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SITE-SPECIFIC QUALITY ASSURANCE PLAN

FOR THE

**CHARLES GEORGE LAND RECLAMATION TRUST
LANDFILL SITE**

**TOWN OF TYNGSBOROUGH
MIDDLESEX COUNTY, MASSACHUSETTS**

**EPA WORK ASSIGNMENT
NUMBER 54-1L16
EPA CONTRACT NUMBER 68-01-6699**

NUS PROJECT NUMBER 0766.11

JULY 1984

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SUBMITTED FOR NUS BY:


JOHN A. GEORGE
PROJECT MANAGER

APPROVED:


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MANAGER, REMEDIAL PLANNING

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1.0 GENERAL

1.1 Introduction

The quality assurance program employed in this Remedial Investigation is based on protocols and procedures detailed in the NUS Corporation's Superfund Division Quality Assurance Manual. Guidance contained in the manual is applied as required on a site-specific basis. The entire quality assurance manual is applicable to the work to be performed. This site-specific plan may be modified by data collected during the Remedial Investigation.

This program complies with the EPA quality assurance requirements specified in the contract as related to monitoring and measurement activities. It encompasses all project activity that may affect the quality of work.

1.2 Project Description

The project includes performance of a Remedial Investigation and Feasibility Study at the Charles George Land Reclamation Trust Landfill Site (Charles George Site) in Middlesex County, Massachusetts. This site is a privately owned, recently closed, municipal and industrial landfill, approximately 70 acres in size. The following is an outline of the proposed RI/FS.

Initial Activities (Phase I)

- Task 1 Preparation of RI/FS Work Plan
- Task 2 Project Management
- Task 3 Community Relations Support Functions
- Task 4 Collect and Evaluate Existing Data
- Task 5 Health, Safety, and General Site Reconnaissance
- Task 6 Permits, Rights of Entry, and Other Authorizations
- Task 7 Subcontractor Procurement
- Task 8 Topographic Map

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- Task 9 Site-Specific Health and Safety Requirements
- Task 10 Site-Specific Quality Assurance Requirements
- Task 11 Site Operations Plan
- Task 12 Field Equipment Mobilization

Site Investigation Activities (Phase II)

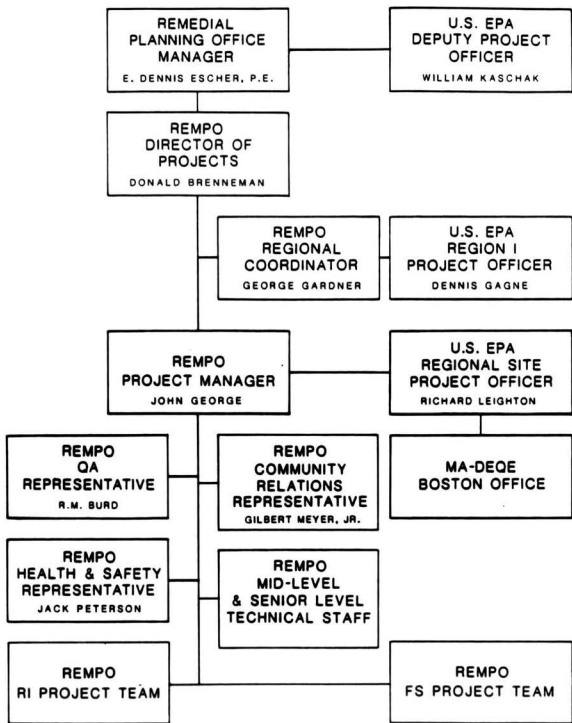
- Task 13 Geophysical Investigation
- Task 14 Drilling and Monitoring Well Installation
- Task 15 Leachate Recirculation System Assessment
- Task 16 Preliminary Ecological Survey
- Task 17 Ecological Investigation
- Task 18 Environmental Sampling and Analysis
- Task 19 Ground Survey of Monitoring Wells and Sampling Points
- Task 20 Data Reduction and Evaluation
- Task 21 Preliminary Identification of Remedial Alternatives
- Task 22 RI Report and Revised FS Work Plan

Feasibility Study (Phase III)

- Task 23 Development and Initial Screening of Remedial Alternatives
- Task 24 Laboratory Studies
- Task 25 Remedial Alternatives Evaluation
- Task 26 Preliminary Feasibility Study Report
- Task 27 Conceptual Design
- Task 28 Final Report

1.3 Project Organization

The project organization is shown in Figure 1-1.



