

SITE QUALITY ASSURANCE PLAN

STORM WATER DRAIN EXCAVATION, CLEANING, REMOVAL, AND REPLACEMENT AT BUILDINGS 5 and 400 ALAMEDA POINT, ALAMEDA, CALIFORNIA (FORMERLY NAVAL AIR STATION, ALAMEDA, CALIFORNIA)

**Project No. USN 97-032
Phase III**

Submitted to:

U.S. Army Industrial Operations Command
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Revision 1

April 1998

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SITE QUALITY ASSURANCE PLAN APPROVALS

STORM WATER DRAIN EXCAVATION, CLEANING, REMOVAL, AND REPLACEMENT AT BUILDINGS 5
and 400

ALAMEDA POINT, ALAMEDA, CALIFORNIA

Revision 1

April 1998

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ALAMEDA POINT
SSIC NO. 5090.3

SITE WORK PLAN
SITE HEALTH AND SAFETY PLAN
SITE QUALITY ASSURANCE PLAN
PHASE III AND IV
STORM DRAIN EXCAVATION, CLEANING,
REMOVAL, AND REPLACEMENT AT
BUILDINGS 5 AND 400
REVISION 2

DATED 01 JULY 1998

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NWT Contract Laboratory

Thermo NU Tech Laboratories
2030 Wright Avenue
Richmond, CA 94804-0040
(510) 235-0438

Government QA Laboratory

TO BE DETERMINED

1.0 PROJECT DESCRIPTION

This project involves the removal of approximately 1,000 linear feet of sewer line located at two locations on the site formerly known and operated as the Naval Air Station, Alameda, in Alameda, California. (Refer to the Drawings and Contract Documents for exact locations and quantities of materials expected to be removed during this contract.)

Approximately 800 linear feet of the pipeline is located in Building 400 and 200 linear feet of the pipeline is located in Building 5. The pipelines are of various sizes with the majority measuring 24-inches internal diameter (ID), the maximum and minimum sizes are 48-inches (ID) and 6-inches (ID), respectively.

The pipeline to be removed begins within the interior of the structures and will be removed and replaced out to the first terminator (manhole) on the exterior of the buildings. Additional lines, not physically connected to the sewer line, run parallel to the pipeline to be replaced and consist of gas service, water and additional sewer/storm drains. Work shall include the blinding and removal of various piping at the terminal point, complete removal and cleaning of the subject pipeline prior to disposal, and the removal and disposal of incidental contaminated soils or ground waters encountered during the removal operations.

Finally, all areas disturbed during the removal portion of the contract shall be restored to their former condition prior to project completion.

2.0 CHEMICAL DATA QUALITY OBJECTIVES

2.1 Data Uses.

Previous investigations at Alameda Point have identified subsurface contamination in the vicinity of the sewer and storm water discharge system. Elevated concentrations of Radium 226 (Ra226) were noted. Although the integrity of the entire sewer and storm water system is not fully known, based on the age of the system it can be assumed that during the removal process additional areas of subsurface contamination will be discovered. The airfield is a restricted use area, therefore control of the effected area can be reasonable attained.

Data from the removal phase will be used to determine the vertical and lateral extent of Radium 226 contaminated soils. This information will be used to determine the extent of any subsurface soil removal authorized for this project.

2.2 Data Types.

During the removal process, Radium 226 contamination is the primary focus. Data collected will be utilized to verify that all contaminated materials, to below the specified cleanup criteria, have been removed. At the present, there is no reason to believe that contaminants other than Ra-226 are present (i.e. pesticides, herbicides, etc.)

2.3 Data Quality Factors.

Prioritized Data Uses:	Soil "over-excavation" Evaluation of Remedial Alternatives Engineering Design and Cost Analysis
Appropriate Analytical Levels:	Field Screening: Level I Analytical Laboratory: Level III
Contaminants of Concern:	Radium 226 (and daughters) BTEX TRPH
Levels of Concern:	Radium 226: (To Be Determined) BTEX: (To Be Determined) TRPH: (To Be Determined)
Required Detection Limits:	See Section 2.6 "Analytical Methods and DQO's"

Critical Samples:	Clean samples at outer boundary of the excavations

2.4 Data Quality Needs.

To meet the requirements of the State of California, samples will be taken at intervals, as required by the contract, below the invert of the former sewer and storm water system. See the Section 4.2 for a more detailed description of sample locations.

2.5 Review of PARCC Parameters.

Precision - Precision shall be evaluated through the collection and analysis of field and laboratory duplicate samples. The relative percent difference for field and laboratory duplicates shall be calculated and used as a measure of precision. Field duplicates shall be collected at a frequency of 10% (1 duplicate sample for each 10 field samples taken) for each matrix being sampled. All duplicates shall be labeled and identified in such a way as to blind the contract laboratory to their true identity.

Accuracy - Accuracy shall be evaluated through the collection and analysis of matrix spike, matrix spike duplicate samples, and laboratory control samples. Each shipment made to the contract laboratory shall include sufficient materials to provide for the preparation of matrix spike and matrix spike duplicate samples. Use of DI water or reagent grade sand for LCS analysis shall be used to independently check for matrix effects.

Representativeness - A sampling grid has been designed based on the State of California model for this type of work to obtain a representative picture of the possible contamination under the sewer and storm water systems. QC duplicates and QA splits shall be taken at the intervals stated under the section titled "Precision". At no time will laboratory procedures effect the concentration of the sample, either in concentrating the analytes or in diluting the analytes of concern.

Completeness - Completeness shall be defined as the percentage of Contract Laboratory controlled QC parameters that are acceptable. Holding times shall not be exceeded for any samples on this contract. Matrix effects shall not impact completeness checks provided the interference is sufficiently documented. Qualitative completeness shall involve the analysis of all events occurring during the sampling event, including, but not limited to, COC procedures, cooler temperatures, custody seals, etc.

Quantitative analysis - shall include contract laboratory QC checks of surrogate recovery, analysis of duplicates for RFD %, matrix spike and matrix spike duplicate analysis for recovery and RFD, initial and continuing calibrations of analytical equipment and analysis of contract laboratory samples recovery, proper preservation and holding times. The minimum quantitative limit for completeness is 90%. All the above parameters shall be analyzed for completeness and no single parameter shall be allowed to exceed the 90% threshold.

Comparability - The use of standard soil sampling procedures and a recognized field analytical procedures should make the resulting data comparable with other data of the same type. Laboratory results shall be reported on a standard form indicating, but not limited to, sample numbers, matrix types, analytes, minimum detection levels (MDL's), and individual sample results.

All results, including MS/MSD, and other QA/QC results shall be reported on the same type report as the results of the sample analyses. Out of compliance reports for any analysis, including QA/QC analyses, shall be stated on the report form as well as stated on a cover sheet accompanying each batch of sample results. Corrective actions and possible root causes for the out of compliance report shall also be included on the cover sheet accompanying the analysis report.

