faults, or other discontinuities), and potential for non-tank related contaminants to influence restoration efforts.

(C) Soil characteristics including soil type and stratification; general mineral composition; texture; porosity; permeability; concentrations of VOCs, TPH, or metals; surface area of contamination; and extent of contamination under structures, in groundwater, and off site.

(D) Groundwater characteristics including depth to uppermost groundwater table; water chemistry (hardness, total dissolved solids, total suspended solids, concentrations of metals); aquifer thickness and type; direction and velocity of groundwater flow; hydraulic conductivity; existence of free product, VOCs, TPH, and metals; vertical and horizontal distribution of groundwater contamination; size of VOC, TPH, and metals plumes; extent of contamination under structures and off site.

(7) Maps, Tables, and Appendices. Provide a visual display for each remediation area. Displays should include: 1) the location of each facility including tanks, streets, nearby structures, and other prominent features; 2) areas of impacted soils within the unsaturated and capillary fringe zones; 3) lateral extent of groundwater contaminant plumes with concentrations exceeding cleanup levels; 4) monitoring wells, including cone penetrometer groundwater sampling locations; 5) groundwater flow direction on potentiometric surface maps; 6) borehole locations and designations (e.g., Geoprobe, soil boring); 7) soil sampling depths including depth to groundwater table; and 8) concentration contour maps for detected constituents.

All maps should provide the STP facility identification number. A system of color coding can be used to depict areas with contaminants exceeding restoration standards. If coverage is available, the most recent Wyoming Department of Transportation air photographs may be used in presenting aerial views of each site.

A brief written summary emphasizing the pertinent information given on each map should be included in the RAP text. To the extent that any pertinent details are not included in the text, the following types of information should be provided in tables or appendices: 1) laboratory reports, including QA/QC documentation for soil and groundwater analyses, 2) summary data tables; 3) copies of all completed well permit completion forms, as filed in the Wyoming State Engineer's Office; 4) individual well completion information, including State Plane Coordinates, latitude/longitude, and water level measuring point elevations; and 5) well borehole and/or Geoprobe survey data, including groundwater surface elevations and State Plane Coordinates.

(8) Preliminary Evaluation of Remediation Technologies and Pilot Testing. Describe the scope and evaluation of preliminary remediation technology selection to demonstrate applicability, reliability, and selection of technologies for pilot testing. Describe the proposed pilot testing program to generate site-specific data necessary to evaluate relative merits and limitations of remedial alternatives and provide data to design remediation systems.

(A) Preliminary Evaluation of Remediation Technologies. Identify available remediation technologies. Based on various screening criteria, identify a technology with potential merit for each site. The RAP should provide a brief overview of each method, including a description of the processes involved, and a demonstration that the technologies are appropriate for given site conditions. Demonstration that technologies are proven to meet WDEQ restoration standards through removal or reduction of concentrations of target constituents is also required. Technologies that are considered extremely disruptive or that are considered emergency measures for imminent risk situations should not be included. In most cases, technologies considered experimental or not well proven in equivalent environments should not be considered.

While monitored natural attenuation (MNA) may meet performance criteria for both soils and groundwater, it should only be proposed as the primary means to achieve restoration standards where available data clearly demonstrate that contamination is of limited degree and extent and has minimal potential for migration to points of exposure. The following conditions must exist before MNA will be considered as the primary remediation technology: 1) contamination must not be migrating or expanding in areal extent; 2) monitoring mechanism must be provided; 3) final environmental restoration standards must be reached in the same time frame as active remediation within the same project; and 4) if active remediation technology is engineered into the core of the primary subsurface contamination plume, MNA may be considered for fringes of the plume.

(B) Pilot Testing Program. Describe the pilot testing program used to assess the site-specific feasibility of the various technologies being considered at each site.

1) Explain why certain remediation technologies are considered appropriate, given chemical and physical characteristics of local soils and/or groundwater, including a discussion of how the scope of pilot testing was determined.

2) Describe the procedures and data collection techniques for the systems, including descriptions of the equipment used, its specifications, and schematic diagrams of the equipment and system layout.

3) Describe the sampling procedures, including shipping methods, name of laboratory, and the analytical methods used.

4) Explain why specific parameters were omitted and why such omissions do not affect the viability of the method or technology.

5) Provide tabular summaries of pilot system sampling data, estimated maximum removal rates, applied vacuum, flow rate, estimated radius of influence, constituent maximum initial concentration, pumping rate, maximum draw down, aquifer flow velocity, hydraulic conductivity, transmissivity, specific capacity, etc.

6) Define terms and parameters, methods of calculating them, and citations of prior studies or papers used.

7) Describe data collection methods and calculations, including descriptions of the equipment selected and methodologies used for data plotting and calculations (may be located in an appendix).

8) Provide brief summaries of the results of the pilot tests, possibly in tabular form, including a brief assessment of overall viability. Full reporting of results may be reserved for an appendix.

9) Identify technologies that do not require pilot testing to accurately determine feasibility and conceptual design and a statement why pilot testing is not necessary. Identify remedial areas having similar characteristics where a given technology would produce similar results.

10) Describe any computer modeling used, including model names.

(9) Feasibility Evaluations and Conceptual Designs. Evaluate the feasibility of potential remediation options based on data generated during the preliminary evaluation and pilot testing. Present conceptual designs of remedial technologies selected. Provide this information for each site requiring remediation. The feasibility evaluation shall include a comparison of the environmental footprint expected from each cleanup alternative, including green house gas emissions. ENGINEER shall consider the need for disposal of potentially hazardous non-media (filters, canisters, etc.) waste generated as a result of the remedial alternative selected. Prior approval by the STP project

manager must be obtained to implement a technology that generates non-media (filters, canisters, etc.) hazardous waste during remedial alternative operation.

(A) Description of Potentially Feasible Remediation Technologies. Provide a schematic diagram of a typical system for each potential technology. Provide an overview of equipment needs, operating and monitoring requirements, and discharge control. If a seemingly appropriate technology was not included in the feasibility evaluation and the reason is not immediately apparent, a brief explanation of why it was not included should be provided.

(B) Evaluation and Selection of Remediation Technologies. Describe the criteria used in evaluating the potential remediation technologies. Compare the technical, institutional, and fiscal merits and limitations of potential remedial technologies and justify the selection of certain technologies. Tabular presentation of the results is appropriate.

1) Base technical evaluations on performance, reliability, implementability, and safety aspects of the technology. Factors affecting performance include effectiveness and useful life of the systems. Reliability includes consideration of operation and maintenance requirements and demonstrated reliability of the technology. Implementability is based on ease of permitting and construction. Factors affecting safety include potential threats to public health and/or the environment during implementation and measures taken to mitigate the potential for adverse effects. Describe the general applicability of each system to hydrogeologic conditions and existing contamination.

2) Institutional considerations include compliance with federal, state, and/or local regulations and ordinances; environmental and public health standards; tank system owner/operator concerns; and community relations. General institutional considerations pertinent to remediation technologies include coordination with: 1) WDEQ, Air Quality Division, for air emissions; 2) municipalities for discharge of water to the sanitary sewer system and/or storm drain system, building permits, fire codes, noise ordinances, electrical codes, roadway crossings, manholes, etc.; 3) WDEQ, Water Quality Division, WYPDES Section, for storm sewer discharges; 4) WDEQ, site owners, and the public where odors and noise nuisances may be problematic; and 5) companies supplying electrical, gas, and telephone service, or other utilities required to operate systems.

3) Analysis of present worth associated with the remedial technologies including capital, operation and maintenance, and shutdown/removal. Capital costs include two categories; direct and indirect. Direct capital costs are those associated with construction of the remediation system and include labor, equipment, and materials. Construction and equipment costs shall be presented as separate line items. Indirect capital costs are those associated with engineering, permitting, and construction management for the remediation system. Operation and maintenance costs include costs to operate and maintain the systems. Shutdown and removal costs include system decommission, system removal, site restoration, and salvage.