PROJECT ORGANIZATION
REMEDIAL INVESTIGATION & FEASIBILITY STUDY
CHARLES GEORGE LAND RECLAMATION TRUST
LANDFILL SITE, TYNGSBORO, MA

1-3



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The Project Manager, Mr. John George, is responsible for all project activities. Key project discipline personnel will be assigned at a later date when specific tasks are initiated.

In carrying out their duties, the quality assurance representative and his personnel must have access to all work areas, if they have received the required safety training. They have the freedom to identify quality assurance problems; initiate, recommend, or provide solutions to quality assurance problems through designated channels; verify implementation of solutions; and ensure that further processing or action is controlled until proper disposition of unsatisfactory conditions has occurred. Quality assurance personnel have access to NUS corporate management, at all levels, as required to resolve problems or coordinate quality concerns.

1.4 Quality Assurance Objectives

The objectives of this site-specific Quality Assurance Plan are as follows:

- To maintain the evidentiary value of the data produced
- To ensure the integrity of results of the remedial investigation, laboratory analysis, and technical reports
- To provide assurance that remedial designs and assessments are properly prepared and reviewed
- To control the activity of subcontractors, consultants, and support agencies or organizations to ensure that they maintain the same quality standards that are required by NUS
- To produce a product (report) that is uniform and of acceptable quality to achieve the purpose of the project.

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1.5 Quality Assurance Training

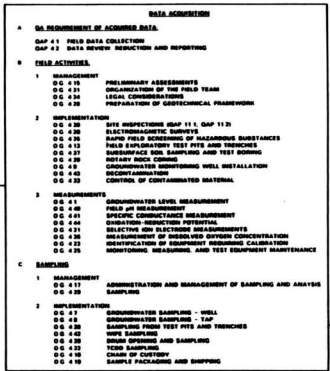
As outlined in the Quality Assurance Manual, training will be provided to all project personnel responsible for activities that may affect the quality of the project work. This training will be implemented in accordance with Quality Assurance Procedure 2.3* (QAP 2.3).

1.6 Standard Operating Procedures

Activities requiring procedures, definition, and/or QA management are displayed in Figure 1-2.

PROJECT MANAGEMENT
GAP 76 PROJECT WORK PLAN

0-1



HEALTH AND SAFETY DR REQUIREMENTS

- DC 4 16 GENERAL SAFETY GUIDELINES APPLICABLE TO ALL FIELD OPERATIONS
- DC 4 4 AND PHOTOLOGICAL OR FLUORINATION OPERATION
- DC 4 2 ORGANIC VAPOR ANALYSIS OPERATION
- DC 4 2 NEARBY PROTECTION DECONTAMINATION

SUBCONTRACTOR REQUIREMENTS

- GAP 41 PROCUREMENT DOCUMENT CONTROL
- GAP 41 PREPARATION OF PROCUREMENT DOCUMENT
- GAP 42 SUBCONTRACTOR QA REQUIREMENTS
- GAP 42 SELECTION OF SUBCONTRACTORS

DC 4 16 OPERATING GUIDELINES FROM THE USE OPERATING GUIDELINES MANUAL

GAP 41 QUALITY ASSURANCE PROCEDURE FROM THE USE QUALITY ASSURANCE MANUAL

LABORATORY RESULTS

- DC 41 QUALITY ASSURANCE REVIEW AND VALIDATION OF ANALYTICAL DATA PACKAGE QA REVIEW AND VALIDATION (OPLANCE)

**REMEDIAL INVESTIGATION ACTIVITIES REQUIRING
QUALITY ASSURANCE MANAGEMENT
CHARLES GEORGE LAND RECLAMATION TRUST LANDFILL,
TYNGSBORO, MA**

FIGURE I-2



CHARLES GEORGE LAND RECLAMATION TRUST LANDFILL ADMINISTRATIVE RECORD

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2.0 WORK PLANS

2.1 Project Work Plan

A Quality Assurance Procedure (QAP 2.5) contained in the NUS Quality Assurance Manual establishes the procedure for preparing a project work plan. It also lists the elements to be addressed by a QA/QC plan as follows: (1) sampling procedures; (2) sample custody; (3) calibration procedures and frequency; (4) analytical procedures; (5) data acquisition; (6) data reduction, validation, and reporting; (7) performance and system audits; (8) preventive maintenance; (10) data precision, accuracy, and completeness; (11) corrective action; and (12) quality assurance reports to management.

