Energy Systems Environmental Restoration Program
ORNL Environmental Restoration Program

**Data Management Implementation Plan for the Site Characterization
of the Waste Area Grouping 1 Groundwater Operable Unit
at Oak Ridge National Laboratory**

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of the Waste Area Grouping 1 Groundwater Operable Unit
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(ORNL/ER-268)

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ACRONYMS AND ABBREVIATIONS

APO	Analytical Projects Office
CASE	Computer-Aided Software Engineering
C&TS	Computing and Telecommunications Services
CERCLA	Comprehensive Environmental Response, Compensation, and Liability Act
CLP	Contract Laboratory Program
COC	Chain-of-Custody
DC	Data Coordinator
DM	Data Manager
DOE	U.S. Department of Energy
DOT	Department of Transportation
DQOs	Data Quality Objectives
DVV	Data Verifier/Validator
Energy Systems	Martin Marietta Energy Systems, Inc.
EPA	Environmental Protection Agency
ER	Environmental Restoration
ESD	Environmental Sciences Division
FAS	Field Activity Sheet
FFA	Federal Facility Agreement
FCTM	Field Collection Task Map
FTM	Field Task Manager
GIS	Geographic Information System
GPS	Global Positioning System
IEF®	Information Engineering Facility®
IMG	Information Management Group
IMS	Information Management System
LC	Laboratory Coordinator
LQAP	Laboratory Quality Assurance Plan
MPRs	Monthly Progress Reports
MV	Monitoring Variance
NCR	Nonconformance Report
OREIS	Oak Ridge Environmental Information System
ORNL	Oak Ridge National Laboratory
ORR	Oak Ridge Reservation
OU	Operable Unit
QA	Quality Assurance
QAAP	Quality Assurance Assessment Plan
QAPjP	Quality Assurance Project Plan
QC	Quality Control
RPD	Relative Percent Difference
RSD	Relative Standard Deviation
SAPs	Sampling and Analysis Plans

SDG	Sample Delivery Group
SDM	Systems Development Methodology
SOW	Statement of Work
SPARCC	Sensitivity, Precision, Accuracy, Representativeness, Completeness, and Comparability
STL	Sampling Task Leader
WAG	Waste Area Grouping

1 INTRODUCTION

The data management needs within the Waste Area Grouping (WAG) 1 Site Characterization are similar to those employed by the WAG 6 Environmental Monitoring Program.

1.1 BACKGROUND

The WAG 1 Groundwater Operable Unit (OU) at Oak Ridge National Laboratory (ORNL) in Oak Ridge, Tennessee, is undergoing a site characterization. This project is not mandated by the Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA); therefore, no formalized meetings for data quality objective (DQO) development were held. Internally, DQOs were generated by the project team based on the end uses of the data to be collected. Oak Ridge is located in both Anderson and Roane counties, Tennessee, and ORNL is located about seven miles south of the city of Oak Ridge. ORNL was constructed in the early 1940s as part of the efforts during World War II to construct an atomic bomb. The research, production, fabrication and maintenance, and decontamination facilities that were constructed and operated as part of that effort have resulted in a variety of environmental contamination throughout the Oak Ridge area.

The 150-acre WAG 1 is contained within the ORNL security area. It includes all of the former ORNL radioisotope research, production, and maintenance facilities; former waste management areas; and some former administrative facilities.

The goal of the WAG 1 Groundwater Site Characterization is to provide the necessary data on the nature and extent of groundwater contamination with an acceptable level of uncertainty to support the selection of remedial alternatives and to identify additional data needs for future actions. Primary objectives for the site characterization are:

1. To identify and characterize contaminant migration pathways based on the collection of groundwater data. These data will be used for assessment of remedial alternatives that will prevent off-site migration of contaminants found in groundwater either by movement of contaminated groundwater off-WAG or by discharge of contaminated groundwater to surface water which subsequently moves off-WAG.
2. To identify sources of groundwater contamination and evaluate remedial actions which could be implemented to control or eliminate these sources.
3. To conduct groundwater monitoring in support of other OUs in WAG 1 (e.g., Surface Impoundments OU, Gunitite and Associated Tanks OU, and Pipeline and Storm Sewer Network Leakage OU) and the ORNL Groundwater OU.

1.2 SCOPE

The WAG 1 and WAG 6 projects have common data management objectives for groundwater sampling and field measurements. WAG 1 will use the WAG 6 Information Management System (IMS) to plan, track, and

load analytical results as described in the *Data Management Plan and Functional System Design for the Information Management System of the Clinch River Remedial Investigation and Waste Area Grouping 6*, (ORNL/ER-210), March 1994. This document describes the common data management strategy and references applicable sections in ORNL/ER-210. Any changes that have been made to the WAG 6 data management activities specific to WAG 1 will be reflected in this document.

WAG 1 sample and field measurement data will be extracted from the database for use in the WAG 1 groundwater model. The data will also be sent to the Oak Ridge Environmental Information System (OREIS) in support of the Oak Ridge Reservation Federal Facility Agreement (ORR-FFA) and Tennessee Oversight Agreement (TOA) that require data reporting activities be coordinated through a consolidated database. The data will also be sent to the Analytical Projects Office (APO) TRACKER system.

Sections 2.2, 2.3, and 2.4 of ORNL/ER-210 describe the data management objectives in greater detail.

2 DATA MANAGEMENT ACTIVITIES

This section summarizes the major processes involved in managing the information generated and required by the WAG 1 program. Data to be incorporated into the IMS will either be recorded on data forms or obtained in electronic format. Where applicable, system rules and data constraints are also described. If data fields have only certain values that are acceptable (e.g., monitoring locations, sampling team badge numbers, and equipment identifiers), the values will be stored in the ORACLE® data base tables used for data entry validation.

Following a section on general information, the remaining sections closely track the order in which the processes normally occur. Responsibility matrix and process flow diagrams are included to summarize information flows and responsibilities. Any process not explicitly described in this section will not be automated. For example, the tracking of samples that fulfill specific monitoring requirements will be performed manually.

2.1 GENERAL INFORMATION

The *Data Management Plan for the Environmental Restoration Division*, (ES/ER/TM-88) requires a data management implementation plan be written by each project. This document was developed to meet that requirement.

The *WAG 6 Information Management System User Guide* documents the use of the system.

Monitoring includes one-time sample collection and repeated sample collection over time. Throughout this document the terms *monitoring* and *sampling* are synonymous.

All unique sample identifiers are retained in the data base and never reused, even if the sample is lost or not collected. To prevent the reuse of preassigned sample identifiers, the sample status attribute will be used to flag unused sample identifiers as "Retired".

The system must permit bar code label information to be read and validated from a bar code wedge reader and/or keyboard.

The IMS will track all forms associated with samples, equipment, and monitoring events. This allows the IMS to document all forms on which a particular sample appears and, conversely, all samples that appear on a particular form. It also documents the forms associated with field measurements and equipment events (e.g., inspection, calibration, and repair).

When an item is placed under configuration control, any changes made to that item will be tracked through the system audit tables. Examples of configuration-controlled items include the Chain of Custody (COC) and the sample collection forms.

2.2 IDENTIFICATION AND SELECTION OF ANALYTICAL SERVICES

The APO reviews subcontracts for direct analytical support for the WAG 1 program. The APO must approve nondirect analytical subcontracts and associated task orders and requests for analytical services from Energy Systems laboratories. APO approval covers analytical methods, QA and QC requirements, deliverables, appropriateness of the laboratories to provide the requested services, and any other requirements specified in the analytical plan.

The sampling subcontractor develops a Statement of Work (SOW) for laboratory procurement. The SOW and laboratory procurement are reviewed and approved by the APO to ensure compliance with internal technical requirements and procedures prior to contracting. The SOW specifies methods, quantitation limits, sample preservation, holding times, containers, QC requirements, required deliverables, reporting forms, standard units and methods, definitions for codes, and electronic data formats. The SOW is distributed to the appropriate task leaders, data base manager, program manager, QA/QC coordinator, ER Division QA specialist, the APO, and any other appropriate technical reviewers as applicable.

The analytical SOWs may be sole-sourced, placed with an internal laboratory, or placed out for bid under the Energy Systems Pricing Agreement. If the laboratory is not part of the Energy Systems Pricing Agreement, a specific procedure detailing the procurement steps will be followed. The laboratory is selected based on the low bid and any exceptions that are placed on the work by the laboratory. Approval of all procurement contracts is the ultimate responsibility of the program or project manager.

Before and after the laboratory is selected, the Laboratory Coordinator (LC) or a designee appointed by the LC will review the Laboratory QA Plan (LQAP) and standard operating procedures, APO audit reports, the laboratory's performance evaluation package, and the cost estimate (with assistance from financial personnel). If needed, the LC may schedule or request other audits or conduct a readiness review with the laboratory. Any corrective actions resulting from these reviews or audits will be documented and resolved before work begins. The SOW is revised, if necessary, and signed. A copy is retained in the project files and another forwarded to the APO.

2.3 CATALOG MONITORING LOCATIONS

A monitoring location is a uniquely-identified physical location where monitoring may be performed. The valid monitoring locations for WAG 1 will be maintained in a table in the IMS. The IMS will also maintain alias names for monitoring locations in order to accommodate historical data. Survey information for the monitoring locations from the X10WELLS database will be loaded into the system. A monitoring location may be taken out of service during the project.

To facilitate the grouping of different monitoring locations for data analysis and reporting, monitoring locations may be grouped into different area groups. IMS users will be able to group monitoring locations by defining and naming area groups. An example of an area group might be a grouping for all wells within a certain area.

2.4 EQUIPMENT RECORDS

The IMS will maintain a list of field equipment and their status. Data relevant to equipment inspection events, calibration events, and repair/maintenance events will also be tracked. The responsibilities and flow for equipment operations are shown in Figure 2.1.