A present worth analysis shall be computed for all technically feasible remediation options, and the lowest cost option will be selected for each site. This analysis should also clearly explain why the chosen technologies are best suited to achieve restoration standards. Appendices may be used to provide further justification.

(C) Alternative Technologies. List other technologies considered, and provide a brief explanation of why each was not selected in terms of the evaluation criteria outlined above.

(D) Conceptual Designs. Display schematically how the selected technologies will be configured and designed to attain optimal results within fiscal and institutional constraints. Site plans should include the general layout of each system including well locations, piping networks, and equipment enclosures. Include process flow diagrams showing extraction/treatment trains. Provide a thorough description of proposed equipment including types, capacities (e.g., horsepower, air volumes), efficiencies, locations, and numbers/densities. Describe groundwater monitoring and all types of remediation wells including horizontal and vertical placement, placement criteria, and pump and flow test results. Provide system operation summaries (e.g., where the treated groundwater will be discharged/re-injected), special design requirements to ensure that a locality's infrastructure will not be overwhelmed by proposed discharge, operation to remain within noise limits or permit limits. Include a site-specific project schedule that tracks the work from construction and start-up through operation and closure. Provide typical construction details including well completion, wellhead assemblies, equipment enclosure layouts, trench cross-sections, and typical sewer connections.

(E) Design and Cost Parameters. Specify the design parameters for each remediation system. Include effective and maximum radii of influence (ROIs) achievable with various flow rates and vacuums applied. Precisely describe the equipment that will be used and separate costs by component in a summary cost table. This table should include direct capital costs, indirect capital costs, annual O&M costs, and shutdown/removal costs.

(10) Progress Monitoring. Describe how remedial progress will be monitored, including: 1) sampling methods, 2) sampling density, 3) sampling frequency (e.g., at start-up, during operations, and after asymptotic conditions have been reached), 4) analyses to be conducted (e.g., contaminants or other constituents, temperature, pH, etc.), and 5) analytical methods to be used.

(11) System Monitoring and Controls. Describe methods of controlling plume migration and soil erosion, propose a rate of contaminant recovery, identify system controls (e.g., overload detectors, alarms, shutoff systems), and describe off-gas recovery and groundwater treatment. Outline a program for system monitoring including identification of monitoring points and inspection frequencies.

(12) Permits and Health and Safety Plan for Operation. Identify the permits needed to implement the remedial actions, describe existing municipal noise restrictions and limits, and provide a health and safety plan for remedial action personnel.

(13) Maps. Provide site maps that are sufficiently detailed to identify all components of the remedial system and site-specific information for the surrounding area. Include the WDEQ identification number for each facility. Area maps included with the document should show, to the extent possible, the locations of: 1) groundwater monitoring wells, 2) soil boring and sampling locations, 3) areas of impacted soils in the unsaturated zone and capillary fringe, 4) lateral extent of the dissolved hydrocarbon and free product plumes, 5) total groundwater contamination plume, 6) total soils contamination plume, 7) groundwater flow direction, 8) groundwater injection wells, 9) remediation wells and radii of influence, 10) remediation system piping, 11) manholes, 12) roadways and alleys, 13) utilities or other buried features, 14) signs, 15) surface materials (vegetation, curb, gutter, sidewalk, etc.), 16) light and power poles, 17) drinking water wells, 18) surface water bodies, 19) playgrounds, 20) parking lots, and 21) buildings (note basements within close proximity to remediation systems).

(14) References. Clearly identify documents, studies, reports, and other resources referenced in or relied upon to assemble the RAP.

(15) Appendices. As indicated throughout this guidance, any information that is too voluminous or technical to include in the major sections outlined above may be assembled into appendices. For example, while the RAP may summarize sampling results, the actual data may be assembled in an appendix. If there is lengthy background material available summarizing a system's specifications and capabilities, this information may be included as an appendix. While site-specific drawings are crucial for displaying the extent of contamination and demonstrating the conceptual design of a remedial system, a map showing the site's relation to structures in the area and to other sites in the project should be included as an appendix.

Obviously, each remedial site is unique. Site-specific conditions govern the content of a RAP, from the nature of the contamination present to the choice of potential technologies for reduction or removal of contaminants. However, WDEQ recommends that the components described above be used as the starting point for development of the RAP. The ENGINEER should coordinate with WDEQ if there are questions or concerns about particular site-specific elements to be included in the RAP.

(iv) Construction and Equipment Plans and Specifications. After the ENGINEER has received authorization from WDEQ to proceed with design, the ENGINEER shall:

(a) Prepare Engineering Design Report. The Engineering Design Report shall address the following: 1) remediation system operation theory and objectives; 2) remediation system hydraulics and treatment processes; 3) summary of the anticipated flows, influent characteristics, and effluent requirements; 4) proposed equipment sizing, safety factors, and design calculations; 5) system interlocks, alarms, and responses; 6) construction/equipment itemized cost estimate(s); 7) value engineering and cost savings; and 8) permits required.

(1) The Engineering Design Report shall include an "Existing System Reuse Evaluation." The evaluation shall discuss steps taken to evaluate existing STP systems that are shut down and waiting for decommissioning at other STP projects. The evaluation shall identify available systems, whether or not any of the available systems can be used for this project, reasons for not using available systems, and a cost comparison between reusing a system and buying a new system. The ENGINEER should contact all STP Project Managers for a summary of sites where equipment is available for reuse. STP Project Managers can provide information on available systems and arrange for the ENGINEER to inspect the equipment. The ENGINEER is responsible for making a complete determination as to whether or not available equipment will meet the project requirements.

(2) The Engineering Design Report shall include product efficiency, reliability, fuel and energy consumption, air emissions, and water consumption for pieces of equipment that require electricity or gas for operation. A comparison shall be made between various pieces of equipment to meet the project needs and conserve energy. A list of components, materials, supplies, etc. that are made from recycled materials or that can be recycled after their intended use shall also be included. Use of renewable resources shall be discussed and any other green remediation technology that was considered during design. A comparison of costs associated with the use of green remediation technologies versus traditional technologies shall be presented for consideration by the WDEQ.

The Department of Energy estimates that 1.37 pounds of CO_2 are emitted for each kilowatt hour of electricity generated in the U.S. Green remediation

technologies that minimize electricity must be considered during design of remediation systems. Technologies that might be considered include:

(A) Using a smaller blower to reduce energy requirements and green house gas emissions. The additional cost and environmental impacts to operate the blower over a longer time frame to reach cleanup objectives should be evaluated.

(B) Using a smaller blower and cycling through different legs of an air sparge system to reduce energy requirements and green house gas emissions. Again, the additional cost to operate the blower over a longer time frame must be evaluated.

(C) Operating pulsed pumping during off-peak hours of electrical demand, if possible, to reduce costs.

(D) Enclosure heat recirculation during winter months, insulating structural housing and equipment, installing energy recovery ventilators to maintain air quality without heat or cooling loss in treatment buildings, weather-proofing system components that are exposed to outside elements, etc.

(E) Use of passive and renewable energy sources.

(F) Use of variable frequency drives to operate equipment.

(b) Prepare Preliminary and Final Construction Plans and Specifications. Two sets of plans and specifications shall be prepared; one for the site construction work and one for the equipment supply.

(1) Preliminary Design Documents. The ENGINEER shall prepare Preliminary Design documents consisting of preliminary drawings including site plans, system layouts, and process flow diagrams. Preliminary Design documents shall include an outline of the construction and equipment supply specifications. If the ENGINEER specifies brand-name equipment, the ENGINEER must also specify "or equivalent in quality and performance." It is important to incorporate an appropriate level of quality into brand name and model because performance alone is not sufficient. If the design specifies a specific piece of equipment, and no other manufacturer makes that specific piece of equipment, the ENGINEER must document and justify that brand named item.