Internal review and approval procedures relating to the work plan are detailed in QAP 2.5.

*Quality Assurance Procedures (QAPs) can be found in the NUS Corporation's Superfund Division Quality Assurance Manual.

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3.0 DATA ACQUISITION ACTIVITIES

These are a number of tasks (or activities) to be performed for completion of the Remedial Investigation, which require the acquisition of data. All of these activities must be carried out with quality assurance in mind. Chronologically, they include (1) obtaining background data; (2) an initial site visit; (3) site reconnaissance; (4) aerial surveying to generate a topographic map; (5) land surveying for topographic map ground control, magnetometer grid layout, and exact location of test borings and monitoring wells; (6) shallow soil screening; (7) magnetometer survey; (8) soil borings/monitoring well installation; (9) rotary rock coring; (10) preparation of water table maps, bedrock contour maps, water level measurements, and groundwater regime definition.

3.1 Background Data Acquisition

Existing data will be compiled and evaluated to establish the background of the site and its problems. This evaluation will be used to finalize the details of the remedial site investigation. Data to be compiled and evaluated includes any additional information pertinent to the Remedial Investigation. Regional information will be gathered on the geology, hydrogeology, surface and subsurface water quality, and soils.

Quality assurance requirements relating to the acquisition of background data are contained in the NUS Quality Assurance Manual in Section QAP 11.1 under inspections. QAP 11.1, describing the quality assurance protocol for offsite reconnaissance, contains the relevant procedures regarding (1) information sources, (2) review of the information, (3) protection of evidentiary value of the background information, (4) offsite sample requirements, (5) photographs, (6) sketch maps, (7) exposed soil and rocks, (8) report, and (9) records.

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3.2 Initial Site Visit

An initial site visit may have multiple objectives, e.g. data acquisition and initial health and safety evaluation. General quality assurance impacts on this activity are generally covered in the NUS Quality Assurance Manual in QAP 11.2 (Onsite Inspections).

3.3 Site Reconnaissance

Basic quality assurance requirements and procedures for the site reconnaissance are covered in the NUS Quality Assurance manual under QAR 11.0 (Inspections) and QAP 11.2 (Onsite Inspections).

All of the applicable sample collection, packaging and preservation, documentation and tagging, and custody protocols are shown in the sampling section.

Data reporting and reduction is covered by the following OG's and QAP's:

- OG 4.2 - Data Review, Reduction, and Reporting (QAP 4.2)
- QAP 7.1, QAP 7.2 - Document Control
- QAP 11.1 - Offsite Reconnaissance (Photographs)

3.4 Aerial Surveying

Quality assurance requirements will influence the production of a topographic map called for in the work assignment. The following QAP's are applicable to achieving the quality assurance objectives related to this particular task:

- QAP 3.1 - Control of Remedial Design Activities
- QAP 4.1 - Field Data Collection
- QAP 7.2 - Controlled Documents

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- QAP 7.4 - Technical Reports
- QAP 5.1, QAP 5.2 - Procurement document control and subcontractor QA requirements

3.5 Ground Survey

All monitoring wells, soil sampling locations, surface water sampling locations, and sediment sampling locations will be surveyed for vertical and horizontal control to permanently record the locations.

Applicable QAP's for the accomplishment of the above work to provide the required quality assurance are

- QAP 4.1, QAP 4.2 - Data Acquisition
- QAP 5.2 - Subcontractor Quality Assurance Requirements
- QAP 7.1 - Document Control
- QAP 8.1 - Control of Procurement Activities
- QAP 12.1 - Implementation of Measuring and Test Equipment Controls
- QAP 16.1 - Storage and Retrieval of Quality Assurance Records

3.6 Geophysical Investigation

Limited geophysical investigations will be conducted during the course of Task 13. Geophysical Investigation, in order to provide additional detail regarding anomalous zones. Geophysical data may be used to optimize the location of borings and the establishment of monitoring wells. Both seismic refraction and electromagnetic conductivity/resistivity methods will be used.