2.4.1 Maintain Equipment Inventory

A list of field equipment and status (e.g., "available for use", "in use", "temporarily out of service", and "retired") will be maintained. Each piece of field equipment will be uniquely identified with a bar code identifier, but it will not have an Energy Systems number. When a piece of equipment is to be entered into the IMS, two bar code labels with the same number will be generated. One will be laminated and attached to the equipment, and the other will be affixed to the record-of-inventory worksheet. Other equipment data to be maintained by the system include the equipment type, the equipment model number, the manufacturer's serial number, the manufacturer, the date the equipment was entered into the system and the badge number of the person performing the inventory, the date the equipment was retired from use, the last date that a particular piece of equipment was calibrated, and any associated comments/remarks.

2.4.2 Perform Field Equipment Inspection

Field equipment will be inspected periodically. The system will track the date of inspection and the badge number of the person who inspected the equipment. In addition, the system will track the form numbers--including the logbook number--associated with the inspection event. The following data will be scanned into the bar code reader and/or entered on the forms during equipment inspection: the monitoring location identifier, the field logbook number used during the event, the badge number of the person inspecting the equipment, and the form number associated with the event. The date and time of the event will be recorded in the bar code reader using its internal date and time. The STL will initiate a field equipment repair event if the equipment fails the inspection.

2.4.3 Perform Field Equipment Calibration

Field equipment may have one or more equipment calibration events. The system will track the type of calibration event being recorded (e.g., initial or check), the date and time of calibration, the badge number of the person who performed the calibration, and any form numbers--including the logbook number--associated with the calibration event. The planned calibration dates will be manually tracked and will not be stored in the IMS. Equipment calibration frequency depends upon the type of measurement equipment used for sampling (e.g., daily calibration, calibration between samples). The following data will be scanned into the bar code reader and/or entered on the relevant calibration form during equipment calibration: the equipment identifier, the monitoring location identifier, the field logbook number used during the event, the badge number of the person calibrating the equipment, and the form number associated with the event. The date and time of the event will be recorded in the bar code reader using its internal date and time.

Fig. 2.1 WAG 1 Responsibility Matrix and Process Flow of Equipment Records

Each equipment calibration event may culminate in one or more results. Information to be stored in the equipment calibration event result includes the temperature at the time of calibration, the resultant calibration value, the calibration unit of measure, a text comment field, and a calibration flag. Calibration results will be manually entered into the bar code reader and/or recorded on the appropriate calibration form.

2.4.4 Perform Field Equipment Repair

When field equipment is repaired, the system will track the date the repair event was initiated, the badge number of the person initiating the repair, the date the equipment is taken out of service at a location, the date the equipment was sent off for repair, the date the equipment was returned after being repaired, the equipment status, and any associated comments. If the equipment cannot be repaired at the location, the equipment status will be changed to "out of service." The form number associated with the repair event will also be tracked by the system. The following data will be scanned into the bar code reader and/or entered on the form when a repair event is initiated: the equipment identifier, the badge number of the person initiating the equipment repair, and the form number associated with the event. The date and time of the event will be recorded in the bar code reader using its internal date and time. If the equipment can be repaired in place, it will be noted in the comments field for the repair event. The status will not be changed.

2.5 DEFINE PROJECT TASKS

A Field Collection Reference Table is populated, using the Sampling and Analysis Plans (SAPs) as a guide, for each task by matrix and by activities within each matrix. The reference table, a planning tool, specifies by task, matrix, and optionally by site, the procedures, preservation requirements, size and type of containers, processing type, collection devices, sample types, and analysis groups required to perform a specific task. Not all of these data will be required for each task and matrix. All fields in the reference table are validated except for the processing type. The Data Coordinator (DC) uses the reference table as a template for generating Field Collection Task Maps (FCTMs). The FCTM is shown in Figure 2.2. This is a screen-only application, and no documentation will be printed from this task.

2.6 PREPARATION FOR FIELD SAMPLING

Sampling preparation includes generating the FCTM and the Field Activity Sheet (FAS), identifying the monitoring event team, and preparing the necessary sampling kits. A sampling kit is used to assemble the containers and paperwork necessary to perform monitoring events on a planned sampling schedule. The responsibilities and flow for these processes are shown in Figure 2.3.

2.6.1 Prepare FCTM

A monthly activity schedule (Figure 2.4) is manually prepared each month by the STL and reviewed and approved by the Field Task Manager (FTM). This schedule identifies the task, sampling location and planned date, and the number and type of samples to be collected. The field collection reference table is then used to populate the FCTMs based on the sample types requested in the monthly activity schedule. A copy of the schedule is sent to the LC.

**Field Collection Task Map
Waste Area Grouping 1**

Field Matrix: _____

Kit Identifier: _____

Task: _____

Kit Preparation Date: _____

Sampling Date: _____

Field Activity Sheet Number: _____

Field Log Book Number: _____

Monitoring Location	Sample ID	Collection Device	Collection POP	Sample Container			Process	Preserv	Analysis Group	Sample Type
				Size	Type	Clean Lot				

Completed by: _____

Document ID:

Date: _____

FCTM-1

Fig. 2.2 WAG 1 Field Collection Task Map

Fig. 2.3 WAG 1 Responsibility Matrix and Process Flow of Field Sample/Field Measurement Processing.

WAG 1-MONTHLY ACTIVITY SCHEDULE (MAS-01)

FTM Badge No.: _____ Date: _____
 Matrix (Groundwater Quality, Surface Water, Seeps and Springs): _____
 Effective Month/Year: _____

[illegible]

Comments: _____

FTM Signature/Date: _____

Data Entry Signature/Date: _____

Fig. 2.4 WAG 1 Monthly Activity Schedule

The DC uses the original schedule to initiate an FCTM, which describes the types of samples to be collected at each location. The FCTM is generated by a data base application program and includes the task, sampling date, kit identifier and preparation date, locations, sample information, FAS number, kit preparation information, and field logbook number. Once the FCTM is complete and stable, the DC will commit the data in the FCTM to the data base. The FCTM must be committed to the data base prior to generation of the FAS. The FCTM is not printed.

2.6.2 Identify Monitoring Event Team

A monitoring event is defined as a set of samples and/or field measurements collected at one monitoring location beginning on a given date. Field samples and measurements are collected by a team composed of one or more members, including a field Sampling Task Leader (STL) and Field Technicians (FTs). A field team may perform several monitoring events during a day, and a monitoring event can span multiple days.

Sampling team members and roles are tracked in the data base by the FAS. WAG 1 will track only the person performing the STL role. If the person performing the task changes during the day, the change is recorded in the field logbook, but not recorded in the data base. Visitors accompanying the team are noted in the logbook but are not recorded in the data base.

2.6.3 Generate Field Activity Sheet

The FAS form is used to prepare the sampling kit and to document the samples collected by a sampling team for laboratory analysis. Figure 2.5 shows the FAS form. All samples listed on the FAS must be placed into a container (i.e., bottle) and returned from the field, unless they are uncollectible. An FAS can cover multiple monitoring locations and events. The FAS accompanies the sampling team to the field and remains with the samples until a sample is transferred to a COC form.

Once the FCTM has been loaded into the data base and the monitoring event team has been identified, the DC prints the FAS, sample labels, and sample bar code labels. The FTM then reviews the FAS.

2.6.4 Prepare Sampling Kit

The STL uses the FAS as a guide to determine the preservative and size and type of container needed for each sample. Once a container is prepared, the STL attaches the preprinted bar code label and the sample label to the container and notes the container cleaning certificate lot number on the FAS report. The labelled containers are grouped with the appropriate forms, usually in a cooler. A copy of the FAS is sent to the DC to use for updating the data base with the kit preparation information.

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Fig. 2.5 WAG 1 Field Activity Sheet

2.7 COLLECT/PROCESS SAMPLES AND FIELD MEASUREMENTS

Figure 2.3 summarizes the process flow and responsibilities for collecting field samples and some field measurements.

2.7.1 Collect/Process Field Samples

Before a team goes into the field, they check their field notebooks to make sure they have enough pages to record all of the information while they are out. This ensures that each field form will only have one field notebook associated with it.

On the day of sampling, the STL obtains the FAS and the sampling kit for sample collection. The STL is ultimately responsible for everything pertaining to a monitoring event. The STL is responsible for all field samples collected during the sampling day.

During the sampling event, the STL records the date, field logbook number, time each sample is collected, the identifier of any equipment used to collect the sample, and a pH reading using the FAS or the bar code reader, if available. If field measurements are taken, the appropriate entries are made on the form and scanned into the bar code reader, if available. The sample is placed in the appropriate sample container as directed by the FAS.

During sample collection, if any information on the FAS is incorrect or a surplus bottle is used, the STL will cross through the incorrect information with one line and will write in the correct information and initial and date the line. The same information can be recorded in the bar code reader. The STL will note the time of collection and any other missing information on the form. Once the form and sample collection are complete, the STL will return a copy of the FAS to the FTM for review. The original FAS will remain with the samples. After reviewing the FAS, the FTM will forward the copy of the FAS and the field measurement forms to the DC for update of the IMS.

If the bar code reader has been used to collect the information about the samples, the STL transfers the bar code reader to the DC upon returning from the field. The bar code reader file is copied to an archive Bernoulli disk and to the workstation for archival there also. A working file is created on the workstation. The system then generates a report of the actual data collected to be compared with the FAS and the field logbook. Once the FTM has made any corrections to the report, the DC edits the working file, if necessary. When the working file is correct, the data base tables are updated with the correct data, and the working file is deleted. The system will automatically change the sample status code from "Planned" to "Collected" when the sampling date and time are loaded.

The fields that will be captured in the bar code reader are the FAS number and the field logbook number, the STL's badge number, the task, monitoring location, sample type, sample time, cleaning lot number, equipment identifier, and pH.