Non-proprietary program logic controls must be provided for all equipment shipped to the project sites. If programmable logic or controls are provided rather than standard relay and timer control logic, the equipment supplier must supply all the software, equipment, access codes, etc. necessary to interface with the control equipment such that the WDEQ, the ENGINEER, and the operation and maintenance personnel can operate and maintain the equipment, including making adjustments to operation, without input or assistance from the equipment supplier. The ENGINEER shall be responsible for insuring that control logic is provided that meets this requirement.

(A) Based on the information contained in the Preliminary Design documents, submit an engineer's estimate of construction and equipment costs.

(B) Furnish two copies of each (site construction and equipment supply) of the Preliminary Design Documents within 60 days after the Final RAP has been

approved by the WDEQ Project Manager. The Preliminary Design documents must be presented and reviewed in person with the WDEQ Project Manager. The Preliminary Design Documents shall be dated and stamped, **Preliminary - Not for Bidding,** or similar language so as not to construe these as final documents. WDEQ will review the Preliminary Design Documents within 30 calendar days and may request a meeting or teleconference to discuss the design.

(2) Final Design Documents. After authorization to proceed with the final design, the ENGINEER shall prepare final construction and equipment design drawings, details, and specifications. Specifications shall comply, in general and only as necessary to provide a concise bidding document, with the 16 division format of the Construction Specifications Institute. Drawings shall contain all known information concerning horizontal and vertical locations of existing underground utilities and any surface structures that may interfere with the work.

(A) Engineer shall advise WDEQ of any adjustments to the engineer's cost estimate caused by changes in general scope, extent, character, or design requirements of the project or construction costs.

(B) The ENGINEER shall submit 90% plans and specifications to WDEQ for review. The ENGINEER shall meet with WDEQ to review and finalize the plans and specifications, if necessary. Two copies of the Final Plans and Specifications shall be submitted to WDEQ within 45 days after authorization to proceed with the Final Design. Each copy of the Final Plans and Specifications shall have an original stamp and seal by the Engineer(s) of record as having responsibility for the design. Prior to distribution, each copy of the individual major sections of the Plans and Specifications (e.g., Civil, Mechanical, Electrical) shall also be signed and sealed by a Wyoming Registered Professional Engineer as having responsibility for the content of the individual sections. All documents offered to the public and prepared or issued under the supervision of a Wyoming licensed Professional Geologist shall include the full name, date, license number, and original seal and signature of the licensee.

(c) Obtain Necessary Permits. The ENGINEER shall provide WDEQ with a summary of the permits necessary to complete the work. A schedule indicating when each permit must be obtained to keep the project on schedule shall be submitted.

The ENGINEER shall obtain all necessary permits for the proposed systems for WDEQ in WDEQ's name, including permits or authorizations issued by other WDEQ agencies. These permits or authorizations may include a Wyoming Pollutant Discharge Elimination System (WYPDES) permit for wastewater discharge to surface waters, Industrial Pretreatment Permit for sanitary sewer discharges, WDEQ Air Quality Division permit for air emissions, State Fire Marshall's Office for electrical system review, and any other permits from state or local government agencies necessary for the installation and operation of the proposed system. Fees billed for permits required from state agencies will be paid directly by WDEQ. The ENGINEER shall assist WDEQ in consultations with appropriate authorities if necessary.

The ENGINEER shall obtain well permits from the State Engineer's Office for all remediation wells that extract groundwater. Permits are not required for 4-inch diameter or less monitoring wells. The remediation well permits shall show WDEQ/SHWD/STP as the well owner. The well contact shall be the STP Program Manager, 122 West 25th Street, Herschler Building 4W, Cheyenne, WY 82001, 307-777-7244.

The ENGINEER shall obtain a license from the Wyoming Department of Transportation (WYDOT) to perform work within WYDOT right-of-way. The ENGINEER shall be responsible for coordination with WYDOT.

If wastewater disposal involves re-injection of the wastewater into a groundwater aquifer, detailed project information and coordination with WDEQ Underground Injection Control Section is required. A public notice, and possible public hearing, may also be necessary based on input received by WDEQ. Wastewater requiring transportation to a commercial disposal facility requires prior WDEQ approval.

(v) Project-Specific Design Tasks. ***[PROJECT MANAGER TO INPUT ANY PROJECT-SPECIFIC DESIGN TASKS HERE. KEEP SAME FORMAT AS REST OF DOCUMENT. ADD TASKS TO RFP COST SCHEDULE IN ATTACHMENT B. IF THERE ARE NO PROJECT-SPECIFIC DESIGN TASKS, REMOVE THIS PARAGRAPH, REMOVE FROM THE OUTLINE IN SECTION 1, AND REMOVE FROM THE COST SCHEDULE IN ATTACHMENT B.]***

D. Construction Oversight Tasks (0906.02)

(i) Construction Oversight Management.

(a) If necessary to reflect current project status, the ENGINEER shall update the Project Management Plan, task schedule, cash flow projections, project Health and Safety Plan, and the Sample Collection and Analysis Plan. The time schedule, task schedule, and cash flow projections will be submitted with each pay request.

(b) All injection wells including, but not limited to, air sparge and chemical oxidation, shall be permitted through DEQ Water Quality Division Underground Injection Control (UIC) program. A UIC permit shall be obtained by the ENGINEER for each injection well.

(c) Construction management and oversight involves two contracts; one for site construction and one for equipment supply. As used in this section, the term Contractor, shall include both the Construction Contractor and the Equipment Supplier.

(ii) Construction and Equipment Bid Assistance. The ENGINEER shall:

(a) Assist WDEQ in advertising and obtaining bids for site construction and equipment supply for installation of the remediation systems. Two sets of bid documents shall be prepared; one for the site construction work and one for the procurement of remediation equipment. The ENGINEER shall be responsible for distributing the bid documents to interested parties (at no cost to WDEQ), maintaining a record of firms receiving bid documents, conducting a prebid conference (for site construction only) at the project site, and receiving and processing deposits for bid documents. The ENGINEER shall prepare three complete sets of both bid documents and one extra copy of WDEQ's boiler plate for both bid documents for WDEQ.

(b) Issue addenda as appropriate to interpret, clarify, or modify the bid documents. All addenda issued by the ENGINEER shall be signed and sealed by the Engineer of record as having responsibility for the Project.

(c) Consult and advise WDEQ as to the acceptability of subcontractors, suppliers, and other persons and organizations proposed by the contractors for those portions of the work requiring subcontractor acceptability by the bid documents.

(d) Consult with and assist WDEQ concerning the acceptability of equivalent substitute materials and equipment proposed by the contractors when substitutions prior to award of the contracts are allowed by the bid documents.

(e) Assist WDEQ in evaluating bids for both the construction contract and the equipment supply contract.

(iii) Construction Oversight. The ENGINEER shall consult with and advise WDEQ and act as WDEQ's representative during construction. The extent and limitations of the duties, responsibilities, and authority of the ENGINEER as assigned in the following paragraphs shall not be modified, except as WDEQ and the ENGINEER may otherwise agree in writing. WDEQ's instructions to the contractors will be issued through the ENGINEER who will have authority to act on behalf of WDEQ.

(a) Preconstruction Meeting. The ENGINEER shall meet with representatives of the contractors and their subcontractors, utility firms, telephone company, City or Town officials, other affected parties, and WDEQ at a preconstruction meeting. The purpose of the meeting is to allow representatives to meet and inform all interested and affected parties of planned activities and schedule. WDEQ will make arrangements for the meeting.

(b) Preconstruction Photographic Documentation. Prior to commencement of any construction activities, the ENGINEER shall document conditions at each site within the project by photographing each site from at least three angles using a 35mm camera and color film or digital camera. The photographs shall be dated and mounted on notebook pages with descriptive and identifying information accompanying each photograph. Photo negatives will be included with the project notebook submitted to WDEQ. The ENGINEER will provide WDEQ with video camera coverage of each site and assemble the coverage on standard DVDs. Facility identification numbers may be photographed prior to coverage at each site as a method of identifying each site while viewing the DVDs.