2.6 Analytical Methods and DQO's

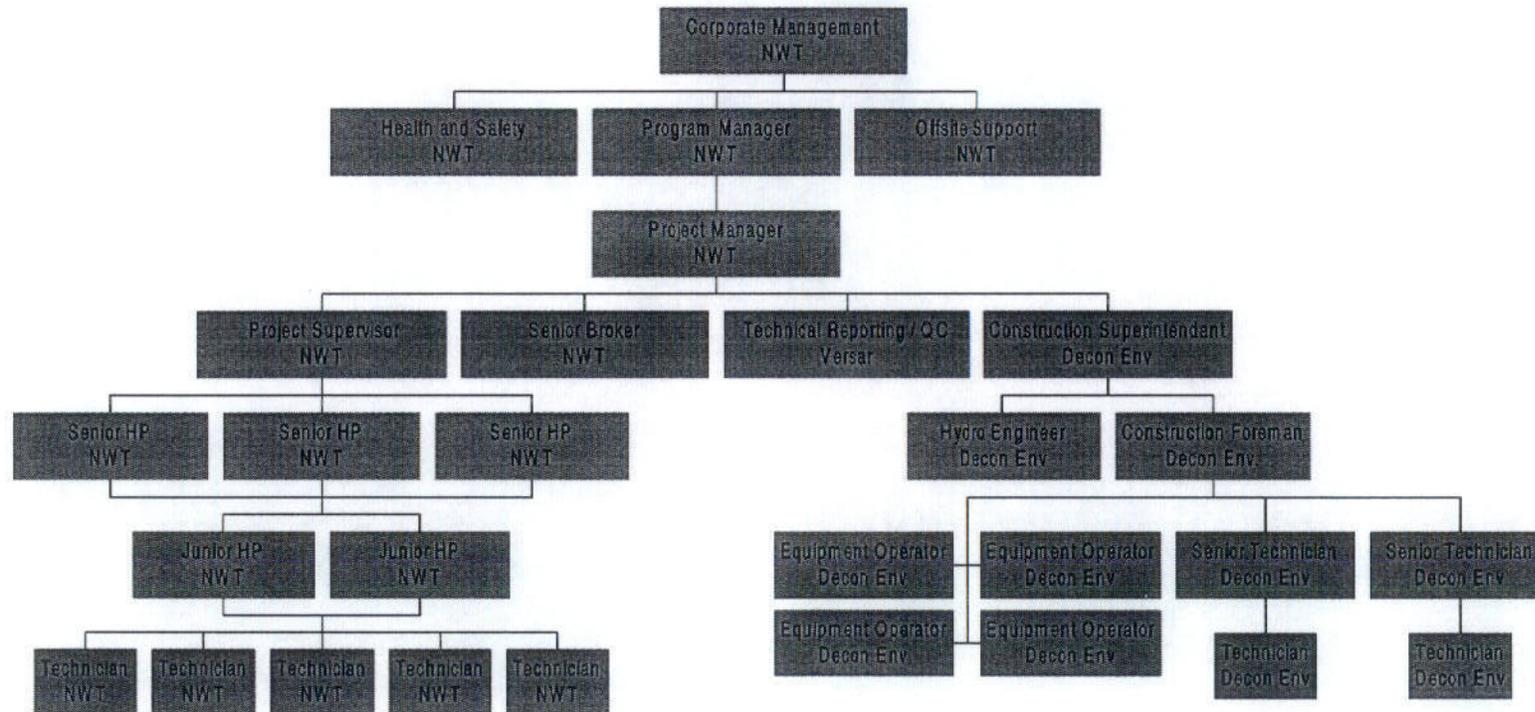
Analyte	Analytical Method
Ra226 (Radium 226)	Gross Gamma and Gamma Spectroscopy
BTEX (Benzene, Toluene, Ethyl Benzene, Xylene)	EPA 8020
TRPH-1 (Total Recoverable Petroleum Hydrocarbons)	EPA 418.1
TRPH-2 (Total Recoverable Petroleum Hydrocarbons as Diesel, Jet Fuel or Kerosene)	EPA 8015M

Analytical Method and DQO's (cont.)

Method Reference	Method Number	Desc. of Method	Matrix	Quantitation Limit	% Spike Recovery	% LCS Recovery	Duplicate RPD
Radiochemistry:							
	901.1	Gamma Scan	Soil	See Table 7.3	N/A	N/A	10
	903.1	Radon Emission	Water	See Table 7.3	65-135	N/A	N/A
TRPH-1							
SW-846	418.1 8020 8021	Infrared Spectroscopy	Soil/Water	See Table 7.3	65-135	65-135	10
BTEX:							
SW-846	8020	Gas Chromatography	Soil/Water	See Table 7.3	65-135	65-135	10
TRPH-2							
SW-846	8015M	Gas Chromatography	Soil/Water	See Table 7.3	65-135	65-135	10

3.0 PROJECT ORGANIZATION AND RESPONSIBILITIES

Phase III Project Organization Chart - Field Operations



4.0 FIELD ACTIVITIES

4.1 Equipment, Containers and Supplies.

All samples will be placed in the appropriate container as determined by a review of the requirements of 40 CFR Part 136 Table II. All containers will be pre-cleaned to meet EPA Protocol A - 3000 requirements. Samples will be acquired using the appropriate methods as detailed in Section 4.4 "Sampling, Decontamination, and Preservation Procedures".

4.2 Sample Locations.

AREA

SAMPLE LOCATIONS AND AMOUNTS

<p>Pipeline Invert</p>	<p>SOILS</p> <p>Continuous use of visual methods and a OVM/PID.</p> <p>Following the overexcavation of contaminated areas Radium 226 samples every six (6) meters (20 feet).</p> <p>WATER</p> <p>As required by incursion.</p>
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All sample locations, when finalized, will be surveyed, using GPS equipment, and marked on appropriate site maps for future location and cross referencing. All samples will be analyzed using the indicated (numbered) EPA Methods mentioned previously in Section 2.6 "Analytical Methods and DQO's"

4.3 General Information and Definitions.

Some commonly used definitions are given below.

Subcontractor Laboratory - The laboratory performing analysis of the field samples. This may be an A&E laboratory, a Remedial Action subcontractor laboratory or a laboratory subcontracted by either.

QA and QC Samples - Samples analyzed for the purpose of assessing the quality of the sampling effort and of the analytical data. QA and QC samples include splits or replicates of field samples, rinsate blanks, trip blanks, and background (up gradient) samples.

QC Samples - Quality Control samples are collected by the sampling teams for use by the contract laboratory. The identity of these samples is held blind to the analysts and laboratory personnel until data is in deliverable form. The purpose of the sample is to provide site specific field originated checks that the data generated by the analytical lab are of suitable quality. QC samples represent approximately 10% of the field samples.