Samples remain in the possession of the STL and are transferred to the staging area (trailers located at WAG 1) for processing prior to shipment to the analytical laboratories.

2.7.2 Process Ground Water Level Measurements

Any calculations using water level data that must be expressed in terms of elevation will require that the data be adjusted by subtracting the depth to water from the appropriate reference point elevation. This reference point is contained in either the well construction record or the well modification record (if one exists) for the point in time for the depth to water measurement value. For example, if a water level measurement occurred after a well modification event, the depth to water reference point will be taken from the appropriate modification record that spans the time and date of the water measurement being examined; otherwise, the well construction record will be used.

The WAG 1 data base will contain a well construction record which will have the originally determined point of reference. Modifications to a well through time will be captured in a well modification record.

Manual water level. No electronic devices will be used in the manual water level event. Therefore, there will be no equipment calibration or initialization events. The measurements will be obtained on a monthly basis with a manual water level probe. The information collected from this measurement will be expressed as depth to water measured from a point of reference. A tape used to obtain manual water levels must be calibrated to .01 according to the Energy Systems procedure. This calibration will be recorded in the field logbook, but will not be recorded in the IMS.

2.8 LABORATORY ANALYSIS OF SAMPLES

Samples collected from the field or created in the staging area are sent to contract laboratories for chemical, radiological, or physical analysis. The following sections explain in detail sample transfer, sample receipt, data review, and tracking of analytical services.

2.8.1 Sample Transfer

When samples are ready for shipment, the STL will note which samples are to be shipped by placing an asterisk in the left margin of the FAS by the samples to be shipped, making a copy of it with the word "copy" stamped on the form, and drawing a line through all samples that are not being shipped. The original FAS will stay with the remaining samples until all are shipped.

The STL will assign shipping containers on the FAS and forward it to the FTM for review. The FTM will review the FAS and forward it to the DC. When held samples are ready for shipment to the analytical laboratory, the FTM will notify the DC of the sample identifiers and the FTM badge number. Figure 2.6 shows the process flow and responsibilities associated with transferring samples to the analytical laboratories. A project may use multiple laboratories.

The COC (Figure 2.7) is generated by the DC using a data base application program. A COC contains samples from one and only one sample delivery group (SDG), but an SDG may require multiple COCs. The DC assigns the SDG numbers when creating the COC. The SDG contains twenty or fewer samples and is the unit used to identify a group of samples sent to an analytical laboratory. The DC enters the SDG, a COC identifier, laboratory name, shipping date, shipping container number, and the identifiers of the samples to be grouped into

Fig. 2.6 WAG 1 Responsibility Matrix and Process Flow of Transfer Samples to Laboratories

[illegible]

Form Bar Code Label:
COC-01

Fig. 2.7 WAG I Chain of Custody

the SDG. The sample shipment date is the date a sample is shipped to the analytical lab. A Shipping Container Number is the number on the container which was used to transport the samples to the contract laboratory. The remaining information on the COC is obtained from the data base.

The DC assigns a document control identifier and prints the COC. The document control identifier is the same as the COC identifier. After the FTM has reviewed the COC, the STL packages the samples for shipment and records the shipping number and cooler temperature on the COC. After the STL signs the COC, two copies will be made, one for the daily project file, and one to be sent to the LC. The LC will be responsible for faxing a copy of the COC to the contract laboratory. The original COC accompanies the samples until custody is transferred to another COC form.

The STL is responsible for ensuring that custody seals are attached to the sample containers before they are transferred to the laboratory. The STL completes the custody seal and attaches it to the shipping container in such a way that the seal must be broken if the shipping container is opened or tampered with. The STL retains a copy of the shipping order and follows standard company procedures for submitting the customer copy of the shipping order to the billing department. The copy of the shipping order is submitted to the project file. When the packaging is completed, the samples are taken directly to the shipper.

Before they are transported to the laboratory, however, all shipping containers must be checked for radiological contamination and tagged by Health Physics. If samples will be transferred to an off-site analytical laboratory and there is not sufficient historical data, the STL will ensure that a certification of non-secondary contamination is completed as needed and that the samples are classified nonhazardous according to Department of Transportation (DOT) and EPA shipping regulations. The STL is responsible for ensuring that a shipping order is included with other sampling documentation recorded in the field. The STL will prepare the documentation for shipping to the analytical laboratory in accordance with DOT regulations and the requirements of the selected laboratory.

2.8.2 Laboratory Sample Receipt

When the samples arrive at the laboratory, a sample custodian signs the shipping manifest. In addition, the sample custodian will:

- Verify that the airbill number for the shipment and the number recorded on the COC match.
- Verify the number of samples received, sample identifiers, and requested analyses by checking the COC and sample labels.
- Note on the COC the condition of the samples and temperature of the container at receipt.
- Record the time and date of receipt and sign the COC.
- Assign laboratory identifiers to the samples and initiate laboratory internal COC.
- Return a copy of the signed and dated COC with a letter that states the laboratory identifier for each sample cross-referenced to the project sample identifier, analyses planned, and any problems including their resolution.
- Retain and file the shipping manifest.

- Retain the original COC for return when samples are disposed of or with any remaining samples.
- Retain and file a copy of the signed and dated COC for inclusion in the data package.
- After the laboratory verifies receipt of a sample shipment, the LC will send all COCs and sample shipping receipts to the APO. The LC is to be immediately notified of any discrepancies.

2.8.3 Data Review

Each laboratory will review and, if necessary, qualify their data as specified by the analysis method. The LQAP will contain a discussion of data evaluation procedures for each analytical method as well as for each entire data set. The process for data review and approval must be outlined, and the process for identifying the person with authority to release the data described. Each SOW requires that the laboratory is responsible for ensuring 100% agreement between the hard copy and electronic deliverables when both are required.

2.8.4 Tracking of Analytical Services

Sample tracking responsibilities involve tracking sampling and analysis from the time of SOW approval to the disposal of the samples. Maintaining contact with the laboratory regarding the progress of analysis and providing early warning of potential exceedances of holding times or delays in delivery of data packages is essential. The LC tracks the samples, results, and associated documentation and resolves any problems. Periodic printouts are available which will track the placement of the laboratory SOWs and the location and status of individual samples (e.g., planned, at analytical laboratory, undergoing validation).

The analytical laboratory provides monthly progress reports (MPRs) to the APO and the LC. The MPRs summarize laboratory throughput and quality issues. The laboratory must address any problems identified through audits and surveillances immediately. Follow-up audits and surveillances may be performed to ensure the problems have been resolved. In addition, laboratories approved by the APO must successfully participate in evaluation over the duration of their ER work, including periodic audits.

2.9 RECEIPT OF LABORATORY DATA DELIVERABLES

All data packages (printed reports and electronic media) from the analytical laboratories are sent to the LC. Process flow and responsibilities are summarized in Figure 2.8. The LC takes the data package to the Records Coordinator for a document control number and the electronic deliverable to the Data Manager (DM) for virus scans. The original data package and electronic deliverable are then placed in the project files. The LC logs in the receipt of the packages and performs a completeness check. A virus detection program will be run against all electronic deliverables prior to loading onto the IMS.

Fig. 2.6 WAG 1 Responsibility Matrix and Process Flow Data from Laboratories.

2.10 COMPLIANCE SCREENING

Compliance screening is a review of the data packages to verify that the field and laboratory met project deliverables. Review of laboratory deliverables includes a review of data to verify that the laboratory met the requirements of the analytical method and SOW deliverable requirements. The review also includes the deliverables required from the field effort and verification that all are present, as required by the project. Completed and reviewed laboratory and field project deliverables go to the data validators for validation.

2.10.1 Field Data

The daily field data package shall contain, as applicable, the FAS, COC, sample schedule form, sample processing information form, field sample collection information form, site maps, field data forms, copy of radiation survey tag, sampling checklists, and a copy of the field logbook pages. The DC shall inventory each work day's field data package and verify that all pertinent information is included, using a field data package checklist.

2.10.2 Laboratory Data

The LC completes the appropriate inventory checklist and notes all exceptions, e.g., items that are missing, incorrect, or incomplete. If the data package is complete and without problems or mistakes, the LC attaches notes, checklists, and forms. Electronic data deliverables are reviewed by the IMS and the LC to ensure they are readable and formatted correctly. If any discrepancies are found during the review process, the LC identifies the item(s) in the notes and photocopies the page(s) necessary to completely document the problem. The LC initiates a nonconformance report (NCR) and forwards a copy to the DC for updating the IMS. The LC will initiate and track the NCR to resolution.

2.11 ANALYTICAL DATA VALIDATION

The validation process is a technical review of the data. The intensity of the review, the types of checks performed, and the degree of reviewer independence from other parties involved are project specific. At a minimum, validation may include checking the accuracy of data transfer, interpretation of raw data, and laboratory review; identifying factors from compliance screening which affect data values; flagging data based on factors external to the laboratory; and certifying the data. Validation will also include reviewing the reasonableness of the data in terms of a model, related sites, or other criteria.

Computer checks of available QC information shall be evaluated according to method criteria by the Information Management Group (IMG) and the LC. Results of these checks will be compared with other available electronic checks and electronic screening reports. Data not within established control limits will be reported as nonconformances and will be flagged as such. These checks for precision and accuracy shall include but not be limited to:

- Assessment of percent recoveries for all surrogates and spikes to evaluate accuracy
- Assessment of holding times
- Assessment of duplicates to evaluate precision

- Assessment of blanks to assess contamination levels
- Assessment of project required detection limits versus reported detection limits
- Assessment of laboratory control samples

Independent data validation will be performed initially on approximately 10 percent of the data packages. The data packages to be validated will be designated by LC. The LC will transfer the appropriate data package, applicable electronic reports, worksheets, and guidelines to the validator, as appropriate. Representative sample data are verified by hand calculations. Documentation of these manual checks will be placed in files with the associated analyses, and copies will be sent to the Document Management Center. If problems are found during validation of the first data package, each succeeding data package is validated until the problems are judged to be of minimal effect on overall data quality.