(c) At sites where corrosion protection systems are operating (impressed current or sacrificial anode), the ENGINEER shall be responsible for locating and marking, on the ground, the corrosion protection components before construction begins. ENGINEER shall have a WDEQ-licensed cathodic protection system tester inspect and test the system prior to the start of any site work and again after site work is completed. ENGINEER is advised that lead time for a licensed tester to be on site may take up to two (2) months or longer. Owner or operator shall be notified by the ENGINEER at least seven (7) days in advance of the testing. Testing shall not be completed more than one (1) month in advance of site work and must be completed again before substantial completion is issued.

(d) Construction Inspection and Oversight. The ENGINEER shall make site visits to observe the work of the contractors while the work is in progress.

(1) The ENGINEER shall make visits to the project site at intervals appropriate to the various stages of construction as the ENGINEER deems necessary in order to observe and evaluate, as an experienced and qualified design professional, the progress and quality of the various aspects of the contractor's work. The ENGINEER will control acceptance of work, materials,

equipment, and substitutions, and may reject work or materials that do not meet the specifications. The ENGINEER shall provide the services of a Resident Project Representative and approved assistants on site to assist the ENGINEER and provide more continuous observation of the work. Based on information obtained during site visits, the ENGINEER shall ensure that the work is being accomplished and equipment is being installed in accordance with the Contract Documents. The ENGINEER shall keep WDEQ informed of the progress of the work.

(2) The purpose of the ENGINEER, Resident Project Representative, and assistant's visits to the sites is to enable the ENGINEER to better carry out the duties and responsibilities assigned to and undertaken by the ENGINEER during construction. The ENGINEER's efforts, as an experienced and qualified design professional, will provide WDEQ with a strong degree of confidence that the completed work of the contractors will conform to the Contract Documents and that the integrity of the design concept has been implemented and preserved by the contractors. On the other hand, the ENGINEER shall not, during such visits or as a result of such observations of the contractor's work, supervise, direct, or have control over the work. The ENGINEER shall not have authority over or responsibility for the means, methods, techniques, sequences, or procedures of construction selected by the contractors; or for safety precautions and programs incident to the work of the contractors; or for any failure of the contractors to comply with laws, rules, regulations, ordinances, codes, or orders applicable to the contractor's furnishing and performing their work. Accordingly, the ENGINEER can neither guarantee the contractor's performance under the contract nor assume responsibility for the contractor's failure to furnish and perform their work in accordance with the Contract Documents.

(3) The Resident Project Representative (RPR) and any assistants agreed upon by WDEQ will be the ENGINEER's agent or employee and under the ENGINEER's supervision. The duties and responsibilities of the RPR include, but are not limited to:

(A) Review the progress schedule, schedule of shop drawing submittals, and schedule of values prepared by the contractors and consult with the ENGINEER concerning acceptability.

(B) Attend meetings with the contractors, such as preconstruction conferences, progress meetings, safety meetings, job conferences, and other project-related meetings; and prepare and circulate copies of minutes thereof.

(C) Serve as the ENGINEER's liaison with the contractors, working principally through the contractor's superintendents. Assist contractors in understanding the intent of the Contract Documents. Assist the ENGINEER in serving as WDEQ's liaison with contractors.

(D) Assist in obtaining from WDEQ additional details or information, when required for proper execution of the work.

(E) Record the date of receipt of shop drawings and samples. Receive samples furnished at the site by the contractors and notify the ENGINEER of availability of samples for examination. Advise the ENGINEER and the contractors of the commencement of any work requiring a shop drawing or sample if the submittal has not been approved by the ENGINEER.

(F) Conduct on-site observations of the work in progress, and report to the ENGINEER if the work is not meeting the time schedule. As soon as possible (i.e., use a cell phone), report to the ENGINEER whenever any work is unsatisfactory, faulty, defective, or does not conform to the Contract Documents; or has been damaged; or does not meet the requirements of any inspection, test, or approval. Advise the ENGINEER of work that should be corrected, rejected, uncovered for observation; or requires special testing, inspection, or approval. Verify that tests, equipment, and system startup and operation and maintenance training are conducted in the presence of appropriate personnel and that the contractors maintain adequate records thereof. Observe, record, and report to the ENGINEER appropriate details relative to test procedures and startups. Accompany visiting inspectors representing public or other agencies having jurisdiction over the project, record the results of these inspections, and report to the ENGINEER.

(G) Report to the ENGINEER when clarifications and interpretations of the Contract Documents are needed. Transmit to the contractor clarifications and interpretations issued by the ENGINEER.

(H) Consider and evaluate contractor's suggestions for modifications in drawings or specifications and report RPR's recommendations to the ENGINEER. Transmit decisions issued by the ENGINEER to the contractors.

(I) Maintain at the job site orderly files for correspondence; reports of job conferences; shop drawings and samples; reproductions of original Contract Documents including all Site Work Orders, Field Orders, Amendments, Addenda, and additional drawings issued subsequent to the execution of the Contract; the ENGINEER's clarifications and interpretations of the Contract Documents; progress reports; and other project related documents. Record names, addresses, and telephone numbers of all contractors, subcontractors, and major suppliers of materials and equipment.

(J) Keep a diary or log book and record daily: contractor's hours on the job site; weather conditions; data relative to questions of Site Work Orders, Field Orders, Amendments, or changed conditions; lists of job site visitors; activities; meetings; decisions; contractor's equipment on site; work force on site, observations in general; and specific observations in more detail as in the case of observing test procedures. Send copies to the ENGINEER daily.

(K) Furnish the ENGINEER periodic reports of progress of the work, contractor's compliance with the progress schedule, and schedule of shop drawing and sample submittals. Consult with the ENGINEER in advance of scheduled major tests, inspections, or start of important phases of the work. Draft proposed Site Work Orders, Field Orders, and Amendments, obtaining backup material from contractors. Recommend to the ENGINEER Site Work Orders, Field Orders, and Amendments. Report any accident immediately to the ENGINEER and WDEQ.

(L) Review applications for payment with contractors for compliance with the established procedure for submission and forward with recommendations to the ENGINEER, noting particularly the relationship of the payment requested to the schedule of values, work completed, and materials and equipment delivered at the site but not incorporated in the work.

(M) Verify that operation and maintenance manuals and other data required to be assembled and furnished by the contractors are applicable to the items

actually installed and in accordance with the Contract Documents. Deliver this material to the ENGINEER for review and forwarding to WDEQ prior to final payment for the work.

(N) The ENGINEER may reject the contractor's work while it is in progress if the ENGINEER believes that such work will not produce a completed Project that conforms generally to the Contract Documents or that it will prejudice the integrity of the design concept of the project as reflected in the Contract Documents.

(e) The ENGINEER shall issue necessary interpretations and clarifications of the Contract Documents and in connection therewith prepare Field Orders and Site Work Orders. The ENGINEER shall provide information necessary for WDEQ to prepare Amendments. The documents shall be in the format specified in the Contract Documents. The ENGINEER shall be responsible for providing a complete package for WDEQ approval including budget and/or schedule revisions, scope changes, and results of negotiations. All changes or clarifications issued by the ENGINEER to the contractors shall be signed and sealed by the Engineer of record as having responsibility for the Project.

(f) The ENGINEER shall review and approve (or take other appropriate action) submittals, samples, and other data that the contractors are required to submit. Review and approval shall be for conformance with the design concept of the project and compliance with the information given in the Contract Documents. Such reviews and approvals or other action shall not extend to means, methods, techniques, sequences, or procedures of construction; or to safety precautions and programs incident thereto.