QA Samples - Samples sent to a QA laboratory and analyzed to evaluate contract laboratory performance. QA samples represent approximately 10% of the field samples. NWT shall coordinate with the designated QA laboratory not less than 48 hours before sampling to assure that the QA laboratory is alerted to receive the QA samples and process them within the time limits specified by applicable EPA regulations and guidelines.

Split Samples - Samples that are collected as a single sample, homogenized (except VOA), divided into two or more equal parts, and placed into separate containers. The sample shall be split in the field prior to delivery to a laboratory. Ordinarily split samples are analyzed by two different laboratories.

Replicate - (duplicate, triplicate, etc.) Samples. Multiple grab samples, collected separately, that equally represent a medium at a given time and location.

Rinsate - Blank. Samples consisting of reagent water collected from a final rinse of sampling equipment after the decontamination procedure has been performed. The purpose of rinsate blanks is to determine whether the sampling equipment is causing cross contamination of samples.

Trip Blank - Containers of organic-free reagent water that are kept with the field sample containers from the time they leave the laboratory until the time they are returned to the laboratory. The purpose of trip blanks is to determine whether samples are being contaminated during transit or sample collection. Trip blanks pertain only to volatile organic analyses; therefore, the containers must contain no headspace. Only one trip blank is needed for one day's sampling and shall satisfy trip blank requirements for all matrices for that day if the volatile samples are shipped in the same cooler.

4.4 Sampling, Decontamination, and Preservation Procedures.

4.4.1 Soil Samples.

Soil samples for laboratory analysis will be collected using the following method;

After marking the location of the sample on the sample location map, a technician will hand auger/slide hammer a core sample from the soil site as required by the sampling plan. The technician will then don a fresh pair of vinyl sample gloves, (new gloves will be donned for each sample taken), and using appropriate hand tools remove 1/4" to 1/2" of soil from the top of the auger/slide hammer to prevent the introduction of slough into the sample stream.

The soil core will then be removed from the auger/slide hammer while still in the brass tube. The container will be capped, sealed with a custody seal and placed into a cooler with blue ice to maintain a temperature of 4° Celsius. Should any chemical preservatives be necessary, other than cooling, the sampling technician will insure that it has been added to the sampling container prior to the sampling effort. Depth, number, time, sampler, description, and any other pertinent data regarding the particular sample will then be entered into the Sample Log and the Sample Label.

Samples will be shipped to the laboratory using a preselected courier service to insure prompt delivery and compliance with the holding time requirements for the samples to be analyzed.

Soil samples for headspace analysis will be collected using the following method;

The technician will use the same method mentioned above to extract the soil in question, the soil will be placed into a clean, one quart, zip lock type bag and the sample label will be applied to the outside of the bag.

The bag will be placed on the ground near the point of extraction and the time will be noted. After 30 minutes of exposure to the direct sun light has occurred, the probe of the OVM/PID will be inserted into the bag and a reading will be taken and recorded. Care will be taken to insure that no water, the result of condensation in the bag, will enter the probe of the measuring instrument.

Soils samples that result in elevated OVM/PID readings will be considered contaminated and treated as a waste until confirmatory laboratory samples have been analyzed and the appropriate disposal option is chosen for the waste stream.

Soil samples for field screening will be collected using the following method;

The technician will use the same method mentioned above to extract the soil in question, the soil will be placed into a new reagent bottle as required in the form the analytical laboratory processing the samples. Records of all samples will be entered in the appropriate field logbook, and the initial chain of custody (COC) form will be completed. Samples will be shipped to the analytical laboratory at the end of each day.

4.4.2 Water Samples.

Water samples will be collected using the following method;

All water sampling procedures are based on the recommended procedures published in SW-846.

Using a stainless steel bacon bomb, water samples will be removed from the excavation. Due to the active hydrology at the site, and the possibility of rain during the sampling event the exact depth at which the water sample will be removed cannot be determined, however all samples will be taken at 1 foot below the upper boundary of the water recharging the excavation. The water will be immediately transferred to the properly prepared sample containers. The containers will be capped with Teflon coated lids, labeled, sealed, and placed into coolers with blue ice. The coolers will be kept at a temperature of 4°Celsius. Depth, number, time, sampler, description, and any other pertinent data will then be entered into the Sample Log and the Sample Label. The bacon bomb will be decontaminated in the same fashion as the soil auger mentioned previously.

At the end of each shift a chain of custody form will be filled out for each sample generated. The samples will be shipped to the laboratory for at the end of each day.

4.4.3 Equipment Decontamination.

All soil sampling equipment and containers will be decontaminated prior to use, using the following procedure.

The sampling equipment decontamination procedure will consist of the following steps, subsequent to each sampling event:

- 1) Detergent wash (with brush) in LOC (Liquid Organic Cleaner).**
- 2) Distilled water rinse.**
- 3) 70%/30% Methanol/DI Rinse**
- 4) Final rinse and air-dry with Laboratory grade Distilled water.**
- 5) Every 15 samples a rinsate blank will be generated using an additional rinse of DI.**

All sampling gloves and rinse waters will be collected and stored in lined DOT approved 55 gallon steel drums, supplied by the contractor. Storage, analysis, and disposal of the materials generated during the sampling activities will be per the specifications and the waste acceptance criteria of New World Technology.

Additionally, the sampling slide-hammer will be triple rinsed at the beginning of every workday to reduce the possibility of cross contamination of samples.

4.4.4 Sample Preservation.

The samples will be placed in an ice chest and maintained at 4° Celsius until they are delivered to the laboratory for analysis. All Chain of Custody documents for any samples held in the cooler shall be stored within the unit to preserve the integrity of the custody chain. Any preservatives required by SW-846 will be introduced to the sample containers during their use in the field, after determining the correct amount necessary to reach the desired pH for proper preservation. The amounts necessary will be dependent on the matrix being sampled, the pH of the matrix, and the volume of the sample necessary to achieve the MDL

specified in the procedures. All types of chemical and/or mechanical preservation will be noted on the Chain of Custody which will accompany each set of samples during transit to the laboratory.

4.5 Field Documentation.

Each sampler will keep a field notebook (bound with pages numbered) to record sample collection procedures, dates, laboratory identification, sample collection location, and the name of the sampler.

The logbook will be signed and dated by this person prior to initiation of field work. All entries into the logbook will be executed by this designated person. If it is necessary to transfer the logbook to alternative personnel during the course of field work the person relinquishing the logbook will sign and date the logbook at the time the logbook is transferred and the person receiving the logbook will do likewise. Corrections to erroneous data shall be made by crossing a line through the entry and entering the correct information. The correction shall be initialed and dated by the person making the entry. Unused portions of logbook pages will be crossed out, signed, and dated at the end of each workday. Logbook entries must be dated, legible, in ink, and contain accurate documentation. Language used shall be objective, factual, and free of personal opinions. Hypotheses for observed phenomena may be recorded, however, they must be clearly indicated as such and only relate to the subject observation.