As part of the data validation process, the validator will identify any exceptions. If an exception is identified, the validator will generate an NCR. Handling of NCRs is discussed in Section 2.16. Review and validation of deliverables include:

Data Review and Validation Package

- A batch narrative summarizing by analysis and/or method type the problems found that affect data quality for the batch. Each narrative shall include the typed name, title, and address of the data reviewer as well as his or her signature and the date. Each narrative shall also state which validation procedure was used.
- A list of data qualifiers and their meanings for use in data evaluation.
- Copies of data reporting forms (CLP Form 1 or equivalent) with validation flags.
- A completed checklist for each batch that lists those QA/QC items that have been reviewed and/or validation worksheets, as applicable.
- The closed NCR that applies to the batch, if applicable.

Electronic entry of validation flags for each sample and analyte into the IMS.

A summary narrative by analysis/method type/matrix/laboratory of the problems that affected the data quality for that particular method/matrix/lab. Each narrative shall include the name, title, and address of the data reviewer as well as his or her signature and the date.

After verifying the completeness and integrity of the documentation, the data validator prints, signs, and dates the completed data review/validation report and associated worksheet forms and transmits the data package and review documentation to the LC. The LC signs receipt and approval of the validation report. The LC then logs the receipt of the validated data package with the associated review/validation report, completed worksheets, and any additional QA/QC documentation (i.e., NCR).

2.12 DATA ASSESSMENT

Data assessment will be formally conducted as the final component of the comprehensive data validation process, although the process of assessing the data actually begins when the data are received from the laboratory. This component involves the integration and evaluation of all information associated with a result. Individual application programs are developed for data assessor use. Documentation provided to the data assessor includes the following:

- Field data package inventory checklist
- Field data package
- Analytical data package inventory checklist
- Electronic data verification output
- Analytical screening reports
- Analytical data validation report, as applicable
- Summary of precision information from the data base
- Summary of accuracy information from the data base

The data assessor is generally the principal investigator responsible for comparing the data to the original assumptions and integrating all relevant information. Documentation will be provided to the responsible personnel as soon as available, so that the conceptual model may be evaluated and modified as needed. The data assessor shall evaluate the field and laboratory data and supporting documentation and assess the reasonableness of the data as compared to: 1) the conceptual understanding of the system, 2) data from similar sites, 3) historic data, 4) trend analysis of the concentration of the analytes, or 5) other criteria, based on the reviewer's professional judgement. Sensitivity, precision, accuracy, representativeness, completeness, and comparability (SPARCC) for field and analytical data shall be reviewed and compared to DQOs. The total error associated with the sample data shall be assessed and documented. Data which do not support DQOs shall be identified and a justification for their unacceptability documented.

The data assessor collects all the data that have been generated—historical and newly collected—to review and analyze according to SPARCC parameters in order to determine usability. He or she will also utilize statistical techniques to evaluate environmental data and to assist in designing appropriate sample plans based on the data. Interpreting accuracy, precision, and completeness can be key in understanding the significance of the reported values and assessing the confidence associated with any decision. When data assessment is completed, the following characteristics of the data should be known:

- Data authenticity

Nonauthentic data may originate from either intentional or accidental reporting of incorrect data. Data entry errors, transcription errors, calculations errors, software failures, poor recording procedures, inadequate training, and lack of management oversight may result in the accidental reporting of incorrect data. Intentional reporting of nonauthentic data may result from unauthorized access to samples and/or sample data, lack of ethics, or manipulation of logbooks, worksheets, or instrument listings.
- Data integrity

Data have integrity if they are reported as the results of procedures that ensured that proper analysis and sampling methods were selected and followed correctly, results were not

compromised as a result of intentional or accidental reporting of incorrect values, and documents were maintained that demonstrate the procedures used.

- Validation and certification

The data validation process involves an evaluation of the data to determine if data meet required criteria. If the data meet all the requirements of the DQOs as stated in the SAP, Quality Assurance Project Plan (QAPjP), and the requested method, then the data may be certified. The data may also be certified with exceptions. For example, a result with a missed holding time may not be flagged as rejected but will be qualified.

- Data usability

If the data meet the DQOs, then the data are usable.

- Outliers

Outliers may be valid or may result from unusual loss or contamination, transcription errors, dilution errors, sample misidentification, bad reagents or standards, calculation errors, faulty instruments, incorrect application of the analytical method, system malfunctions and loss of sample integrity.

- Sensitivity, Precision, Accuracy, Completeness, Comparability, and Representativeness

Sensitivity is the capability of methodology or instrumentation to discriminate between samples having differing concentrations of analytes. Sensitivity is defined by the limit of detection, limit of quantitation, instrument detection limit and the method limit of detection.

Precision is the degree of mutual agreement between independent measurements made under specified conditions. Standard deviation, relative standard deviation (RSD), and relative percent difference (RPD) are used to express precision.

$$RSD = CV = 100 (\text{STANDARD DEVIATION}/\text{MEAN})$$

For replicate results, X_1 and X_2

$$RPD = 100 [(X_1 - X_2)/((X_1 + X_2)/2)]$$

Accuracy is the closeness of agreement between an observed value and an accepted reference value. When applied to a set of observations, accuracy will be a combination of a random component and of a common systematic error component (*bias*). *Bias* is calculated as

$$B = x_i - T \quad \text{or} \quad B = (x_s - x_u) - K$$

where x_i = measure value for reference sample,

x_s = measure value for spiked sample,

x_u = measure value for unspiked sample, and

K = known value of the spike in the sample.

T = known value for reference sample

Percent recovery may be expressed as the following:

$$\%R = 100 (x_i/T), \text{ or } \%R = 100 (x_s - x_u)/K$$

Completeness is a measure of the amount of valid data obtained from the analytical measurement system. It is typically expressed as the total number of samples taken for which acceptable analytical data are generated, divided by the total number of samples collected and multiplied by 100.

Comparability is the confidence with which one data set can be compared to another data set produced by different laboratories. The use of accepted methods, SOPs, and participation in intra-laboratory performance evaluation testing demonstrates comparability.

Representativeness expresses the degree to which the data actually reflect the analyte or parameter of interest at an environmental site.

Data used for assessments must meet project-defined QA/QC criteria. Historical data must be screened to ensure that the necessary QA/QC criteria have been met and that any deficiencies are clearly identified. In addition, it must be verified that the procedures used to convert data from collection media and formats into formats used by analysts have not compromised the data. Software quality assurance and application program quality assurance and documentation must apply to the control of software applications.

2.13 DATA ANALYSIS

Under this task, data analysis personnel will work with site personnel to identify all data that potentially are relevant to the current study. Once a list of these data has been compiled, the data coordinator will consult with the project managers and project scientists to identify those data sets and base maps that should be obtained. These data will be requested, downloaded, and reformatted as appropriate to perform analyses. Links will be created between map information and attribute data. Upon receipt of data from the IMS, staff scientists will document their acceptability by completing a Data Base Checklist.

During data analysis, specific subsets of data will be retrieved from the IMS data base and transferred to the ORNL Central Groundwater Level data base for use in determining chemicals of concern, comparing concentrations to background levels and regulatory limits, and performing risk assessments and modeling activities. A Geographic Information System (GIS) is used for the analysis, manipulation, and display of coordinate data, as well as the linkage of spatial data to attribute data from the validated centralized data base. Spatial data sets are categorized and stored as cartographic coverages or thematic layers representing the geometry and shape of different geographic objects. The source data may be in hardcopy form requiring digitization, or they may be in digital form and require transformation into the GIS structure. The collection history and methodology are documented along with the source data characteristics (such as scale, resolution, map projection, and geographic area) and the digitization and/or transformation steps. Spatial data are used to perform spatial analyses, plume modeling, land use mapping, volume calculations, and chemical characterization contouring.

All data reports and listings presented in technical reports are computer generated, using application programs (following software QA procedures) that access and summarize data contained in the validated data

base. The validity of application programs will be entered into the project files. If appropriate, validity will be demonstrated through successful performance of benchmark applications. Widely accepted commercial software (e.g., LOTUS) will not require validation; however, successful performance of derived applications, such as spreadsheets or reports must be documented in the project file. All data summaries, maps, reports, application programs, and data base files are indexed and stored in the project file. As a result, reports and summaries can be successfully replicated. Relevant data from the data base will then become available to regulators and to other internal and external users.

If the data appear acceptable by all criteria described above, they are examined for spatial and temporal consistency. This examination consists of plotting concentrations of selected analytes in space, time, or frequency distributions as appropriate for the data. Analytical results that appear out of place in the plots are examined for problems in sampling, analysis, or reporting. This type of analysis can identify incorrect measurement units, misplaced decimal points, or other transcription errors that might otherwise remain undetected. Data are corrected or deleted depending on the problem identified and appropriate changes are initiated and documented. If no problem is identified, the data are used in the analysis. Data that do not fit expected patterns may represent real conditions that are important in understanding the site.

2.14 DATA BASE VERIFICATION

Data base verification involves an evaluation of the project data base to ensure accountability, traceability, correctness, and completeness. Verification identifies errors that can be corrected. Accountability checks include confirming that data collectors and generators are identified and reviewing data transfer and data entry documentation. Traceability of the data base entries to hardcopy sources and to electronic deliverables will be documented. Hardcopy sources include all field data sheets and sample collection forms, analytical data packages, and data validation reports. Correctness involves verification of data transfer processes, double data entry for non-electronic analytical data, and comparison of data base values with the source. Completeness checks will verify that all required descriptors for both samples and individual results are present, correct, and consistent with applicable plans and procedures, and OREIS formats. These checks will review location identifiers, coordinates, sample identifiers, units, dates, laboratory sample identifiers, methods, parameter names, result formats, laboratory flags, and validation flags, among others, as appropriate. Deliverables that result from the data verification process could include:

- Comparisons of sample tracking information entered by program personnel with corresponding data entered by the analytical laboratory
- Summary table of the number and type of samples collected for each monitoring event
- Summary table of the number and type of samples collected for each site

2.15 INVENTORY OF PROJECT CASE FILES

The records manager performs an inventory of each complete case file. Each case file is identified by a previously assigned accession number. All copies of documents shall be complete and legible. Original documents which include information relating to more than one case or sample shall be filed by lowest sample number. The copy(s) shall be placed in the other applicable files and marked *copy* in red ink. In order to provide document accountability of the completed file, each item in the case file shall be inventoried and assigned a serialized

number. A table of contents shall preface each file.