The following QAP's and OG's are applicable to this task:

- QAP 2.5 - Work Plans
- QAP 4.1, QAP 4.2 - Data Acquisition

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- QAP 7.1, QAP 7.2 - Document Control
- QAR 12.0, QAP 12.1 - Control of Measuring and Test Equipment
- QAP 16.1 - Storage and Retrieval of Quality Assurance Records
- OG 4.2 - Data Review, Reduction, and Reporting
- OG 4.20 - Electromagnetic Surveys

3.7 Drilling and Monitoring Well Installation

Borings and monitoring wells may be installed at approximately 12 locations to determine hydraulic gradients around the landfill and the relationship between glacial soils and bedrock groundwater systems, as they relate to contaminant migration. Soil samples will be procured using a split-barrel sampler with Standard Penetration Testing. The soil in bedrock borings will be sampled for soil classification, permeability estimation, and contaminant analysis purposes.

Quality assurance aspects of this task are generally covered by the following QAR's, QAP's and OG's:

- QAP 2.5 - Work Plan
- QAR 4.0, QAP 4.1, QAP 4.2 - Data Acquisition
- QAP 5.1 - Preparation of Procurement Documents
- QAP 5.2 - Subcontractor Quality Assurance Requirements
- QAP 6.1 - Preparation of Instructions and Procedures
- QAP 7.1, QAP 7.2 - Document Control
- QAP 16.1 - Storage and Retrieval of Quality Assurance Records
- OG 4.2 - Data Review, Reduction, and Reporting
- OG 4.9 - Groundwater Monitoring Well Installation
- OG 4.37 - Subsurface Soil Sampling and Test Boring
- OG 4.39 - Rotary Rock Coring
- OG 4.43 - Decontamination
- OG 4.33 - Control of Contaminated Material
- OG 4.12 - Falling Head/Rising Head/Permeability Testing

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3.8 Ecological Investigation

The Ecological Investigation is intended to focus upon potential offsite impacts on the aquatic environments, resulting from surface and subsurface leachate migration. Benthic macroinvertebrate communities within the receiving streams will be evaluated to define the current condition of the aquatic environment. At each station within Dunstable Brook and Bridge Meadow Brook, surface water and sediment samples will be taken as noted in Task 16, Preliminary Ecological Survey.

Additional samples will be taken in Task 17, Environmental Investigation, which will include sampling of fish from Flint Pond. Sampling methods for fish collection will be defined following the Preliminary Ecological Survey.

Applicable Quality Assurance Requirements and Procedures include

- QAP 2.5 - Work Plan
- QAP 4.1, QAP 4.2 - Data Acquisition
- QAP 6.1 - Preparation of Instructions and Procedures
- QAP 7.1, QAP 7.2 - Document Control
- QAP 16.1 - Storage and Retrieval of Quality Assurance Records

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4.0 SAMPLING PROCEDURES

The sampling and analyses activity, as implemented, is described in Section 3 of the Work Plan. A summary of the sampling plan is shown on Table 4-1.

4.1 Ambient Air Sampling

Ambient air samples will be obtained by adsorption on special resins in air sampling tubes. A site sampling program will be implemented, focusing on tasks, such as drilling and monitoring well installation, where exposure is possible, in order to define the levels of protection required in the air breathing zone by investigation personnel.

Quality assurance aspects of the air sampling program are covered by the following:

- QAP 9.1 - Chain of Custody
- QAP 9.2 - Sample Control
- OG 4.17 - Administration and Management of Sampling and Analysis
- OG 4.29 - Sampling
- OG 5.5 Organic Vapor Analyzer Operation
- OG 5.4 HNu Photoionization Detector Operation

4.2 Surface Soil Sampling

The surface soil sampling program is designed to sample sediments, eroded from the site, at points where they tend to accumulate before entering the local drainage. Points of accumulation would include ditches around the perimeter of the site, catch basins, ditches and obvious sediment accumulation areas along the roads, and culverts beneath the roads.