5.0 SAMPLE CHAIN OF CUSTODY, PACKING AND TRANSPORT

All sample labeling, packing, transportation and chain of custody procedures shall follow the USCOE Sample Handling Protocol (ER 111-01-263).

5.1 Chain of Custody Record.

See attached example. It is important to note that only one site may be listed per form even if the sites have the same project number. Top original goes with the samples; a copy should be saved for the sampler's files.

5.2 Procedures for a Chain of Custody (COC) Form.

This procedure will familiarize the reader with the different sections and requirements of a completed Chain of Custody (COC) form as is necessary for the proper tracking and acceptance of hazardous / radioactive samples by EPA certified laboratories and disposal facilities across the United States.

This procedure is not a primer on basic sampling procedures and a certain amount of knowledge concerning sample preparation and procedures is assumed. Wherever possible examples and sample forms will be used in this procedure to demonstrate the correct methodology for completing the required documentation associated with sample submission.

Overview

Refer to Illustration #1 the " Chain of Custody / Analysis Record " form following this page.

Section A relates all of the pertinent project information as well as the point of contact and the destination for any correspondence.

Section B is used to list each sample container, and the specific information concerning each sample as well as any analysis required.

Section C is used to denote any hazardous/radioactive hazards associated with the samples in addition to certain basic physical features used for preliminary analysis/treatment suitability comparisons.

Section D is the Custody Tracking record and is used to establish the responsible party for the samples at any time during the evolution of generation, transport, analysis, and disposal.

INSERT COC W/SECTION HEADERS HERE.

Procedure

Section A:

1. Completely fill in all areas with the required information. Any area that does not apply, i.e. the project has no dedicated fax line, should be noted with " N/A ".

2. Standard practice is for the Project Manager to remain the point of contact (POC) through out the duration of the project. However, if the project personnel includes a Project Chemist or Project Health Physicist then this person should be the POC. Additionally the Project Manager may, at his/her discretion choose to assign another member of the project team and/or a non-project related person as the POC depending on the circumstances relating to the specific project. At no time is an employee or representative from a firm other than NWT to be designated as the POC. All attempts should be made to keep the POC the same person throughout the duration of the project in an effort to limit the possibility of confusion between the laboratory/disposal facility and the Project Manager.

3. While it is recommended that at least a fax of the sample results be sent to the project site so that timely action can be taken in response to the results, it is not recommended that the final copies of the laboratory analyses be sent to the job site. The primary reason for this is to insure the integrity of the result documents. Sending the reports to a fixed office allows adequate copies to be made and archiving of the original documents pending the final reporting for the project. Copies of the final analytical results, as a matter of procedure, will be immediately forwarded to the job site upon their receipt and duplication.

4. In the upper left corner of Section A is a space for the "Document No.". This area is to be used to CONSECUTIVELY number the COC's generated on a job site. A number is preprinted in this space and should be used as a reference concerning all samples listed on the document. All correspondence and questions concerning a sample listed on the particular COC should also reference this number.

Section B:

1. This section is used to individually list each sample container and the analysis required. Refer to illustration #2 for a sample of a partially completed COC form.

2. There is room for ten (10) samples on each form. Any unused lines should have a single line marked through them, i.e. if only four (4) samples are shipped, then lines 5 through 10 should be lined through, see Illustration #2.

3. EACH SAMPLE should be given its own line on the COC form. Some laboratory procedures require more than one container of material for the same analysis, i.e. Volatile Analysis in soil require three (3) VOA vials per analysis, the number of containers should be listed in the "Notes" area of the COC form on the line dedicated to that sample. An example of this can be seen on Line 4 of the sample COC in Illustration #2.

4. "Sample ID" refers to the identification number assigned each sample by NWT field personnel. These numbers are to be unique identifiers for each sample and shall be logged in the project sample log maintained at the project site.

5. "Type" refers to the sample matrix. In other words the materials that comprise the sample. Acceptable descriptions include, but are not limited to; soil, sand, gravel, tar, sludge, mud, water, liquid, or gas. Unacceptable descriptions include; dirt, goo, black stuff, etc.

6. "Container" and "Volume" describe the type of container used to hold the sample. Container types include, but are not limited to, glass, hdpe, plastic, VOA, and brass tube. The volume indicated should be the nominal volume of the container prior to use, not the actual volume of materials placed in the container. Container volumes should be annotated with the correct volume designation, i.e. ml for milliliter, l for liter, etc. Use of the containers recommended in EPA SW-846 (Solid Waste Procedures Manual 846) is mandatory for all NWT operations involving hazardous materials/wastes sampling.

7. NOTE: When sampling material, it is important to pick the appropriate size container necessary, based upon the analytical requirements of the project and the detection limitations imposed by the laboratory equipment. Prior consultation with the contract laboratory and the NWT Corporate Health and Safety Office will determine the containers and volumes necessary to attain the project's analytical goals. Additionally when placing sample materials into the specified container it is always recommended that the entire container be filled, insuring that no voids are left when the container is sealed.

8. "Preservative" refers to either the physical or chemical materials necessary, as specified by the laboratory and SW-846, to prepare the sample for analysis. Preservatives will either be external treatments such as cooling to 4° Celsius or chemical treatments added to the sample such as pH lowering using acids. Most in-container pre treatments are done by the container supplier prior to shipment to the project site, however there may be occasions when the on site personnel will be required to add the specified materials at the time of sampling.

9. "Analysis Req'd" is used to determine which tests will be conducted on a specific sample. This is one of the most critical sections of the COC since it determines the fate of the sample upon reaching the laboratory. Ambiguity or unclear instruction will cause delays in analysis that would impact the success of the entire project and/or the safety of the crews working at the site. Standard practice is to specify the analysis required using the EPA SW-846 test number i.e. metals analysis is Method 6010. It is also acceptable to request analysis using the materials of concern, specifically the chemicals of interest to the sampler, using the example above, it would be sufficient to list the metals by their IUPAC designations, i.e. Pb is lead, Ba is barium, etc. It is unacceptable to request analysis using vague or general categories of chemicals such as solvents or fuels.

10. "Notes" is a section in which any information deemed vital is added concerning the listed sample. If certain samples were requested to be analyzed on a rush basis it would be appropriate to designate this request in the Notes area.

11. "[Laboratory ID #]" is for the use of the contract laboratory to note the in house sample number given to each NWT sample sent. This area should be left blank at the time of submission to the laboratory.

Section C:

1. This section provides the laboratory/disposal facility with vital information concerning the health and safety hazards associated with the samples listed. It also provides valuable physical information necessary for the proper characterization and analysis of the materials.

2. While the information provided by this section is important, it is not always possible to determine all of the values requested at the time of submittal. At a minimum the sections pertaining to hazards and physical form should be filled in. If it is not possible to determine the remaining information, a notation of "CBD - Cannot Be Determined" or simply "CBD" should be inserted into the spaces.