2.16 TRACKING PROGRAMMATIC EXCEPTIONS

An exception can be identified at any step in the process of sampling, analysis, data reporting, and data review. The two types of program exceptions are NCRs and Monitoring Variances (MVs). An NCR is completed when a procedure was not performed as required. An MV is completed when a procedure needs to be varied. The variance is noted and approved before the procedure is performed. Both are processed through the IMS in the same manner.

The person that identifies an exception completes an NCR form and transfers the form to the STL. The STL will complete the MV form before initiation of the task. The STL delivers the completed form (NCR/MV) to the FTM for concurrence and processing. The FTM forwards a copy of the NCR/MV to the DC for initial entry of the form into the IMS. The DC inputs information that includes monitoring location, procedure number, matrix, date initiated, and the badge number of the initiator. The FTM forwards the original form to the appropriate personnel (e.g., LC, DM, Project Manager, Energy Systems Technical Lead, QA Manager) for approval. When the NCR/MV has been approved, the original is forwarded to the DC who then enters the approval date into the IMS. The Records Coordinator will issue a controlled copy of all NCR/MV forms monthly to the personnel on the project distribution list. If the NCR/MV is not approved, the FTM will be notified and the appropriate personnel will come to concurrence regarding the outstanding issues. The DC will maintain an NCR/MV trending data base.

2.17 MAINTAIN REFERENCE TABLES

There are many tables in the data base which contain reference information that changes infrequently, if at all. These tables will be loaded and modified by appropriate personnel through table maintenance edit screens.

2.18 HISTORICAL DATA

There are several sources of historic data for WAG 1 in varying electronic formats that will be used in analyzing trends on the site. Pertinent historical data to be loaded into the IMS will be required to meet, at a minimum, the data constraints of the OREIS Version 1.2 data structures. Data that cannot meet these constraints will not be loaded into the IMS, unless specifically called for by the Project Manager.

3 ROLE DESCRIPTIONS

The following narrative describes the various roles that interact with the project data base. These roles are not mutually exclusive (e.g., a person may have more than one designated role at a time).

1 Field Task Manager (FTM): The FTM assists in the implementation of the sampling defined in the SAP. This role coordinates and prepares for field sampling activities and oversees all field data collection, recording, and documentation activities. The FTM will ensure and document that all field and laboratory personnel are properly informed and trained. The FTM will manage and/or perform inspections and calibrations, and maintain accurate documentation of all site equipment calibration and servicing activities. This role manages and/or performs field monitoring and sampling activities, and ensures that all such activities are performed and documented in accordance with QA protocols and approved procedures. This role does not have access to the data base.

2 Laboratory Coordinator (LC): The LC coordinates the development of applicable SOWs to procure subcontract technical services to support the project and verifies that methods specified are appropriate for meeting DQOs. The LC serves as a receiving and review point for all laboratory data, ensures that laboratory supplemental QC data are placed in program files, and ensures that the laboratory data are properly validated and verified in accordance with the project requirements. The LC is responsible for assembling and organizing the validation personnel. The LC acts as the coordinator of the data validation program and any deviations or modifications to the program must be approved by him/her. This role has limited write access to the data base.

3 Data Verifier/Validator (DVV): The DVV is responsible for performing the verification and validation on the field and laboratory data. The DVV is responsible for assigning qualifiers to the data as part of the verification or validation process. The DVV also evaluates QC information relative to technical and analytical viability. This role has limited write access via a software application to the data base.

4 Data Coordinator (DC): The DC incorporates all field data from the monitoring devices, bar code equipment, and field documentation to the data base. The DC prints all sample labels, necessary bar code labels, field activity sheets, and chain of custody forms. This role has limited write access via a software application to the data base.

5 Data Manager (DM): The DM is responsible for verifying all information uploaded to the data base by the DC. The DM also makes all changes needed to items under configuration control. The DM has write access via a software application.

6 Sampling Task Leader (STL): The STL performs and documents all field activities; installs and maintains all dedicated equipment; and oversees sample collection, monitoring, and data acquisition activities. This includes maintaining and calibrating all portable equipment, inventorying supplies, preparing sample kits, shipping samples, and overseeing waste management. There will be an STL for each sampling/monitoring project. The STL will have limited write access via a software application to the data base.

7 General Applications User: This category covers the majority of the users of the project data base. Examples of users in this category include data analysts, risk assessors, task leaders, and program managers. This role has read only access to the data base.

8 System Manager: The system manager is the point of contact with the user organization. The system manager approves changes to the operating system, system software, and application software. In addition, the system manager identifies software problems/enhancements, requests software modifications, works with other users to test software modifications, and verifies that the software is production ready.

9 Application Configuration Manager: The application configuration manager assesses the changes requested by the system manager and works with the persons in the roles listed below to schedule and implement these changes. The application configuration manager ensures that application modifications are thoroughly tested, documented, approved, and publicized prior to implementation.

10 System Administrator: The system administrator manages the workstation hardware and operating system software and performs functions that require root privileges. The tasks performed by the system administrator are directed by the application configuration manager.

11 ORACLE® Configuration Manager: The ORACLE® configuration manager installs/modifies the ORACLE® Data Base Management System and application development products. The tasks performed by the ORACLE® configuration manager are directed by the application configuration manager.

12 SAS® Configuration Manager: The SAS® configuration manager installs/modifies the SAS® products. The tasks performed by the SAS® configuration manager are directed by the application configuration manager.

13 Developer: The developer creates, modifies and tests the application software components. The tasks performed by the developers are directed by the application configuration manager.

14 Data Base Configuration Manager: The data base configuration manager manages the data base data definition language (DDL), participates in the logical to physical data base transformation, and addresses data base performance and tuning issues. The tasks performed by the data base configuration manager are directed by the application configuration manager.

15 Data Model Configuration Manager: The data model configuration manager manages the IEF® model and participates in the logical to physical data base transformation.

4 DATA REQUIREMENTS

The Entity Hierarchy Report, contained in Appendix A, lists the entities and attributes included in the data model. The complete Entity Relationship Diagram, the entity definitions, and the attribute definitions are maintained by the Data Model Configuration Manager using the IEF® CASE tool.

5 DATA MANAGEMENT SYSTEM

5.1 SYSTEM OBJECTIVES

Sections 3.1 - 3.6 of ORNL/ER-210 describe the system requirements.

5.2 SYSTEM COMPONENTS

The hardware and software specifications for the system are as follows:

Hardware: Sun SPARCstation 10, Model 40

Operating System: Solaris 2.3

Data base: ORACLE® 7.0.15.1

Programming Language:

ORACLE® Forms 3.0, ORACLE® Report Writer 2.0, ORACLE® SQL*Plus, SAS® 6.09

5.3 SYSTEMS DEVELOPMENT METHODOLOGY (SDM) DOCUMENTATION

The application configuration manager maintains copies of the documentation for WAG 6 to support the phases of SDM. The WAG 6 documentation is also applicable to WAG 1. The SDM phases include Project Initiation, Feasibility Study, Requirements Definition, Functional System Design, Computer System Design, Programming and Implementation, Validation and Acceptance, and Configuration Control.

6 DATA MANAGEMENT SYSTEM AND PROCESS ADMINISTRATION

Sections 6.1 - 6.4 of ORNL/ER-210 describe the system requirements.

APPENDIX A

ENTITY HIERARCHY REPORT

Appendix A contains the entity hierarchy report. It contains an alphabetic list of the entities with their corresponding attributes. An attribute is a distinct piece of information kept about an entity.

ENTITY HIERARCHY REPORT

Entity: ANALYSIS_METHOD
Attrs: ANLY_METH_AGENCY
 ANLY_METH_ID
 ANLY_METH_DESC
 ANLY_METH_NAM

Entity: ANLY_METH_LAB_TEST
Attrs: AMLT_DTE

Entity: AREA_GROUP
Attrs: AREA_GRP_NAM
 AREA_GRP_TYP
 AREA_GRP_DESC
 AREA_GRP_ID

Entity: AREA_GRP_LOCATION
Attrs: AG_LOC_BEG_DTE
 AG_LOC_END_DTE
 AG_LOC_PURG_SEQ

Entity: BADGED_PERSON
Attrs: BDGD_PRSN_UID
 BDGD_PRSN_LAST_NAM
 BDGD_PRSN_MID_NAM
 BDGD_PRSN_FRST_NAM
 BDGD_PRSN_BADGE_NO

Entity: BORE_HOLE
Attrs: BH_PERMIT_NO
 BH_ROCK_CORE_DESC
 BH_DRAW_NO
 BH_RPT_NO
 BH_RPT_TITLE
 BH_RPT_DRAW_DTE
 BH_COMMENT
 BH_CONV_WELL_FLG
 BH_DPTH
 BH_ROCK_DPTH
 BH_INIT_WTR_DPTH
 BH_DIAM_UNIT
 BH_DIAM

Entity: COC_CONFIG_CTL_1
Attrs: SSC_CONTNR_SEQ_NO
 DATE_TIME_STAMP
 CHANGE_COMMENT
 BDGD_PRSN_UID
 SSC_SHIP_ORD_FRM
 SSC_SHIP_TEMP
 SDG_NO
 SSC_CONTNR_NO