(g) The ENGINEER is responsible for ensuring that proposed substitute materials and/or equipment maintain the same performance as the originally specified materials and/or equipment. The ENGINEER will evaluate all proposed Value Change proposals and make a recommendation to the WDEQ Project Manager.

(h) The ENGINEER shall have authority to require special inspection or testing of the work. The ENGINEER shall receive and review all certificates of inspections, tests, and approvals required by laws, rules, regulations, ordinances, codes, orders, or the Contract Documents (but only to determine generally that the content complies with the requirements of, and the results certified indicate compliance with, the Contract Documents).

(i) The ENGINEER shall assign technically qualified personnel to inspect enclosures and equipment and witness the wet test of each different type of integrated unit at the contractor's assembly location.

(1) The ENGINEER shall verify that each type of unit is functioning at design specifications including, but not limited to, noise, capacity, pressure, vacuum, and temperature. Prior to shipment to the project site, the ENGINEER shall ensure that components of each type of enclosure/equipment unit is functioning properly, both individually and as a unit. The ENGINEER shall be responsible for evaluating the acceptability of each type of unit and providing WDEQ with a recommendation for acceptance prior to shipment to the project site.

(2) The ENGINEER shall verify that electrical wiring is correctly sized and installed.

(3) The ENGINEER shall verify that the components meet the specifications and plans.

(4) The inspectors shall have the authority, with assistance of the Engineer of Record, to reject work, request modifications, etc. that are, in the opinion of the Engineer, necessary for the enclosures and equipment to meet the intent of the Contract Documents.

(5) The ENGINEER shall require a signed certification from the Equipment Supplier stating that all units satisfactorily passed the factory wet test. The certification will be provided to the ENGINEER and WDEQ before the units are shipped by the Equipment Supplier to the project sites.

(j) Based on the ENGINEER's on-site observations as an experienced and qualified design professional, information provided by the RPR, and review of applications for payment and the accompanying data and schedules:

(1) The ENGINEER shall review the amounts owed to the contractors and recommend, in writing, payments to the contractors in such amounts. Such recommendations of payment will constitute a representation to WDEQ, based on such observations and review, that the work has progressed to the point indicated. Further, that to the best of the ENGINEER's knowledge, information, and belief, the quality of such work is generally in accordance with the Contract Documents (subject to an evaluation of such work as a functioning whole prior to or upon Substantial Completion, to the results of any subsequent tests called for in the Contract Documents, and to any other qualifications stated in the recommendation). In the case of unit price work, the ENGINEER's recommendations of payment will include final determinations of quantities and classifications of such work (subject to any subsequent adjustments allowed by the Contract Documents).

(2) By recommending payment, the ENGINEER will not be deemed to have represented that exhaustive, continuous, or detailed reviews or examinations have been made by the ENGINEER to check the quality or quantity of the contractors' work as it is furnished and performed beyond the responsibilities specifically assigned to the ENGINEER in the Contract Documents. The ENGINEER's review of the contractors' work for the purposes of recommending payments will not impose on the ENGINEER responsibility to supervise, direct, or control such work; or for the means, methods, techniques, sequences, or procedures of construction; or safety precautions or programs incident thereto; or the contractors' compliance with laws, rules, regulations, ordinances, codes, or orders applicable to their furnishing and performing the work. It will also not impose responsibility on the ENGINEER to make any examination to ascertain how or for what purposes the contractor has used the funds paid on account of the Contract Price; or to determine that title to any of the work, materials, or equipment has passed to WDEQ free and clear of any lien, claims, security interests, or encumbrances; or that there may not be other matters at issue between WDEQ and the contractors that might affect the amount that should be paid.

(k) The ENGINEER shall receive and review owner's manuals, schedules, guarantees, bonds, certificates of inspection, tests, and approvals that are to be assembled by the contractors in accordance with the Contract Documents. Such review will also be to determine that the content complies with the test and approval requirements needed for certificates of inspection and for compliance with the Contract Documents. The ENGINEER shall use this information in preparation of the operation and maintenance manual.

(l) The ENGINEER shall conduct an inspection to determine if the work is substantially complete and conduct a final inspection to determine if the completed work is acceptable so that the ENGINEER may recommend, in writing, that final payment be made to the contractors. The ENGINEER may give written notice to WDEQ and the contractors that the work is acceptable (subject to any conditions therein expressed).

(m) The ENGINEER shall not be responsible for the acts or omissions of the contractors; the contractors' subcontractors or suppliers; the contractors', subcontractors', or suppliers' agents or employees; or any other persons (except the ENGINEER's own employees, subcontractors, and agents) at the project sites. The ENGINEER shall not be responsible for furnishing or performing any of the contractors' work. However, nothing contained herein shall be construed to release the ENGINEER from liability for failure to properly perform duties and responsibilities assumed by the ENGINEER in the Contract Documents.

(n) As installation of each remediation system is completed, the contractors shall notify the ENGINEER of readiness for full operation. The ENGINEER must observe, verify, and document that each system has operated satisfactorily, as designed, for a continuous period of time to be specified by the ENGINEER in the technical specifications before the system can be accepted as substantially complete. If a system does not meet these requirements, the ENGINEER will submit to contractors a list of items requiring change, modification, correction, or completion. Changes must be made by contractors and a new operating period initiated. After all systems have met the completion requirement, excluding sites remediated by excavation, the ENGINEER will issue a Certificate of Substantial Completion to the contractors. A joint final inspection by the ENGINEER, WDEQ, and the contractors will follow issuance of the Certificate, and a final list of items that must be completed or corrected will be prepared by the ENGINEER and submitted to the contractors. After the ENGINEER has determined that the listed items have been satisfactorily completed, the ENGINEER will recommend acceptance to WDEQ.

(iv) Operation and Maintenance Manual and Equipment Startup

(a) Prepare Operation and Maintenance Manual. An Operation and Maintenance (O&M) manual shall be developed to describe detailed operational and maintenance practices and provide schematics, diagrams, and as-built drawings. This information shall be provided in enough detail to allow each system to be operated as designed and shall be provided in sufficient time to allow startup and operation of the systems.

(1) Included in the manual shall be maintenance requirements and schedules, replacement requirements and schedules, and the location of spare parts. A spare parts list, the locations and phone numbers of each manufacturer's representative and service location, a troubleshooting guide, a description of health and safety risks related to operation and care of the equipment, and a health and safety plan for the operator shall be included in the O&M Manual. The final O&M Manual shall include all the original owners' manuals provided by the equipment manufacturers or other sources and a list of those manuals.

(2) The O&M Manual shall include a schedule for collecting water and vapor samples from remediation equipment and a list of methods to be used for sample analyses. The sampling schedule and methods shall meet the requirements of local and state agencies having jurisdiction. The schedule shall include collection and analyses of groundwater samples from monitoring wells. All monitoring schedules will be reviewed and approved by WDEQ prior to implementation.

(3) The O&M Manual shall include a section on Remedial System Evaluations. The Remedial System Evaluation schedule shall be determined to evaluate:

(A) Is the plume still being captured?

(B) Are new wells needed to capture the plume?

(C) Is energy-intensive equipment oversized or set at rates/temperatures higher than needed?

(D) Are wells that are no longer contributing to the cleanup effort taken off line timely?

(E) Consider alternate technologies (e.g., low-power or passive SVE, passive bioventing) with lower cost and energy after the bulk of the contamination has been removed.

(4) The ENGINEER shall submit a draft O&M Manual to WDEQ for approval no later than 75 percent completion of project remedial system construction. The date when 75 percent of the construction contract time has elapsed, calculated using the Notice to Proceed date and the date of substantial completion, will be defined as the 75 percent completion date. All draft copies of the O&M Manual shall be dated and marked **"Draft - For Review Only."** WDEQ shall review the draft O&M Manual and provide comments to the ENGINEER no later than the system startup date. Within 30 days of startup, the ENGINEER shall prepare the final O&M Manual.