3. "Sample TAT Req'd" indicates the turn around time (TAT or speed of analysis) requested for the majority of the samples. As noted earlier if rush analysis is required for certain samples this should be noted in the individual Notes area for each sample. Standard TAT's include 24 hour, 72 hour, 5 day, and 15 day. Never indicate a turn around time as "standard" or "normal" since this will vary between laboratories. Care should be taken when specifying TAT's since high premiums are usually charged for accelerated analysis. Also certain tests require minimum times for processing that may delay specific results, an example of this is a metals analysis for Pb (lead), which requires a minimum 48 hours for digestion thereby precluding the possibility of a 24 hour turn around time. Consult with the NWT Project Manager and the contract laboratory to determine the correct turn around times.

4. The section titled "SAMPLE CHARACTERISTICS" is used by the laboratory/disposal site for the purposes of worker protection and sample characterization. At a minimum the hazard classes and physical

characteristics of the samples should be indicated. An effort should be made when completing the COC forms to group the samples by similar physical characteristics in an effort to simplify this portion of the documentation. Any radioactive data or hazardous waste ID numbers should be noted in the Notes area of this section as a precautionary measure.

5. Determination of the other physical characteristics is not mandatory, however this information will facilitate the analysis/disposal process and an effort should be made to complete as much of this area as possible.

6. "Sp. Grav." refers to the specific gravity of the samples and should be indicated by ">1.0", heavier than water, "=1.0", same as water, or "<1.0", lighter than water.

7. "Flash Pt." refers to the flash point of the materials to be sampled. The temperature of flash ignition should be reported in either degrees Fahrenheit or Celsius.

8. "Color" and "Odor" refer to the physical properties of the materials. Colors should be reported as either a primary color or a mix of primaries, i.e. Black, Brown, Gray/Green, etc. Odor should be reported as a qualitative amount such as "Slight", or "Heavy".

Section D:

1. The final section of the COC is the Custody Tracking portion. This section is used to show the person(s) responsible for the samples from the point of origin through final analysis and disposal.

2. After sampling operations are completed for the work shift, the designated responsible party, commonly the POC mentioned previously, collects all samples and completes the required labels and COC forms prior to shipment of the sample containers. This is the first person to sign the COC in space number 1 "Relinquished By". When the samples are picked up for delivery to the laboratory/disposal facility the courier will sign for the samples on Line number 1 "Received By". Upon delivery of the samples to the appropriate destination the courier will then sign on line number 2 "Relinquished By" and the laboratory/disposal facility will sign on line number 2 "Received By". An additional line is included if there is an intermediate transition between the point of origin and the final destination.

Summary

The COC form is a three part, three color form. The pages are all the same, being made with carbonless paper for the two bottom sheets. The distribution of copies is as follows:

WHITE (Top) - Included with samples as original signature document. This page must remain with the samples until disposal.

YELLOW (Middle) - Sent to Corporate Office for inclusion in the main project files. This copy is a backup in case the originals or job site copies are misplaced/destroyed.

PINK (Bottom) - Retained at the job site for referral should questions arise from the laboratory / disposal facility. Also used as a cross reference when results are received.

Documentation of samples is the most important portion of any sampling effort. All writing should be in block lettering and in waterproof blue or black ink. No cursive writing or pencil is allowed. Errors should be lined out and initialed. Whenever possible typed reports should be used. Finally, only experienced sample technicians or their supervisors should be responsible for completing the forms associated with a sampling effort.

INSERT SAMPLE COC HERE.

5.3 Sample Documentation.

Each sample will be marked with a date, time of collection, site name, samplers signature, and analytes of concern on a label that will not float/soak off – do not use masking tape. Use only indelible ink on all labels. Numbered sample labels should be used on all samples. Some projects may also require the use of sample tags in addition to labels.

5.4 Sample Logging.

Each sample or field measurement shall be logged into the appropriate log books, (bound with consecutively numbered pages), maintained at the site using waterproof ink. All log entries shall occur at the time of measurement or sample generation. Only the designated sample technician or his/her supervisor shall make or correct entries into the project log books. Copies of the log books shall be made weekly and forwarded to the contractor's corporate offices so that backups of all data may be archived in the event of loss or damage to the original logs.

5.5 Sample Numbering System.

A sample numbering system has been developed to identify each sample removed from the project site. The system provides a tracking mechanism to allow retrieval and cross referencing of sampling information and allow for anonymity of the samples at the contract laboratory. A listing of all sample numbers will be maintained in a designated field Sample log book.

The numbering system to be used on the project will take the form:

S-00001-XX

The 'S' used before the dash denotes the matrix of the sample as soil, 'W' will be used to designate water samples. The number is a consecutive, unique number assigned to each sample. The final letters denote the area being sampled and a key of these two letter codes will appear as the first page of the field Sample log book and will be summarized in the Closure Report.

5.6 Custody Seals.

Each sample container will be sealed with a tamper proof custody seal to insure the integrity of the sample. The seal will be attached in such a way so that any attempt to open the container will result in the breaking of the seal. The coolers used for shipment of the samples will also be sealed with custody seals to add an additional layer of security to the samples.

INSERT SAMPLE LOG FORM IN THIS SPACE

5.7 Chain of Custody Record.

A chain of custody record will be completed and accompany each shipment of samples. Procedures and samples of complete COC's are included in this section.

5.8 Corrections to Documentation.

Unless prohibited by weather conditions, all original data will be entered in the field using waterproof ink. When an error is made on an accountable document, corrections will be made by marking a single line through the entry, initialing the line out and entering the correct data.

5.9 Definition of Custody.

A sample will be under custody if one or more of the following criteria are met;

- 1) It is in the technicians possession.
- 2) It is in view after being in the technicians possession.
- 3) It was in the technicians possession and then locked up to prevent tampering.
- 4) It is in a designated area of the technicians responsibility.

5.10 Field Custody.

The sampling technician will have responsibility for the care and custody of the samples from the time of collection until they are transferred to another individual or shipped off site. The sampling technician will be responsible for properly filling out the chain of custody documentation for all samples in his/her care. When transferring custody, the individuals relinquishing and receiving custody will sign, date, and note the time of the transfer on the appropriate spaces of the chain of custody record.

5.11 Packaging and Shipping.

The following is a general checklist to following when preparing a sample shipment.

- Waterproof metal (or equivalent strength plastic) ice chests or coolers only.
- After filling out the pertinent information on the sample label and tag, put the sample in the bottle or vial and screw on the lid. For bottles other than VOA vials, secure the lid with strapping tape. (NOTE: Tape on VOA vials may cause contamination.) Then, secure the string from the numbered approved tag around the lid.
- Mark volume level on bottle with grease pencil.
- Place about 3 inches of inert cushioning material such as vermiculite in the bottom of the cooler. Enclose the bottles in clear plastic bags through which sample tags and labels are visible, and seal the bag. Place bottles upright in the cooler in such a way that they do not touch and will not touch during shipment.