SDG_LAB_SHIP_DTE
 LAB_CODE
 FRM_CHANGE_SEQ_NO
 FRM_NO
 Entity: COC_CONFIG_CTL_2
 Attrs: PARAM_ANLY_GRP_COD
 SMPL_ID
 FRM_DETAIL_SEQ_NO
 Entity: COMPANY
 Attrs: CO_NAM
 CO_CODE
 Entity: COMPONENT_TYPE
 Attrs: COMP_TYP_NAM
 COMP_TYP_CODE
 Entity: COMP_MATERIAL
 Attrs: COMP_MATL_NAM
 COMP_MATL_CODE
 Entity: COMP_TYP_MATERIAL
 Attrs: COMP_TYP_MATL_DTE
 Entity: CONFIG_CTL_REASON
 Attrs: CC_REAS_DESC
 CC_REAS_CODE
 Entity: CUST_SAMPLE_RESULT
 Attrs: CSR_RSLT_USE_FLG
 CSR_FIN_QUAL_CODE
 CSR_UP_LIM_VAL
 CSR_LOW_LIM_VAL
 CSR_DET_LIM_VAL
 CSR_EXCEPTION_FLG
 CSR_UNCERT_VAL
 CSR_PREFIX_QUAL
 CSR_COMMENT
 CSR_REV_COMMENT
 CSR_REV_FLG
 CSR_DILUTION_FAC
 CSR_RSLT_UNIT
 CSR_RSLT_VAL
 Entity: DATA_FORM
 Attrs: FRM_CONFIG_CTL_FLG
 FRM_DOC_MGT_CTL_NO
 FRM_TYP
 FRM_NO
 Entity: DATA_RECEIPT_GROUP
 Attrs: DRG_NO
 Entity: DATA_USE_QUALIFIER
 Attrs: DATA_USE_QUAL_CODE
 DATA_USE_QUAL_DESC
 Entity: DATA_XFER_FILE

Attrs: DATA_XFER_FILE_NAM
 Entity: DRG_MILESTONE
 Attrs: DRGM_SUB_DTE
 DRGM_SEQ_NO
 DRGM_RESP_PERS_NAM
 DRGM_EXP_DTE
 DRGM_ACT_DTE
 Entity: DRILLING_EVENT
 Attrs: DE_COMMENT
 DE_TOT_DEVIAT
 DE_DEVIAT_METH
 DE_AUGR_REFSL_ELEV
 DE_GEO_LOG_FLG
 DE_CMPLT_DTE
 DE_EQUP_TYP
 DE_EQUP_MAK
 DE_GEO_CONTCTR
 DE_CONTCTR
 DE_GEOGLST_NAM
 DE_BEG_DTE
 Entity: DRILLING_METHOD
 Attrs: DRILL_METH_DESC
 DRILL_METH_CODE
 Entity: ENV_MON_LOC_FLOW
 Attrs: EMLF_MIN_RATE
 EMLF_MAX_RATE
 EMLF_TIME
 EMLF_RATE
 EMLF_DTE
 EMLF_CONV_MIN_RATE
 EMLF_CONV_MAX_RATE
 EMLF_METH_CODE
 EMLF_CONV_RATE
 EMLF_UNT_ABBR
 EMLF_CONV_UNT_ABBR
 Entity: ENV_PROJECT
 Attrs: EP_COMMENT
 EP_SPON
 EP_OU_ACRONYM
 EP_ADS_NO
 EP_ADS_NAM
 EP_RQMT_SRCE_ID
 EP_NAM
 EP_END_DTE
 EP_BEG_DTE
 EP_ID
 EP_DESC
 Entity: ENV_PROJECT_LAB

Attrs: ENV_PROJ_LAB_DTE
 Entity: ENV_PROJECT_TASK
 Attrs: ENV_PROJ_TASK_DESC
 ENV_PROJ_TASK_CODE
 Entity: ENV_PROJ_TASK_LOC
 Attrs: ENV_PROJ_TASK_DTE
 Entity: ENV_PROJ_VLD_QUAL
 Attrs: EPVQ_DTE
 Entity: EQUIP_CALB_EVENT
 Attrs: EQUIP_CALB_FREQ_COD
 EQUIP_CALB_COMMENT
 EQUIP_CALB_SEQ_NO
 EQUIP_CALB_TYP
 EQUIP_CALB_TIME
 EQUIP_CALB_DTE
 Entity: EQUIP_CALB_EVT_FRM
 Attrs: EQUIP_CALB_FRM_DTE
 Entity: EQUIP_CALB_RESULT
 Attrs: EQUIP_CALB_RSLT_TOL
 EQUIP_CALB_LOT_NO
 EQUIP_CALB_STD
 EQUIP_CALB_FND_UNIT
 EQUIP_CALB_FND_VAL
 CALB_RSLT_COMMENT
 EQUIP_CALB_FLG
 EQUIP_CALB_TEMP
 CALB_RSLT_SEQ_NO
 EQUIP_CALB_UNIT
 EQUIP_CALB_VAL
 Entity: EQUIP_INIT_EVT_FRM
 Attrs: EQUIP_INIT_FRM_DTE
 Entity: EQUIP_LOC_INIT_EVT
 Attrs: EL_INIT_COMMENT
 EL_INIT_TIME
 EL_INIT_DTE
 Entity: EQUIP_LOC_INSP_EVT
 Attrs: EQUIP_INSP_COMMENT
 Entity: EQUIP_LOC_INSP_FILE
 Attrs: ELIF_DTE
 Entity: EQUIP_LOC_REM_EVENT
 Attrs: EL_REM_TIME
 EL_REM_COMMENT
 EL_REM_DTE
 Entity: EQUIP_REM_EVT_FRM
 Attrs: EQUIP_REM_FRM_DTE
 Entity: EQUIP_REPAIR_EVENT
 Attrs: EQUIP_REPR_EVT_DTE
 EQUIP_REPR_RET_DTE

EQUIP_REPR_COMMENT
 EQUIP_REPR_SND_DTE
 Entity: EXCEPTION_EVENT
 Attrs: EXCP_EVT_APPR_DTE
 EXCP_EVT_EFF_DTE
 EXCP_EVT_COMMENT
 EXCP_EVT_SEV_COD
 EXCP_EVT_DET_DTE
 Entity: FAS_CONFIG_CTL_1
 Attrs: CHANGE_COMMENT
 DATE_TIME_STAMP
 BDGD_PRSN_UID
 LOGBOOK_FRM_NO
 SMPL_DTE
 FRM_CHANGE_SEQ_NO
 FRM_NO
 Entity: FAS_CONFIG_CTL_2
 Attrs: SMPL_DUPL_OF_ID
 EQUIP_ID
 SMPL_COMMENT
 SMPL_PROCED_REV
 SMPL_PROCED_NO
 SMPLR_TYP_CODE
 PH_SR_RSLT_VAL
 PRESERVATIVE_CODE
 PARAM_ANLY_GRP_COD
 SMPL_CERT_LOT_NO
 SMPL_CONT_MATL_COD
 SMPL_CONT_UNT_ABBR
 SMPL_CONT_MIN_VOL
 SMPL_TYP_CODE
 ML_ID
 SMPL_STAT_CODE
 SMPL_TIME
 SMPL_ID
 FRM_DETAIL_SEQ_NO
 Entity: FIELD_ACT_METHOD
 Attrs: FLD_ACT_METH_DESC
 FLD_ACT_METH_CODE
 Entity: FIELD_EQUIPMENT
 Attrs: EQUIP_RETIRED_DTE
 EQUIP_COMMENT
 EQUIP_MFG_NAM
 EQUIP_BEG_DTE
 EQUIP_MODEL_NO
 EQUIP_STAT_CODE
 EQUIP_LAST_CALB_DTE
 EQUIP_ID

EQUIP_MFG_SER_NO
 Entity: FIELD_EQUP_TYPE
 Attrs: FLD_EQUP_TYP_DESC
 FLD_EQUP_TYP_CODE
 Entity: FIELD_MEASUREMENT
 Attrs: FM_CONT_MEAS_CODE
 FM_DATA_USE_QUAL
 FM_RSLT_VALID_QUAL
 FM_RSLT_QUAL
 FM_DEPTH_UNIT
 FM_DEPTH
 FM_COMMENT
 FM_DTE_COLL
 FM_TIME_COLL
 FM_RPT_RSLT
 FM_RPT_UNIT
 FM_INIT_FNL_INDCTR
 FM_CONV_RPT_RSLT
 FM_CONV_UNIT
 FM_SEQ_NO
 FM_REVISED_FLG
 FM_SUM_METH_CODE
 Entity: FIELD_TASK_MAP
 Attrs: ME_SEQ_NO
 PARAM_ANLY_GRP_COD
 SMPL_PROCED_REV
 LOAD_FLAG
 STATUS_CODE
 SPEC_INSTR
 AREA_GRP_ID
 FLD_SEQ
 FCTM_FRM_NO
 LAB_CODE
 PARAM_ANLY_CAT_COD
 LOGBOOK_FRM_NO
 FCOC_FRM_NO
 CO_NAM
 SMPL_TYP_CODE
 PRESERVATIVE_CODE
 SMPL_CERT_LOT_NO
 SMPL_CONT_MATL_COD
 SMPL_CONT_UNT_ABBR
 SMPL_CONT_MIN_VOL
 SMPL_PROC_TYP_COD
 SMPL_PROCED_NO
 SMPLR_TYP_CODE
 SMPL_ID
 ML_ID