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TABLE 4-1

SUMMARY OF PROPOSED ENVIRONMENTAL SAMPLING AND ANALYSIS PROGRAM
CHARLES GEORGE SITE

Medium	Sample Collection Task	Analytical Parameters	Number of Samples		
			Tour 1	Tour 2	Tour 3
Ambient Air	5	Volatile Organics (Field) HSL Vol. Org. (Lab)	10	10	
			2	2	
Subsurface Soil	14	HSL TOH, HSL Metals	5		
			10		
Surface Soil/Sediment	18	HSL	15		
Streambed Sediment	16	HSL	6		
	17	Ind.		19	
Surface Water	5	HSL/MEK/MIBK	12		
	17	Ind.		19	
	18				19
Groundwater	5	HSL	3		
		HSL Org./MEK			
	18	MIBK/HSL Metals Ind.	20	35	35
Leachate Recirculation System	15	*	6		
Fish Fillets	17	HSL	10		
		HSL Metals, TOH, Ind.	15		
Benthic Macroinvertebrates	17	None	19		

NOTES:

HSL = Hazardous Substances List
HSL Vol. Org. = HSL Volatile Organics
HSL Org. = HSL Organics
Ind. = Indicator parameters (see text)
* = See text

TOH = Total Organic Halogens
MEK = Methyl Ethyl Ketone
MIBK = Methyl Isobutyl Ketone

Tour indicates the respective sampling round for each medium, and is not intended to imply, for example, that all Tour 1 sampling will occur at the same time.

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Applicable Quality Assurance Requirements, Procedures, and Operating Guidelines include

- QAP 2.5 - Work Plans
- QAP 4.1, QAP 4.2 - Data Acquisition
- QAP 6.1 - Preparation of Instructions and Procedures
- QAP 7.1, QAP 7.2 - Document Control
- QAR 12.0, QAP 12.1 - Control of Measuring and Test Equipment
- QAP 16.1 - Storage and Retrieval of Quality Assurance Records
- OG 4.18 - Chain of Custody
- OG 4.19 - Sample Packaging and Shipping
- OG 4.27 - Field Classification of Soil and Rock Samples
- OG 4.29 - Sampling

4.3 Surface Water Sampling

Analysis will be for HSL parameters, with field measurements of pH, temperature, specific conductivity, and flow rate, as well as other parameters which can be detected via field screening equipment.

A second round of sample collection is anticipated involving samples from 19 stations within the surface drainages and Flint Pond.

A third sampling round has been projected in which follow-up samples will be collected from the 19 sample stations within a period of approximately six weeks of tour No. 2.

Analyses of samples taken during the second and third rounds will be for field parameters and laboratory indicator parameters only. The latter will be selected based upon the results of the HSL scans of surface water and leachate recirculation system samples and field screening.

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Procedures for the sample collection, packaging and preservation, documentation and tagging, and chain-of-custody are generally presented in the following QAP's and OG's:

- QAP 7.1, QAP 7.2 - Document Control
- QAP 9.1 - Chain-of-Custody (OG 4.18)
- QAP 9.2 - Sample Control
- OG 4.29 - Sampling
- OG 4.17 - Administration and Management of Sampling and Analysis
- OG 4.19 - Sample Packaging and Shipping
- OG 4.40 - Field pH Measurement
- OG 4.41 - Specific Conductance Measurement

4.4 Streambed Sediment Sampling

Composite sediment samples will be collected from 6 of the 19 proposed sample stations within streams in the site vicinity. Analysis of these samples will be for full HSL scans.

The following QAP's and OG's apply:

- QAP 7.1, QAP 7.2 - Document Control
- QAP 9.2 - Chain-of-Custody (OG4.18)
- QAP 9.2 - Sample Control
- OG 4.29 - Sampling
- OG 4.17 - Administration and Management of Sampling and Analysis
- OG 4.19 - Sample Packaging and Shipping

4.5 Leachate Collection/Recirculation System

Six samples are anticipated to be collected from various points within the leachate collection/recirculation system. Four of these samples will be analyzed for the following parameters:

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- pH
- Specific conductance
- Total dissolved solids
- Biological oxygen demand
- Ammonia
- Nitrate
- Sulfate
- Chloride
- HSL organics
- MEK
- MIBK
- HSL metals

Two samples will be subjected to a complete HSL scan in addition to the non-HSL parameters noted above.