- **Put in additional inert packing material to partially cover sample bottles (more than halfway). Place bags of ice around, among, and on top of the sample bottles. If chemical ice is used, it should be placed in a plastic bag.**
- **Fill cooler with cushioning material.**
- **Put paperwork (chain of custody record) in a waterproof plastic bag and tape it with masking tape to the inside lid of the cooler.**
- **Tape the drain shut.**
- **Secure lid by taping. Wrap the cooler completely with strapping tape at a minimum of two locations. Do not cover any labels.**
- **Attach completed shipping label to top of the cooler .**
- **Put "This Side Up" labels on all four sides and "Fragile" labels on at least two sides. "Fragile" labels are optional for coolers not containing glass bottles. In cases where ice is not required (metals), fill cooler with only packing material.**
- **Affix numbered and signed custody seals on front right and back left of cooler. Cover seals with wide, clear tape .**
- **NOTE: Each cooler cannot exceed the weight limit set by the shipper.**

Sample containers will be delivered to the laboratory by private courier. The courier service will be coordinated between the sampler with the Laboratory.

6.0 EQUIPMENT CALIBRATION AND CARE

6.1 Calibration Frequency.

Field instruments shall be calibrated daily or performance checked. Specific quality control criteria for initial and continuing calibrations for all analytical instruments is detailed in the following table. All analytes in the calibration or performance check samples must meet a standard of $\pm 15\%$ from the initial calibration.

Field Measurement	Instrument	Calibration Procedure	Precision
Depth or Length	Steel/Fiberglass tape	Comparison to new tape	± 0.1 foot
Soil Gases	FID/PID	2 standard gas comparisons	$\pm 1.0\%$
Flammable/Toxic Gases	LEL/O ₂ /CO/CO ₂ /H ₂ S	Ambient & 1 standard gas comparison	$\pm 0.1\%$
Airborne Particulates	Portable Pump	Digital bubble column	± 10 cc/Min
Radiation	Survey Meters	Performance check sources, NIST traceable	$\pm 15\%$ cpm, mR/hr, uR/hr

6.2 Preventative Maintenance.

Preventative maintenance will be only be performed by qualified personnel. Records of repair, adjustments, and calibration will be maintained and available for inspection by the CO on request.

Proper training, by and experienced user, shall be given to all field personnel prior to their operating any equipment used in the environmental investigation portions of the project. This training will include the correct procedures for calibrating, using, transporting, maintaining, and cleaning of the instruments. Upon completion, this training will be documented for review by the Project Manager/HSO and placed in the personnel files of the project.

During field operations, all instrumentation, including PPE, will be inspected and tested prior to issuance and usage in the field. Instrument inspections and calibration records will be completed and maintained daily in the field office of the project. Instrumentation that fails the in field testing and calibration shall be tagged as "Out of Service" and returned for corrective repairs. At no time will field operations be allowed to proceed without the minimum required field instruments, on site and in proper working order.

7.0 Contract Laboratory Internal Procedures

7.1 Contract Laboratory Responsibilities.

The laboratory contracted to perform all off site analyses for the Alameda Point pipeline removal project is :

Thermo NU Tech Laboratories
2030 Wright Avenue
Richmond, CA 94804-0040
(510) 235-0438

All samples will be analyzed at fully permitted and authorized facilities within the State of California.

All samples will be acquired, labeled, packaged, and delivered by NWT, Inc personnel. All in field sampling procedures are the responsibility of the contractor and are detailed in the appropriate sections of this CDAP.

DQO's and Contract Laboratory QA/QC requirements are listed under the section "Analysis Methods and DQO's". Additional requirements for PARCC (Precision, Accuracy, Representativeness, Completeness, Comparability) are listed under the appropriate sections.

Included in the following sections are the contract laboratories operating procedures for equipment maintenance, record keeping, and analysis (inclusive of QA/QC). Data requirements and confidence levels as stated in the specifications, in addition to the analytes of concern and types of matrices expected to be encountered lend themselves to the use of laboratory SOP's rather than project specific operating procedures. Should conditions at the site or analytes of concern change during the course of the on site operations changes in the operating procedures will be implemented on a case by case basis with the prior approval of the NWT PM/HSO and the IOC Contracting Officer (CO).

7.1.1 Contract Laboratory QA/QC Procedures

Thermo Nutech – Richmond QUALITY ASSURANCE PROCEDURE QAP-11, rev. 06; 12-10-96

Evaluation of Quality Control Sample Data

1.0 Introduction

2.0 1.1 Preface

3.0 Quality Control (Q.C.) samples (blanks, duplicates, or spikes) are submitted to the chemistry groups by the Quality Assurance (Q.C.) Officer who uses the analytical results to assure that the goals of precision and accuracy are met, and to verify that the chemistry groups are performing within acceptable limits. This procedure establishes the protocol for the submission of Q.C. samples to the chemistry groups, the methods for calculating and evaluating the resulting data, and the actions required as a result of the data.

4.0 1.2 Purpose

5.0 To establish a protocol for the processing of quality control samples and the evaluation of the resulting analytical data.

6.0 1.3 Scope

- 7.0** This procedure applies to personnel who generate and process QC samples and to those who evaluate the analytical results.
- 8.0** 2.0 References
- 9.0** 2.1 Thermo Nutech Quality Assurance Program Manual
- 10.02.2** Specific Procedure Manuals applicable to the analysis being performed.
- 11.02.3** Reg Guide 4.15 “Quality Assurance for Radiological Monitoring Programs (normal operations) – Effluent Streams and the Environment”
- 12.03.0** Definitions
- 13.03.1** Quality Control (QC): The overall system of technical activities that measures and controls the quality of a process, item, or service so that it meets the stated need of the user.
- 14.03.2** Quality Control Sample: A sample processed through the analytical system, which provides a means to determine the precision and accuracy of the monitoring processes.
- 15.03.3** Duplicate sample: A QC sample that provides a means to determine a precision.
- 16.03.4** Laboratory Blank: A QC sample that provides a means to detect and measure radioactive contamination of analytical samples.
- 17.03.5** Spiked Sample: A QC sample which, with known concentration of nuclides, provides a means to determine accuracy.
- 18.04.0** Responsibility
- 19.04.1** The Laboratory Manager is responsible to assure implementation of this procedure.
- 20.04.2** The Q.A. Officer is responsible to assure that QC samples are prepared and submitted to the chemistry groups, that results are received and evaluated, and that corrective action is requested when results are not in compliance with prescribed policy.
- 21.04.2** Program Managers are responsible to request specific QC samples to satisfy contractual, technical, and internal QC requirements.
- 22.04.3** The Operations Manager is responsible to assure QC samples are analyzed on a timely basis and that results are reported to the QA Officer.
- 23.05.0** Safety
- 24.0**The requirements of Thermo NUtech- Richmond Laboratory Safety Manual and the Thermo NUtech – Richmond Radiation Safety Manual shall be observed during all operations in the laboratory.
- 25.0.0** Material
- 26.0**In addition to the material normally used in the laboratory, certified radioactive tracer and standard material will be needed.
- 27.07.0** Procedures
- 28.0**The program Manager determines the type and quantity of QC samples to be submitted to the laboratory for analysis based on program, procedure, or QC requirement. This information is provided to the QA officer who causes the required QC sample to be produced. After analysis, radiometrics personnel or the program manager provides the QA officer with the results and the associated error. (a). The QA officer will evaluate the results for acceptability in accordance with this procedure.
- 29.0**The fact that the results of a QC sample meets the acceptance criteria outlined in this procedure does not relieve the program manager of the responsibility for investigating and correcting deficiencies resulting from a more stringent requirement imposed by a particular program, contract, or by the program manager’s own procedure for data review.
- 30.07.1** Out of Control and Warning Conditions