KIT_PREP_DTE
 KIT_ID
 ME_BEG_DTE
 ENV_PROJ_TASK_CODE
 MATRX_TYP_CODE
 Entity: FLD_COLL_REF
 Attrs: ME_SEQ_NO
 PARAM_ANLY_GRP_COD
 SMPL_PROCED_REV
 FLD_SEQ
 SPEC_INSTR
 AREA_GRP_ID
 LAB_CODE
 CO_NAM
 SMPL_TYP_CODE
 PARAM_ANLY_CAT_COD
 PRESERVATIVE_CODE
 SMPL_CONT_MATL_COD
 SMPL_CONT_UNT_ABBR
 SMPL_CONT_MIN_VOL
 SMPL_PROC_TYP_COD
 SMPL_PROCED_NO
 SMPLR_TYP_CODE
 ML_ID
 MATRX_TYP_CODE
 ENV_PROJ_TASK_CODE
 Entity: GEOLOGIC_FORMATION
 Attrs: GEO_FORM_CODE
 GEO_FORM_NAM
 Entity: GEOLOGIC_GROUP
 Attrs: GEO_GRP_NAM
 GEO_GRP_CODE
 Entity: GPSL_LOCATION
 Attrs: GPSL_COMMENT
 GPSL_MEAS_METH
 GPSL_SEQ_ID
 GPSL_DATA_COLL_DTE
 GPSL_ELLPS_STD_ERR
 GPSL_LONG_STD_ERR
 GPSL_LAT_STD_ERR
 GPSL_ELLPS_HGHT
 GPSL_LONGITUDE
 GPSL_LATITUDE
 GPSL_PDOP_VAL
 GPSL_NO_SATELLITE
 GPSL_NO_MEAS_VAL
 GPSL_NUM_USED
 GPSL_ROOT_MEAN_SQ

Entity: GW03_CONFIG_CTL_1
 Attrs: BDGD_PRSN_BADGE_NO
 CHANGE_COMMENT
 FM_DTE_COLL
 LOGBOOK_FRM_NO
 BDGD_PRSN_UID
 DATE_TIME_STAMP
 EQU_P_ID
 FRM_CHANGE_SEQ_NO
 FRM_NO

Entity: GW03_CONFIG_CTL_2
 Attrs: FM_COMMENT
 M_RPT_RSLT
 FM_TIME_COLL
 ML_ID
 FRM_DETAIL_SEQ_NO

Entity: GWQ01_CONFIG_CTL_1
 Attrs: ME_COMMENT
 ME_WEATHER
 FM_DTE_COLL
 LOGBOOK_FRM_NO
 BDGD_PRSN_BADGE_NO
 ENV_PROJ_TASK_CODE
 ME_BEG_DTE
 ML_ID
 CHANGE_COMMENT
 BDGD_PRSN_UID
 DATE_TIME_STAMP
 FRM_CHANGE_SEQ_NO
 FRM_NO

Entity: GWQ01_CONFIG_CTL_2
 Attrs: FLD_ACT_METH_CODE
 FM_RPT_UNIT
 FM_RPT_RSLT
 EQU_P_ID
 FRM_DETAIL_SEQ_NO

Entity: HOLE_INTERVAL
 Attrs: HI_ACT_SOIL_RECV
 HI_PLAN_SOIL_RECV
 HI_ASTM_CODE
 HI_DIAM_UNIT
 HI_DIAM
 HI_COMMENT
 HI_END_DPTH
 HI_BEG_DPTH
 HI_VSUAL_DESC

Entity: HOLE_INTERVAL_CHAR
 Attrs: HOLE_INTV_CHAR_DTE

Entity: INTERVAL_CHAR_TYPE
 Attrs: INTV_CHAR_TYP_DESC
 INTV_CHAR_TYP_NAM
 INTV_CHAR_TYP_CODE

Entity: KIT
 Attrs: KIT_PREP_DTE
 KIT_ID

Entity: LAB
 Attrs: LAB_ZIP_CODE
 LAB_STATE
 LAB_CITY
 LAB_STREET
 LAB_NAM
 LAB_CODE

Entity: LAB_ANALYSIS_GROUP
 Attrs: LAG_DATA_PROC_GRP

Entity: LAB_INSTRUMENT
 Attrs: LAB_INST_ID

Entity: LAB_INST_CHAR
 Attrs: LAB_INST_CHAR_DESC
 LAB_INST_CHAR_TYP

Entity: LAB_PROC_MAP
 Attrs: SMPL_PROCED_REV
 SEQ
 LAB_SMPL_ID
 LOAD_FLAG
 SPEC_INSTR
 LPTM_FRM_NO
 PARAM_ANLY_GRP_COD
 LAB_CODE
 LAB_MATRX_TYP_COD
 SMPL_TYP_CODE
 PRESERVATIVE_CODE
 SMPL_CERT_LOT_NO
 SMPL_CONT_MATL_COD
 SMPL_CONT_UNT_ABBR
 SMPL_CONT_MIN_VOL
 SMPL_PROCED_NO
 SMPL_DTE
 SMPL_END_INTV
 SMPL_BEG_INTV
 SMPL_PROC_TYP_COD
 ME_BEG_DTE
 ENV_PROJ_TASK_CODE
 MATRX_TYP_CODE
 SMPL_ID
 FLD_SEQ

Entity: LAB_PROC_REF

Attrs: SMPL_PROCED_REV
 SEQ
 SMPL_INTV_UNIT
 NEW_SMPL_FLAG
 SPEC_INSTR
 SMPL_END_INTV
 SMPL_BEG_INTV
 PARAM_ANLY_GRP_COD
 LAB_CODE
 PRESERVATIVE_CODE
 SMPL_CONT_MATL_COD
 SMPL_CONT_UNT_ABBR
 SMPL_CONT_MIN_VOL
 SMPL_PROCED_NO
 SMPL_PROC_TYP_COD
 MATRX_TYP_CODE
 FLD_SEQ
 Entity: LAB_QC_SAMPLE
 Attrs: SMPL_LAB_SEQ_NO
 ORIG_SMPL_TYP
 ORIG_SMPL_ID
 ORIG_LAB_CODE
 SMPL_ID
 SMPL_LAB_ID
 Entity: LAB_QC_SMPL_ID_GEN
 Attrs: LQCS_CLP_SMPL_CODE
 LQCS_LAST_GEN_ID
 Entity: LAB_SAMPLE_RESULT
 Attrs: LSR_RSLT_USE_FLG
 LSR_UP_LIM_VAL
 LSR_LOW_LIM_VAL
 LSR_DET_LIM_VAL
 LSR_EXCEPTION_FLG
 LSR_UNCERT_VAL
 LSR_PREFIX_QUAL
 LSR_COMMENT
 LSR_REV_COMMENT
 LSR_REV_FLG
 LSR_DILUTION_FAC
 LSR_RSLT_UNIT
 LSR_RSLT_VAL
 LSR_RSLT_CAT
 Entity: LAB_TEST
 Attrs: LAB_TST_ID
 LAB_TST_NAM
 LAB_TST_TYP
 Entity: LAB_TIR_RESULT
 Attrs: LTIR_KEV_VAL

LTIR_NAM
 LTIR_COMMENT
 LTIR_REV_COMMENT
 LTIR_REV_FLG
 LTIR_DILUTION_FAC
 LTIR_RSLT_UNIT
 LTIR_RSLT_VAL
 Entity: LAB_TIR_RSLT_QUAL
 Attrs: LTIR_RSLT_QUAL_DTE
 Entity: LAG_MILESTONE
 Attrs: LAGM_SUB_DTE
 LAGM_SEQ_NO
 LAGM_RESP_PERS_NAM
 LAGM_EXP_DTE
 LAGM_ACT_DTE
 Entity: LOC_INSP_EVT_FRM
 Attrs: LIEF_DTE
 Entity: LQC_SMPL_RSLT_QUAL
 Attrs: LQCSR_QUAL_DTE
 Entity: LQS_ASSOC_LAG
 Attrs: LQS_ASSOC_LAG_DTE
 Entity: MATRIX_EXCP_EVENT
 Attrs: MATRX_EXCP_EVT_DTE
 Entity: MATRIX_TYPE
 Attrs: MATRX_TYP_USE_CODE
 MATRX_TYP_DESC
 MATRX_TYP_CODE
 Entity: MEASUREMENT_UNIT
 Attrs: MEAS_UNIT_ABBR
 MEAS_UNIT_NAM
 Entity: MEAS_UNIT_CONV_FAC
 Attrs: MUCF_PREF_UNIT_ABBR
 MUCF_RPT_UNIT_ABBR
 MUCF_RSLT_VAL
 MUCF_RSLT_VAL_EXP
 Entity: ME_DATA_XFER_FILE
 Attrs: ME_DATA_FILE_DTE
 Entity: ME_SMPL_COLL_EQUIP
 Attrs: MESCE_DTE
 Entity: MILESTONE_TYPE
 Attrs: MILST_TYP_USE_CODE
 MILESTONE_TYP
 MILESTONE_DESC
 Entity: MONITORING_EVENT
 Attrs: ME_END_TIME
 ME_END_DTE
 ME_COMMENT
 ME_SEQ_NO

ME_WEATHER
 ME_BEG_TIME
 ME_BEG_DTE
 Entity: MONITORING_TEAM
 Attrs: MONIT_TEAM_ID
 Entity: MONIT_EVT_DATA_FRM
 Attrs: ME_FRM_BEG_PAGE_NO
 Entity: MONIT_LOCATION
 Attrs: ML_GPS_VAR_CODE
 ML_MARKER_UNIT
 ML_MARKER_NO
 ML_NAM
 ML_STAT_CODE
 ML_MEAS_ERR
 ML_MEAS_METH
 ML_ELEV_MEAS_METH
 ML_ELEV_MEAS_ERR
 ML_NORTHING
 ML_EASTING
 ML_GND_ELEV
 ML_COMMENT
 ML_GRID_SYS
 ML_DESC
 ML_TYP
 ML_ID
 Entity: MONIT_LOC_ALIAS
 Attrs: MLA_BEG_DTE
 MLA_NAM
 MLA_ID
 Entity: MONIT_LOC_INSP_EVT
 Attrs: ML_INSP_COMMENT
 ML_INSP_WEATHER
 ML_INSP_TIME
 ML_INSP_DTE
 Entity: MONIT_LOC_SRVC_PER
 Attrs: MLSP_COMMENT
 MLSP_END_DTE
 MLSP_BEG_DTE
 Entity: PARAMETER
 Attrs: PARAM_USE_CODE
 PARAM_SAS_NAM
 PARAM_CODE
 PARAM_ABBR
 PARAM_CAS_ID
 PARAM_STD_NAM
 Entity: PARAM_ANALYSIS_GRP
 Attrs: PAG_PLAN_HLD_UNIT
 PAG_PLAN_HLD_QTY