The following QAP's and OG's apply:

- QAP 7.1, QAP 7.2 - Document Control
- QAP 9.1 - Chain-of-Custody (OG 4.18)
- QAP 9.2 - Sample Control
- OG 4.17 - Administration and Management of Sampling and Analysis
- OG 4.19 - Sample Packaging and Shipping
- OG 4.29 - Sampling
- OG 4.40 - Field pH Measurement
- OG 4.41 - Specific Conductance Measurement

4.6 Fish Sampling

Approximately 25 fish will be collected from Flint Pond. Edible portions of 10 of the fish will be subjected to the full HSL scan with the addition of MEK and MIBK. The remaining 15 samples will be analyzed for HSL metals, Total Organic Halogens

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(TOH), and specific indicator parameters based upon Tour 1 stream and sediment sampling.

The following QAP's and OG's apply:

- QAP 7.1, QAP 7.2 - Document Control
- QAP 9.1 - Chain-of-Custody (OG 4.18)
- QAP 9.2 - Sample Control
- OG 4.17 - Administration and Management of Sampling and Analysis
- OG 4.19 - Sample Packaging and Shipping
- OG 4.29 - Sampling

4.7 Benthic Macroinvertebrates

The benthic macroinvertebrate community in receiving streams will be sampled at 19 stations during Task 17, Ecological Investigation. No laboratory analytical support will be required.

Benthic macroinvertebrates will be collected with the aid of a stream bottom sampler such as the Surber Sampler. Where the depth of flow prohibits the use of this type of sampler, dredge-type samplers will be used. See Work Plan, Task 17, for method of evaluation of samples.

The following QAP's and OG's apply:

- QAP 7.1, QAP 7.2 - Document Control
- OG 4.17 - Administration and Management of Sampling and Analysis
- OG 4.29 - Sampling

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4.8 Groundwater Sampling and Analysis

The sampling and chemical analysis outlined in this task will be focused on groundwater samples to be taken during the drilling and monitoring well installation.

All monitoring wells containing water will be sampled and analyzed for the following parameters:

- pH
- Specific Conductance
- Ammonia, Nitrate, Nitrite
- TOC
- TOX
- HSL Organics

Procedures for the sample collection, packaging and preservation, documentation and tagging, and chain-of-custody are generally presented in the following QAP's and OG's:

- QAP 9.2 - Sample Packaging and Preservation
- QAP 9.2 - Sample Tagging and Documentation
- QAP 9.1 - Chain-of-Custody (OG 4.18)
- OG 4.7 - Groundwater Well Sampling
- OG 4.17 - Administration and Management of Sampling and Analysis
- OG 4.19 - Sample Packaging and Shipping
- OG 4.29 - Sampling
- OG 4.40 - Field pH Measurement
- OG 4.41 - Specific Conductance Measurement

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5.0 LABORATORY ANALYSES

All samples collected for data acquisition will be forwarded to assigned laboratories in the USEPA Contract Laboratory Program (CLP).

5.1 Analytical Procedures

The analytical procedures employed are determined by the substances involved. Standard Operating Procedures (SOP) are generally used in environmental data analysis. Most have received EPA approval as published in "Methods for Chemical Analysis of Water and Wastes". Additional suitable reference sources for analytical procedures are as follows:

- Viar & Co., August 1982, "User Guide to the EPA Contract Laboratory Program" prepared by Sample Management Office: Alexandria, Virginia.
- APHA 1981, "Standard Methods for the Examination of Water and Wastewater," 15th Edition American Public Health Association: Washington, D.C.
- USEPA, July 1982, "Test Methods for Evaluating Solid Waste, Physical/Chemical Methods," Solid Waste Report No. 846, Washington, D. C.