(b) Prepare As-Built Drawings. A complete set of Drawings and Specifications incorporating all Site Work Orders, Field Orders, Amendments, Addenda, and any other revisions shall be supplied to WDEQ at the conclusion of the system construction. The as-built drawings shall be signed and sealed by the Engineer of record as having responsibility for the project certifying that the drawings are complete and accurate reflecting installed conditions.

(c) Equipment Startup

(1) The ENGINEER shall develop a plan and schedule for equipment start-up. The ENGINEER shall describe the plan for staffing and accomplishing start-up of the equipment. The plan shall be submitted to WDEQ no later than 30 calendar days prior to startup of the systems.

(2) The ENGINEER shall coordinate with the local power company and other utility companies, as necessary, to insure power and other utilities are available and connections are made such that startup is not delayed.

(3) Startup of the systems shall be completed by the ENGINEER and the Contractors. WDEQ may be present to witness startup. The ENGINEER shall take measurements and conduct sampling, including sampling and analysis of discharges necessary to make adjustments to the systems so they will operate most effectively and within permit limits. The ENGINEER is responsible for sampling and analyses to determine if the systems are meeting performance and discharge requirements.

(4) Following the construction of any active subsurface remediation system that has the potential to liberate or move petroleum vapors from source areas (e.g., air sparge), a follow up vapor intrusion evaluation will be required using the same procedures as the initial evaluation (see task B(vii)(i) above). This is intended to ensure the active system has not caused a vapor intrusion problem.

(d) Update O&M Manual. Following system startup, the O&M manual shall be updated to take into account any changes made during startup. The final O&M manual shall be signed and sealed by the Engineer of record as having responsibility for the project.

(v) Project-Specific Construction Overview Tasks. [*PROJECT MANAGER TO INPUT ANY PROJECT-SPECIFIC CONSTRUCTION MANAGEMENT AND OVERSIGHT TASKS HERE. KEEP SAME FORMAT AS REST OF DOCUMENT. ADD TASKS TO RFP COST SCHEDULE IN ATTACHMENT B. IF THERE ARE NO PROJECT-SPECIFIC CONSTRUCTION MANAGEMENT AND OVERSIGHT TASKS, REMOVE THIS PARAGRAPH, REMOVE FROM THE OUTLINE IN SECTION 1, AND REMOVE FROM THE COST SCHEDULE IN ATTACHMENT B.]*

E. Operation and Maintenance (O&M) and Monitoring Tasks (0907.06)

(i) O&M Management.

(a) If necessary to reflect current project status, the ENGINEER shall update the Project Management Plan, task schedule, cash flow projections, project Health and Safety Plan, and the Sample Collection and Analysis Plan. The time schedule, task schedule, and cash flow projections will be submitted with each pay request. During O&M, if the O&M Manual requires modifications, the ENGINEER shall make the necessary changes.

(b) The ENGINEER shall prepare an O&M Plan and Schedule that corresponds to O&M detailed in the O&M Manual. The ENGINEER shall operate and maintain the systems beginning immediately after startup. A qualified, trained technician must be able to respond to the site within 1 hour, regardless of weather conditions, of being notified of a situation requiring immediate attention. Failure to respond may result in WDEQ terminating the contract.

(c) The ENGINEER shall develop a method for tracking all major pieces of equipment within each enclosure. The ENGINEER shall be responsible for inventory of major pieces of equipment from installation through final disposition. At a minimum, the STP inventory tracking form shall be maintained in each enclosure.

(d) If injection wells are installed as part of O&M, all such wells including, but not limited to, air sparge and chemical oxidation, shall be permitted through DEQ Water Quality Division Underground Injection Control (UIC) program. A UIC permit shall be obtained by the ENGINEER for each injection well.

(e) If construction-related activities are completed during O&M, the activities must be registered with the DOR if the consultant is a non-resident or whenever non-resident subcontractors are used. See Section B.(i)(a) above.

(ii) O&M

(a) Prior to injecting any oxygenate on a site with a cathodic protection (CP) system (sacrificial anodes or impressed current), a WDEQ-licensed cathodic protection system tester must test the CP system. Testing frequency shall be recommended by the ENGINEER. If the CP system shows a failing test, the ENGINEER and CP tester must determine how to counteract the injection program to protect the tank(s). A CP system is considered effectively protecting a tank if the system test shows a reading of less than -850 millivolts (mv). When the injection program is complete, the CP tester must retest the system and make necessary adjustments. Required CP testing should be considered part of the injection program and associated costs shall be included in the ENGINEER'S cost estimates for O&M.

(b) Following is a list of general tasks the ENGINEER will be responsible to complete. The list may not be inclusive. Specific tasks will be identified and agreed upon by the ENGINEER and WDEQ after the systems have been designed and the O&M Manual written. The ENGINEER shall conduct routine O&M activities as outlined in the WDEQ-approved O&M Manual and Plan. Regardless of the specific equipment used, the ENGINEER is responsible for keeping the systems operating and performing routine and out-of-scope maintenance (through the force account mechanism), as necessary. General responsibilities include:

(1) Complete and submit quarterly O&M data to WDEQ using the EDS form. A brief quarterly letter summarizing system maintenance activities shall be provided to the WDEQ Project Manager. Project data shall be evaluated continually with respect to clean-up objectives. The ENGINEER shall notify WDEQ when clean-up objectives appear to be met at each site.

(2) Provide utility locating services as needed, including joining the applicable One-Call registration service(s).

(3) Ensure environmental protection and prevention of human health risks through the safe and proper operation and maintenance of the systems.

(4) Maintain operating equipment in working condition and ensure continuous operation of the remediation systems.

(5) Develop and update a maintenance management system and maintain adequate operation and maintenance records.

(6) Monitor, inspect, record, and report conditions of operation of each system and general observations about each system.

(7) Complete O&M procedures outlined in the O&M Manual. Corrective maintenance activities shall be scheduled with no interference to the routine preventative and monitoring activities described in the O&M Manual.

(8) Collect water and vapor samples from remediation equipment and submit the samples for analyses according to the schedule in the O&M Manual.

(9) Collect groundwater samples from monitoring wells and submit the samples for analyses according to the schedule in the O&M Manual.

(10) Dispose of any treatment residuals including, but not limited to, recovered fuel, wastewater treatment sludges, used oil, used filters, and petroleum

contaminated soils, etc., in an environmentally safe manner and in accordance with all applicable local, state, and federal regulations.

(11) Adjust the operating conditions of the systems, as necessary, so the systems operate in the most efficient manner possible and within permit limits.

(12) Measurements and checks the ENGINEER believes are important for effective system operation (i.e., vacuum pressures, fluid levels, temperatures, etc.) shall be recorded, as often as necessary. Adjustments to valves, well pump levels, floats, etc. shall be made, as necessary, to keep the systems operating in the most optimum manner possible and within permit limits.

(13) Provide building and equipment repairs, such as but not limited to, repairs of wells, piping, electrical wiring, and utility boxes. Arrange for repair of equipment by licensed specialists (e.g., electrician, plumber), where applicable. Out-of-scope maintenance and repairs shall be performed following approval from WDEQ.

(14) Obtain local discharge permit, if necessary.

(15) Soil sampling collection and analyses may be completed over the course of the project to determine remediation effectiveness.

(16) Qualified and trained personnel must be available 24-hours per day, 365 days per year to respond to emergency calls by Town officials, police or fire departments, WDEQ, or property owners. The ENGINEER shall maintain a pager for the duration of the Contract. Although the individual carrying the pager may change, the pager number must remain constant and must always be within calling range of the project site. If required, the ENGINEER's technician must respond **TO THE SITE** within **1 HOUR** of being notified of an emergency, regardless of weather conditions.

(17) O&M may include redesigning or modifying remediation systems, conducting small-scale excavations, in-situ remediation efforts, etc. in an effort to expedite the cleanup effort at recalcitrant sites.