31.0 Results are out of control if greater than or less than the upper or lower control limit respectively. The results are in the warning range is greater than or less than the upper or lower warning limit respectively. The warning limits are defined as two thirds of the control limits.

32.07.2 Control and Warning Limits

33.07.2.1 Spike results

34.0 The Found (F) to Added (A) ratio is the recovery (R) and is calculated as $R = F/A$. This ratio is the control parameter and the limits are defined as follows:

	Control Limits		Warning Limits	
	<u>Lower</u>	<u>Upper</u>	<u>Lower</u>	<u>Upper</u>
Gross Alpha	0.60	1.40	0.73	1.27
Gross Beta, C-14	0.70	1.30	0.80	1.20
All other	0.80	1.20	0.87	1.13

35.0 Specific contract requirements may result in spiked samples with very low activities. If, as a result of this, the one sigma error of the spike result is greater than 10%, then the control limits are widened by the one sigma error value.

36.07.2.2 Blank results

37.0 Blank results are compared to the MDA (Minimum Detectable Activity) of the blank analysis. The control limits for all analyses are defined as ± 2 times the MDA except for analyses performed in the high level lab, in which case the control limits are defined as ± 5 times the MDA. The calculation of the MDA is method specific and is documented in the appropriate calculation procedures. No warning limits are defined for blanks.

38.07.2.3. Duplicate Results

39.07.2.3.1. If both duplicate and the original sample results are less than or equal two times their respective MDAs, or two times their respective MDAs for analyses performed in the high level lab; then no RPD, (Relative Percent Difference) is calculated and the duplicate sample result is acceptable.

40.07.2.3.2 If the results plus or minus their respective 2 sigma absolute errors overlap, then the duplicate sample result is acceptable and a RPD is calculated.

41.07.2.3.3 If both the original and the duplicate sample results are reported as upper limits and the difference between the two values is less than a factor of 10, then no RPD is calculated and the duplicate sample result is acceptable.

42.07.2.3.4 If only the original or the duplicate is reported as an upper limit and if the result not reported as an upper limit is less than 2 times the reported upper limit, then no RPD is calculated and the duplicate sample result is acceptable.

43.07.2.3.5 If the RPD is less than or equal to one of the following values, then the result is acceptable:

- 43.1 Gross Alpha 40
- 43.2 Gross Beta, C-14 30
- 43.3 All other analyses 30

43.47.2.3.6 If none of the above criteria is met, then the duplicate result is not acceptable.

43.57.3 Trend Analysis – Analysis of the history of QC results may reveal trends in the QC program that require corrective actions. Trend analysis is performed once a month on the previous month’s history of QC results. All data generated the previous month will be reviewed. In cases where fewer than 10 data points were generated, the review will extend as far as the previous 3 months. The following circumstances result in out of control trends:

43.67.3.1 Two results in succession are out of control.

43.77.3.2 Four results out of ten are out of control.

43.87.3.3 Four results out of ten are lower than the lower warning limit.

43.97.3.4 Four results out of ten are greater than the upper warning limit.

43.10 7.4 Evaluation of Calibration Bias – On a semi-annual bases, an average of the QC Spike found/added ratios for the previous six months will be calculated. Obvious outliers will be rejected before the averaged are computed. Any bias value that is greater than one half of the warning limits for that analysis are considered out of control.

43.11 7.5 Corrective Action – A Corrective Action Request (CAR) will be issued when an out of control trend as defined in 7.3 is observed. A CAR will not be issued for an individual out of control result.

7.2 Accuracy - General Chemistry.

Section 2.6 of this plan details the matrix, method, and analyte specific quality control criteria for all the sample analyses used to determine the contract laboratory accuracy. Accuracy will be determined through the analysis of matrix spike and matrix spike duplicate (MS/MSD) samples, laboratory control samples (LCS) and by spiking samples with surrogate compounds where applicable.

QC criteria (surrogate recoveries, LCS recoveries, MS/MSD recoveries) must fall within the 65 to 135 percent range. These quality control criteria will be subject to the approval of the IOC CO. Failure of the contract laboratory to present QC criteria (including appropriate corrective actions) that are acceptable to the US IOC will result in NWT retaining another laboratory for the contract services.

Accuracy is a quantitative parameter of the bias in a measurement system. Sources of possible error are the sampling process, field contamination, preservation, handling, sample matrix, sample preparation and analytical procedures. Accuracy is calculated as follows:

For measurements where matrix spikes are used:

$$\%R = 100\% \times \left(\frac{S - U}{C_{sa}} \right)$$

%R	-	percent recovery
S	-	measured concentration in spiked aliquot
U	-	measured concentration in unspiked aliquot
C _{sa}	-	actual concentration of spike added

For situations where a surrogate or a standard reference material (SRM) is used instead of, or in addition to matrix spikes:

$$\%R = 100\% \times \left(\frac{C_m}{C_{arm}} \right)$$

%R	-	percent recovery
C_m	-	measured concentration of SRM
C_{arm}	-	actual concentration of SRM

For each shipment of the samples that are shipped to the contract laboratory, one sample will be provided in sufficient quantity such that a matrix spike and a matrix spike duplicate can be generated in addition to an aliquot reserved for actual sample analysis. The frequency of duplicates will be 5% or 1 in 20 samples, whichever is greater, per shipping container.

This sample will include sufficient volume such that one re-extraction/reanalysis of the MS/MSD pair may be performed as necessary. Only samples from this project will be used for MS/MSD procedures. Trip blanks and rinsate blanks will not be knowingly used for MS/MSD analysis.

The matrix spike and matrix spike duplicate samples will be spiked with a series of method target compounds, while a third aliquot of the sample will be analyzed unspiked. Accuracy will be measured in terms of percent recovery of each of the spiked components.

MS/MSD not meeting the contract laboratory quality control criteria specified in section 2.6 will be re-extracted and reanalyzed once at no additional cost to the US IOC. Failure of different spike analytes on successive runs for methods with multiple spike analytes will be considered a reanalysis failure and will satisfy the requirements for reanalysis.