Other QA documents which generally describe the quality assurance aspects of laboratory activities are as follows:

- QAP 9.1, QAP 9.2 - Sample Control and Chain-of-Custody
- QAR 10.0 - Control of Laboratory Analysis Processes
- QG 4.2 - Data Review, Reduction and Reporting

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5.2 Internal Quality Control Checks and Frequency

To maintain confidence in the results of laboratory analysis, quality control checks will be employed. Their specific usage depends upon the substances involved. All quality control checks employed are based upon nationally recognized procedures. During the project, procedures outlined by the EPA will be employed, as applicable.

The CLP User's Guide describes all quality control procedures used in central laboratory operations. These procedures include the use of replicates, blanks, spiked samples, split samples, and surrogate samples.

The frequency of the quality control checks varies in accordance with the complexity of the measurement technique involved. Customarily, every twentieth sample or one sample from every case of bottles, is analyzed for the quality control parameters; this procedure provides data needed for laboratory control charts. Spiked samples are also prepared and analyzed to determine accuracy or bias.

Procedures for NUS QA review of analytical data have been prepared and are available for use.

5.3 Data Precision, Accuracy, and Completeness

EPA will verify that the contract laboratories employ a quality assurance program. Included in the laboratory quality assurance procedures will be the specific procedures used to assess data precision, accuracy, and completeness. The procedures should address the quality assurance objectives, which include techniques for data reduction, validation, reporting, and internal quality control checks.

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6.0 PRODUCT QUALITY ASSURANCE

Since the product associated with the remedial investigation is the report, which incorporates illustrations, drawings, photos and reproductions, some quality assurance requirements are necessary. In addition, control of the documents is an essential element of the development of a remedial investigation report.

The following documents provide quality assurance guidance in the production of the Remedial Investigation report:

- NUS Style Guide
- QAP 3.1 Control of Remedial Design Activities
- QAR 7.0 Document Control
- QAP 7.1 Identification of Controlled Evidentiary Documents
- QAP 7.4 Technical Reports

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7.0 DATA REDUCTION, VALIDATION, AND REPORTING

Data analysis will be based on logical and systematic procedures using acceptable engineering methods and will be documented. Preliminary analysis or calculations need only be reviewed by a qualified individual. All preliminary or informal analyses or calculations must be uniquely defined as such.

The source document status must be identified in any report in which it is being used as input. Data analysis will be legible and in a form suitable for reproduction and filing. Analyses will be sufficiently detailed and in a format so that they may be reviewed or verified without recourse to the originator. The tester, subject, date, and specific data used in the analyses will be identified. Data analysis will be reviewed by qualified individuals other than those performing the analysis. The method of analysis used will provide for the review of consistency and defensibility of all references, technical concepts, methods, assumptions, calculations, and conclusions. Proper documentation of the review is required, as stated in QAP 7.5, Document Review Procedure.

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8.0 PERFORMANCE AND SYSTEMS AUDITS

The effectiveness of quality assurance techniques and their implementation can be evaluated through audits. Project activities will be audited by the Manager of Quality Assurance and Security. The overall quality assurance program is audited periodically by other NUS organizations.

Audits are performed on the basis of written checklists or lists of questions prepared prior to the audit. During the conduct of the audit, each item on the list is marked as to satisfactory, unsatisfactory, not applicable, or not audited.

Checklists will include such items as equipment calibration and maintenance, documentation, recordkeeping, reporting, chain-of-custody, standard operating procedures, non-conformances, corrective actions.

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9.0 CORRECTIVE ACTION

Corrective actions will be described for each task, purchased items, service, or procedures in the project for which non-conformances have been reported.

Corrective action required by audit findings or significant non-conformances will be documented in accordance with the Project Quality Assurance Manual.

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10.0 QUALITY ASSURANCE REPORTS TO MANAGEMENT

Each month, the project Quality Assurance Representative will forward to the Project Manager, the Zone Deputy Project Manager, and the Manager of Quality Assurance and Security, a report summarizing the quality assurance and quality control status for the project and any conditions adverse to quality. Topics to be included in the monthly report are as follows:

- Assessment of data accuracy, precision, and completeness
- Results of any performance audits
- Results of system audits
- Any non-conformances initiated
- Any significant quality assurance problems, together with recommended solutions

The monthly reports will be compiled into quarterly and annual reports.

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