(iii) Data Evaluation and Annual Reports

An annual O&M report will be prepared, unless another time frame is requested by the WDEQ Project Manager.

Each report shall contain all monitoring, sampling, and analyses data obtained during each reporting period and an ongoing compilation of the data available up to the time of the report. The report shall contain a discussion and analysis of the rate of cleanup and percent of cleanup that has been attained during the reporting period for each of the major contaminants at each system location and a summary of the progress of each system cleanup attained to date. Each report shall indicate all problems and concerns for the reporting period, the solutions, and continuing problems. Reasons for any force account work will be described. The ENGINEER shall make an analysis of progress of the operation and recommend improvements. These reports shall be provided in computer software format as directed by WDEQ. Each report shall be signed and sealed by the Engineer of record as having responsibility for the project.

(iv) Post-Remediation Verification Sampling and Testing

(a) The ENGINEER will advise WDEQ when contaminant levels in soil and groundwater at individual remediation sites are at or near remediation cleanup standards or when remediation efforts are nearing the limit of their effectiveness. The ENGINEER and WDEQ will jointly review data and discuss the need and extent of verification sampling and testing to be performed.

(b) The ENGINEER shall prepare a plan for verification sampling and analyses to document site clean-up or the need for additional remediation. The ENGINEER shall collect and submit soil samples and groundwater samples for verification analyses according to the WDEQ-approved Verification Sampling Plan. The ENGINEER shall evaluate the data relative to WDEQ remediation standards or risk-based clean-up standards.

(c) A vapor intrusion evaluation shall be completed by the ENGINEER at all sites where vapor intrusion was an issue during the life of the project. Applicable portions of Section B(vii)(i) above shall be completed to ensure the vapor hazard has been eliminated.

(v) Site Remediation Completion Reports

(a) When the ENGINEER determines that a remediation system is no longer operating effectively or efficiently or that required clean-up levels have been satisfied, a recommendation shall be made to close out the system. If required clean-up levels have not been met, an environmental risk assessment shall be conducted as provided in WDEQ Water Quality Rules and Regulations, Chapter 17. A summary report shall be prepared supporting the recommendation for system closeout or for alternative action. The report shall contain a discussion on the success of the system including:

(1) Were the cleanup goals attained?

(2) Is additional remediation effort required?

(3) Proposed future action(s), if any.

(4) Preliminary estimate of salvage and/or reuse value of the system components.

(b) One report shall be prepared for each system and site within the project. The reports shall be signed and sealed by the Engineer of record as having responsibility for the Project.

(vi) Project-Specific O&M Tasks. [*PROJECT MANAGER TO INPUT ANY PROJECT-SPECIFIC O&M AND MONITORING TASKS HERE. KEEP SAME FORMAT AS REST OF DOCUMENT. ADD TASKS TO RFP COST SCHEDULE IN ATTACHMENT B. IF THERE ARE NO PROJECT-SPECIFIC O&M AND MONITORING TASKS, REMOVE THIS PARAGRAPH, REMOVE FROM THE OUTLINE IN SECTION 1, AND REMOVE FROM THE COST SCHEDULE IN ATTACHMENT B.*]

F. Project Closeout Tasks (0907.07)

Project closeout tasks will depend on the number of sites/systems ready for decommissioning at one time and the estimated cost to complete the decommissioning. If the

decommissioning is small in nature and extent (e.g., one system being removed at the request of the property owner, well abandonment at several sites, etc. and defined by WDEQ as costing less than $100,000) and can be completed by the ENGINEER, the ENGINEER shall complete the work necessary to decommission the site(s). If the decommissioning entails a significant amount of work or the cost will exceed $100,000, the following work tasks shall be completed:

(i) Closeout Management. If necessary to reflect current project status, the ENGINEER shall update the Project Management Plan, task schedule, cash flow projections, project Health and Safety Plan, and the Sample Collection and Analysis Plan. The time schedule, task schedule, and cash flow projections will be submitted with each pay request.

After authorization to proceed with Project Closeout is received from WDEQ, the ENGINEER shall complete the tasks discussed below.

(ii) Site Closeout Plans

(a) Within 60 days following authorization to begin site closeout, the ENGINEER shall submit a Site Closeout Plan. The plan shall include an assessment of the usability of the equipment, management of the equipment, and site restoration.

(b) The ENGINEER shall assess the condition of equipment and enclosures and determine which individual pieces of equipment and enclosures may be effectively reused, as is, as a unit. Provide estimates of equipment and enclosure unit values for reusable units. Determine which individual pieces of equipment and which individual enclosures may be cost-effectively reconditioned for immediate reuse at another STP site and provide an estimated reconditioning cost for each item worthy of reconditioning. Provide a reconditioned value for each item. Determine which pieces of equipment and enclosures are subject to sale for scrap and estimate their salvage value. Determine which items may have no value and estimate the cost of their disposal. WDEQ's standard boilerplate decommissioning specification will be provided to the ENGINEER to assist in completing this task. To maintain closeout consistency within the program, the ENGINEER shall use the standard boilerplate specification to the extent possible.

(c) The ENGINEER shall recommend management of each piece of equipment and each enclosure. The ENGINEER shall recommend which monitoring and remediation wells should remain for future sampling. Equipment and/or enclosure transfer to a property owner or third party must be completed in accordance with STP Guidance Document #5 entitled, "Used Remediation Equipment or Enclosure Disposition." This Guidance Document can be found on the STP website. The associated net value calculations and "Condition of Sale" form must be completed, signed, and submitted to the WDEQ Project Manager.

(d) The ENGINEER shall propose methods for closing pipelines and wells, removing enclosure foundations, and restoration at all sites. WDEQ's standard boilerplate specification will be provided to the ENGINEER to assist in completing this task.

(iii) Closeout Bidding and Administration

(a) In consultation with WDEQ and on the basis of the Site Closeout Plan(s), determine the general scope, extent, and character of the project.

(b) Prepare a preliminary Scope of Work detailing equipment and enclosure reuse, reconditioning, salvage, and disposal information and criteria. Include a description of reclamation and restoration work to be performed to complete project closeout that includes, but is not limited to, damage created during removal of remediation equipment and structures, resurfacing, and well abandonment.

(c) Based on the information contained in the Site Closeout Plan(s), submit an engineer's estimate for decommissioning that includes estimated reclamation and restoration costs.

(d) Present two copies of the preliminary Scope of Work and engineer's estimate to WDEQ and review them in person with WDEQ. The preliminary Scope of Work shall be dated and stamped, "**Preliminary - Not for Bidding,**" or similar language, so as not to construe it as a final document.

(e) Prepare a Final Scope of Work based on review with WDEQ for inclusion in the bidding documents.

(f) The ENGINEER shall assist WDEQ in advertising and obtaining bids for the closeout of the remediation systems. The ENGINEER shall be responsible for distributing the biding documents at no cost to WDEQ to interested parties, maintaining a record of firms that received bid documents, conducting a mandatory prebid conference at the project site, and receiving and processing deposits for bidding documents. The ENGINEER shall prepare three complete copies of the final bid documents and one copy of the WDEQ boilerplate for WDEQ.

(g) Issue addenda as appropriate to interpret, clarify, or expand the bid documents. All addenda issued by the ENGINEER shall be signed and sealed by the Engineer of record as having responsibility for the project.

(h) Consult and advise WDEQ as to the conditions of acceptability of subcontractors, suppliers, and other persons and organizations proposed by the prime contractor for those portions of the work requiring subcontractor acceptability by the bid documents.

(i) Consult with WDEQ concerning the acceptability of equivalent substitute materials and equipment proposed by the closeout contractor when substitution prior to award of the contract is allowed by the bid documents.

(j) Assist WDEQ in evaluating bids or proposals. WDEQ shall be responsible for advertising the bid and receiving bids.