Analysis exhibiting out of control surrogate recoveries will be reanalyzed once at no additional cost to the US IOC. For GC/MS analyses involving semi-volatiles, the CLP QC acceptance criteria for surrogate recoveries may be employed.

LCS analyses are matrix spikes on a blank matrix (de-ionized water, reagent grade sand) to assess contract laboratory accuracy independent of matrix effects. Use of sodium sulfate and/or other matrices may be used only after receiving prior approval from the US IOC CO. Failure of the MS/MSD and/or LCS analyses to meet the contract laboratory QC criteria will be cause to initiate a review of all analytical data generated in the corresponding analytical batch.

If the review indicates out of control data due to laboratory error, NWT's contract laboratory will perform resampling/re-extraction/reanalysis to correct the out of control condition. With the exception of compromised data due to well substantiated and documented matrix effects, the contract laboratory will perform resampling/re-extraction/reanalysis at no additional cost to the US IOC.

7.3 Sensitivity.

Detection limits for analyses are detailed in table 7.3. The detection presented in the final CDAP will be considered Contract Required Quantitation Limits (CRQL's). The detection limits will be subject to the approval of the US IOC CO. Failure of the contract laboratory to present detection limits that are acceptable to the US IOC will result in NWT retaining another laboratory for the contract services. Failure of the contract laboratory to achieve the CRQL's as specified in this plan will be cause for the rejection of the data and resampling/reanalysis at the expense of the contract laboratory.

Detection limits will be consistent with those specified in SW-846.

If dilution to bring the reported concentration of a single compound of interest results in non-detect results for all other analytes with detectable concentrations in the initial analysis, the data of the original run and the dilution will be reported with the appropriate notations in the narrative history of the sample analysis procedures.

Matrix effects will be considered in assessing the contract laboratory's compliance with the requirements for sensitivity. A detailed analysis of all failure to meet the requirements for sensitivity will be included in the narrative section of the required certificate of analysis.

Table 7.3 Analyte Detection Limits

Type Analysis	Material	Form	Detection Limit
Chemical	Petroleum Hydrocarbons	Soil	< 2 mg/ kg
Chemical	Petroleum Hydrocarbons	Water	< 2 ug/l
Chemical	Benzene	Soil	<0.5 mg/kg
Chemical	Benzene	Water	< 2 ug/l
Chemical	Toluene	Soil	<0.5 mg/kg
Chemical	Toluene	Water	<2mg/l
Radiological	Radium	Soil	< 1pCi/g
Radiological	Radium/Radon	Water	<4pCi/l
Chemical	Ethyl Benzene	Soil	0.5 mg/kg
Chemical	Ethyl Benzene	Water	< 2 ug/l
Chemical	Xylene	Soil	<0.5 mg/kg
Chemical	Jet Fuel (Kerosene)	Soil	< 2 mg/kg
Chemical	Jet Fuel (Kerosene)	Water	< 60 ug/l
Chemical	Diesel Fuel	Soil	< 2 mg/kg
Chemical	Diesel Fuel	Water	< 60 ug/kg

7.4 Precision.

Section 2.6 specifies the contract laboratory quality control criteria for precision (expressed a relative percent difference (RPD)). Precision will be evaluated through the collection and analysis of field and laboratory duplicate samples. Laboratory duplicate not meeting the quality control criteria will be re-extracted/reanalyzes once.

For organics analysis, failure of different matrix spike compounds to meet QC criteria on successive runs will constitute failure and satisfy the requirement for reanalysis. These quality control criteria will be subject to the approval of the US IOC CO. Failure of the contract laboratory to present QC criteria for precision (including appropriate corrective actions) that are acceptable US IOC will result in NWT acquiring a new contract laboratory to complete the project.

Precision is a quantitative parameter for the variability of a group of measurements compared to their average value. Sampling precision is evaluated from field duplicate samples and analytical precision is evaluated from matrix spike duplicate samples and split samples.

Precision is calculated in terms of the relative percentage difference as follows:

$$RPD = \left(\frac{(C_1 - C_2) \times 100\%}{(C_1 + C_2) \div 2} \right)$$

- RFD - relative percent difference
 C₁ - larger of the two observed values
 C₂ - smaller of the two observed values

RPD's will not be calculated in cases in which one analyte of the duplicate pair is reported as nondetected. The RPD for field and laboratory duplicates will be calculated and used as a measure of precision; however, only laboratory duplicates will be included in the quantitative assessment of completeness. Results of field duplicates will be described in the qualitative assessment of completeness.

Field duplicates (QC samples) will be collected at a frequency of 1 sample for every 10 samples of a given matrix. The identity of the QC sample will be held blind to the contract laboratory until after the analyses have been completed.

Precision for organic analyses may be determined by the analysis of matrix spike/matrix spike duplicate samples at a rate of one in twenty (one for each batch to a maximum of twenty).

8.0 CDQM DELIVERABLES

8.1 Daily Quality Control Report.

A report shall be generated for each day of activities at the project site. The report shall be in summary form and shall contain as a minimum the following items;

- Location of work.
- Weather conditions
- Work Performed.

- **Results of any inspections.**
- **Problems encountered and corrective actions applied.**
- **Types and quantities of tests performed, including sample technician's name.**
- **Instructions or directions received from the US IOC representatives or other agency representatives.**
- **General comments or notes.**
- **Calibrations performed.**
- **Contractors Certification of Compliance**

8.2 Non-Routine Occurrences Reports.

A report, in writing, shall be made to the US IOC representative concerning any occurrences or conditions encountered on the project that will impact the quality, quantity, and/or cost of the sampling data or work to be performed. Submission of the problem, corrective actions taken, or recommended and the instructions of the US IOC representative shall be received by the IOC within 48 hours of discovery.

8.3 Certificates of Analysis.

All samples are scheduled for a normal turn around time (TAT) of 28 days (calendar) for the receipt of formal certificates of analysis. All certificates shall be submitted to the IOC as they are received, but no later than the 28 days previously mentioned.

8.4 Contractor Quality Control Summary Report.

A report summarizing the following items shall be submitted at the completion of the sampling effort;

- **Project scope.**
- **Project description.**
- **Sampling procedures used.**
- **Summary of Daily Quality Control Reports.**
- **Analytical procedures.**
- **Data presentation including analysis and validation.**
- **QC activities.**
- **Conclusions and Recommendations.**

9.0 REFERENCES

- **California WRCB, 1989. LUFT Field Manual**

- **Keith, Lawrence H. Environmental Sampling and Analysis. Lewis Publishers**
- **US EPA, 1988. CERCLA Compliance with Other Laws Manual Volume I**
- **US EPA, 1989. CERCLA Compliance with Other Laws Manual Volume II**
- **US EPA, 1988. A Compendium of Superfund Field Operations Methods**
- **US EPA, 1992. Guidance for Data Usability in Site Assessment**
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