(iv) Closeout Contractor Oversight

(a) The ENGINEER shall make visits to the project sites at intervals appropriate to the various stages of closeout as the ENGINEER deems necessary in order to observe and evaluate the progress and quality of the various aspects of the closeout contractor's work. Based on information obtained during such visits and on such observations, the ENGINEER shall ensure that the work is being accomplished in accordance with the Contract Documents. The ENGINEER shall keep WDEQ informed of the progress of the work.

The purpose of the ENGINEER's visits to the site will be to enable the ENGINEER to carry out the duties and responsibilities assigned to and undertaken by the ENGINEER during site closeout. By exercising the ENGINEER's efforts as an experienced and qualified design professional, WDEQ will be provided with a strong degree of confidence that the completed work of the closeout contractor will conform to the Contract Documents. During site visits, or as a result of such observations of the closeout contractor's work in progress, the ENGINEER shall not supervise, direct, or have control over the closeout contractor's work. The ENGINEER shall not have authority over or responsibility for the means, methods, techniques, sequences, or procedures selected by the closeout contractor. The ENGINEER shall not be responsible for safety precautions and programs incident to the work of the closeout contractor; or for any failure of the closeout contractor to comply with laws, rules, regulations, ordinances, codes, or orders applicable to the closeout contractor's furnishing and performing the work. Accordingly, the ENGINEER can neither guarantee the performance of the contract by the closeout contractor nor assume responsibility for the closeout contractor's failure to furnish and perform the work in accordance with the Contract Documents.

(1) Defective Work. During site visits and on the basis of observations, the ENGINEER may reject the closeout contractor's work while it is in progress if the ENGINEER believes that such work will not produce a completed product that conforms generally to the Contract Documents or that it will prejudice the integrity of the concept of the project as reflected in the Contract Documents.

(2) Interpretations and Clarifications. The ENGINEER shall issue necessary interpretations and clarifications to the Contract Documents and in connection therewith prepare Field Orders and Site Work Orders. The ENGINEER will provide WDEQ information necessary to prepare Amendments. The documents shall be in the format as specified in the Contract Documents. The ENGINEER shall be responsible for providing a complete package to the WDEQ for approval, including budget and/or schedule revisions, scope changes, and results of negotiations. All changes or clarifications issued by the ENGINEER to the closeout contractor shall be signed and sealed by the Engineer of record as having responsibility for the project.

(b) Applications for Payment. Based on the ENGINEER's on-site observations as an experienced and qualified design professional, and on review of applications for payment and the accompanying data and schedules:

(1) The ENGINEER shall review the amounts owed to the closeout contractor and recommend, in writing, payments to the closeout contractor in such amounts. Such recommendations of payment will constitute a representation to WDEQ, based on such observations and review, that the work has progressed to the point indicated. Further, to the best of the ENGINEER's knowledge, information, and belief, the quality of such work is generally in accordance with the Contract Documents. In the case of unit price work, the ENGINEER's recommendations of payment will include final determinations of quantities and classifications of such work.

(2) By recommending any payment, the ENGINEER will not be deemed to have represented that exhaustive, continuous, or detailed reviews or examinations have been made by the ENGINEER to check the quality or quantity of the closeout contractor's work as it is furnished and performed beyond the responsibilities specifically assigned to the ENGINEER in this Contract. The ENGINEER's review of the closeout contractor's work for the purpose of recommending payments will not impose on the ENGINEER responsibility to supervise, direct, or control such work. The ENGINEER is also not responsible for the means, methods, techniques, sequences, or procedures; or safety precautions or programs incident thereto; or the closeout contractor's compliance with laws, rules,

regulations, ordinances, codes, or orders applicable to furnishing and performing the work. It will also not impose responsibility on the ENGINEER to make any examination to ascertain how or for what purposes the closeout contractor has used the funds paid on account of the Contract Price; or to determine that title to any of the work, materials, or equipment has passed to WDEQ free and clear of any lien, claims, security interests, or encumbrances; or that there may not be other matters at issue between WDEQ and the closeout contractor that might affect the amount that should be paid.

(c) Inspections. The ENGINEER shall conduct an inspection to determine if the work is substantially complete and conduct a final inspection to determine if the completed work is acceptable so that the ENGINEER may recommend to WDEQ, in writing, that final payment be made to the closeout contractor. The ENGINEER may give written notice to WDEQ and the closeout contractor that the work is acceptable (subject to any conditions therein expressed), but any such recommendation and notice will be subject to the limitations expressed in the preceding paragraph.

(d) Limitation of Responsibility. The ENGINEER shall not be responsible for the acts or omissions of the closeout contractor, or of any subcontractor or supplier, or any of the closeout contractor's or subcontractor's or supplier's agents or employees, or any other persons (except the ENGINEER's own employees, subcontractors, and agents) at the site or otherwise furnishing or performing any of the closeout contractor's work. However, nothing contained in this section, shall be construed to release the ENGINEER from liability for failure to properly perform duties and responsibilities assumed by the ENGINEER in the Contract Documents.

(e) Periodic Reports. A monthly report shall be prepared, unless another time frame is requested by the WDEQ Project Manager. Each report shall contain a discussion and analysis of tasks performed during the reporting period, and the percent of completion that has been attained by the close of the reporting period.

(v) Final Site Closeout Reports. Upon completion of the project or a site through system removal and site restoration, the ENGINEER shall prepare a Final Site Closeout Report. The report shall include an executive summary of the initial and supplementary site investigations and a complete report on remedial action taken, including but not limited to, remediation system installation, operation, and removal, and final site condition. The Final Report shall also include discussion of the final conditions in the subsurface at each site including a final environmental risk assessment if required clean-up levels have not been obtained. The Final Report must include a list of equipment affected by the closure and the final disposition of each piece of equipment. The report shall include the salvage value of equipment sold for salvage or reconditioning. The Final Report shall be signed and sealed by the Engineer of record as having responsibility for the Project.

(vi) Public Meeting. A public meeting may be scheduled to present the results of the environmental remediation project to the site owners, general public, and interested parties. If a meeting is scheduled by the WDEQ Project Manager, it will be held at a central location to the project site(s). This public meeting shall be scheduled after completion of the ENGINEER's review of the periodic monitoring reports and presentation of a project closure recommendation to WDEQ. The ENGINEER shall attend the public meeting with WDEQ to present the project conclusions and answer technical questions.

(vii) Project-Specific Closeout Tasks. [*PROJECT MANAGER TO INPUT ANY PROJECT-SPECIFIC PROJECT CLOSEOUT TASKS HERE. KEEP SAME FORMAT AS REST OF DOCUMENT. ADD TASKS TO RFP COST SCHEDULE IN ATTACHMENT B. IF THERE ARE NO PROJECT-SPECIFIC PROJECT CLOSEOUT TASKS, REMOVE THIS*

PARAGRAPH, REMOVE FROM THE OUTLINE IN SECTION 1, AND REMOVE FROM THE COST SCHEDULE IN ATTACHMENT B.]

G. Additional Work.

(i) The STP understands that due to the nature of the work involved at all phases, unknown conditions may arise for which additional work is necessary. This work includes, but is not limited to, well repair/replacement; in-situ remediation (e.g., injection programs); minor construction for repair, replacement, or abandonment of portions of a system, etc. When additional work is identified, the ENGINEER shall notify the WDEQ project manager and provide a proposed scope of work and costs to complete the work. No additional work shall be completed without prior approval of the WDEQ. An amendment will be necessary to complete the work. If additional construction work is necessary that exceeds $100,000, the ENGINEER shall prepare plans and specifications and the work shall be bid using the State's procurement process.

(ii) The STP understands that work necessary to complete cleanup of the sites may go on for years. The STP will renew the contract in 2- or 3-year terms to complete the work necessary to reach closure of all the sites in this project. The scope of work may change depending on how the contaminants respond to the treatment methods chosen. The ENGINEER shall recommend the work needed for each amendment to bring the sites to closure as soon as possible

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