PAG_USE_CODE
 PARAM_ANLY_GRP_NAM
 PARAM_ANLY_GRP_COD
 Entity: PLUGGING_EVENT
 Attrs: PLUG_EVT_LOC_ID
 PLUG_EVT_DTE
 Entity: PLUGGING_METHOD
 Attrs: PLUG_METH_NAM
 PLUG_METH_DESC
 Entity: PLUG_INTV_MATERIAL
 Attrs: PLUG_INTV_END_DPTH
 PLUG_INTV_BEG_DPTH
 Entity: PLUG_MATERIAL
 Attrs: PLUG_MATL_NAM
 PLUG_MATL_CODE
 Entity: PRESERVATIVE
 Attrs: PRESERVATIVE_NAM
 PRESERVATIVE_CODE
 Entity: PURGE_EVENT
 Attrs: PURG_EVT_DUR_UNIT
 PURG_EVT_DUR_VAL
 PURG_EVT_DISP_CODE
 Entity: QC_MEASURE_TYPE
 Attrs: QC_MEAS_TYP_NAM
 Entity: QC_RESULT
 Attrs: QC_RSLT_TYP
 QC_RSLT_LOW_LIM
 QC_RSLT_UP_LIM_VAL
 QC_RSLT_UNIT
 QC_RSLT_VAL
 QC_RSLT_DESC
 Entity: REF_MATL_SOURCE
 Attrs: REF_MATL_SRCE_DESC
 REF_MATL_SRCE_NAM
 Entity: SAMPLE
 Attrs: SMPL_AUTO_DVC_POS
 SMPL_SEX_CODE
 SMPL_GEN_HIST_ID
 SMPL_HIST_ID
 SMPL_COMPOSITE_FLG
 SMPL_PROC_TYP_COD
 SMPL_BANK_CODE
 SMPL_SEDIMENT_TYP
 SMPL_STAT_CODE
 SMPL_INTV_UNIT
 SMPL_CERT_LOT_NO
 SMPL_DTE
 SMPL_TIME

SMPL_FLD_LOG_BG_PG
 SMPL_END_INTV
 SMPL_BEG_INTV
 SMPL_ID
 SMPL_COMPL_CHK_FLG
 SMPL_COMMENT
 Entity: SAMPLER_TYPE
 Attrs: SMPLR_TYP_DESC
 SMPLR_TYP_CODE
 Entity: SAMPLE_ANLY_STAGE
 Attrs: SA_STAGE_ANLY_ID
 SMPL_LAB_SEQ_NO
 SA_STAGE_COMMENT
 SMPL_ID
 SA_STAGE_LVL
 SA_STAGE_COMPL_TIM
 SA_STAGE_COMPL_DTE
 SA_STAGE_BATCH_POS
 SA_STAGE_END_QTY
 SA_STAGE_INIT_UNIT
 SA_STAGE_END_UNIT
 SA_STAGE_INIT_QTY
 SA_STAGE_BATCH_NO
 SA_STAGE_TIME
 SA_STAGE_DTE
 SA_STAGE_REP_NO
 Entity: SAMPLE_LAB
 Attrs: SMPL_LAB_SEQ_NO
 HARD_COPY_RCD_DTE
 SMPL_LAB_ID
 Entity: SAMPLE_STATUS_HIST
 Attrs: SSH_SEQ_NO
 SSH_STAT_CHG_REAS
 SSH_STAT_CHNG_DTE
 SMPL_STAT_CODE
 Entity: SAMPLE_TYPE
 Attrs: SMPL_TYP_NAM
 SMPL_TYP_DESC
 SMPL_TYP_CODE
 Entity: SAMPLE_WASTE_CODE
 Attrs: SMPL_WST_CODE_DTE
 Entity: SAMPLING_PROCEDURE
 Attrs: SMPL_PROCED_REV
 SMPL_PROCED_DESC
 SMPL_PROCED_NO
 Entity: SDG_MILESTONE
 Attrs: SDGM_EXP_DTE
 SDGM_ACT_DTE

Entity: SMPL_ASSOC_FORM
 Attrs: SMPL_ASSOC_FRM_DTE
 Entity: SMPL_COLL_BC_TRAN
 Attrs: SMPL_CERT_LOT_NO
 SMPL_ID_REPLACED
 REASON_NO_SAMPLE
 SMPL_PH
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 TEAM_LEADER_BADGE
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 LOGBOOK_NUMBER
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 TRANSACTION
 Entity: SMPL_CONT_TYPE
 Attrs: SMPL_CONT_DESC
 SMPL_CONT_MIN_VOL
 SMPL_CONT_UNT_ABBR
 SMPL_CONT_MATL_COD
 Entity: SMPL_DELIVERY_GRP
 Attrs: SDG_LAB_NO
 SDG_LAB_SHIP_DTE
 SDG_SHIP_CONT_NO
 SDG_NO
 Entity: SMPL_PROC_EXCP_EVT
 Attrs: SPEE_DTE
 Entity: SMPL_RSLT_QUAL
 Attrs: SMPL_RSLT_QUAL_DTE
 Entity: SMPL_SHIP_CONTNR
 Attrs: SSC_CONTNR_SEQ_NO
 SSC_SHIP_ORD_FRM
 SSC_TEMP_UNIT
 SSC_RCPT_COND
 SSC_RCV_TEMP
 SSC_SHIP_TEMP
 SSC_CONTNR_TYP
 SSC_CONTNR_NO
 Entity: SMPL_STAT_DATA_FRM
 Attrs: SSDF_DTE
 Entity: SOW_METHOD
 Attrs: AGENCY_CLP_VERS_NO

Entity: SOW_METHOD_MATRIX
 Attrs: SMM_MAX_SMPL
 SMM_SMPL_COST_AMT

Entity: SOW_METH_MATRX_PAR
 Attrs: SMMP_HLD_UNIT
 SMMP_HLD_QTY
 SMMP_LIM_UNIT
 SMMP_LOW_LIM_VAL

Entity: SOW_PARAM_QC_LIM
 Attrs: SOWQC_CRI_UNIT
 SOWQC_LOW_LIM_VAL
 SOWQC_UP_LIM_VAL

Entity: STATEMENT_OF_WORK
 Attrs: SOW_EFF_DTE
 SOW_REV_NO
 ER_APO_TRACKING_NO
 SOW_FUND_AMT
 SOW_PURCH_REQ_NO
 SOW_CHARGE_NO
 SOW_APO_NO
 SOW_NO

Entity: SW08_CONFIG_CTL_1
 Attrs: BDGD_PRSN_UID
 CHANGE_COMMENT
 DATE_TIME_STAMP
 SMPL_PROCED_REV
 SMPL_PROCED_NO
 ME_WEATHER
 BDGD_PRSN_BADGE_NO
 SMPL_TIME
 LOGBOOK_FRM_NO
 SMPL_DTE
 ML_ID
 FRM_CHANGE_SEQ_NO
 FRM_NO

Entity: SW08_CONFIG_CTL_2
 Attrs: SMPL_SPLIT_FROM_ID
 SMPL_COMPOS_TO_ID
 PH_SR_RSLT_VAL
 PRESERVATIVE_CODE
 PARAM_ANLY_GRP_COD
 SMPL_CERT_LOT_NO
 SMPL_TYP_CODE
 SMPL_CONT_MATL_COD
 SMPL_CONT_UNT_ABBR
 SMPL_CONT_MIN_VOL
 FM_RPT_RESULT
 SMPL_ID

FRM_DETAIL_SEQ_NO
 Entity: SWFM_CONFIG_CTL_1
 Attrs: ME_COMMENT
 ME_WEATHER
 FM_TIME_COLL
 FM_DTE_COLL
 LOGBOOK_FRM_NO
 BDGD_PRSN_BADGE_NO
 ENV_PROJ_TASK_CODE
 ME_BEG_DTE
 ML_ID
 CHANGE_COMMENT
 BDGD_PRSN_UID
 DATE_TIME_STAMP
 FRM_CHANGE_SEQ_NO
 FRM_NO
 Entity: SWFM_CONFIG_CTL_2
 Attrs: FM_RPT_UNIT
 FM_RPT_RSLT
 EQUIP_ID
 FRM_DETAIL_SEQ_NO
 Entity: TEAM_MEMBER_ROLE
 Attrs: TEAM_MEM_ROLE_DTE
 Entity: TEAM_ROLE
 Attrs: TEAM_ROLE_NAM
 TEAM_ROLE_CODE
 Entity: TIC_RESULT
 Attrs: TIC_RETENT_TIME
 TIC_CAS_ID
 TIC_NAM
 TIC_COMMENT
 TIC_REV_COMMENT
 TIC_REV_FLG
 TIC_DILUTION_FAC
 TIC_RSLT_UNIT
 TIC_RSLT_VAL
 Entity: TIC_RSLT_QUAL
 Attrs: TIC_RSLT_QUAL_DTE
 Entity: TIR_RESULT
 Attrs: TIR_KEV_VAL
 TIR_RETENT_TIME
 TIR_NAM
 TIR_COMMENT
 TIR_REV_COMMENT
 TIR_REV_FLG
 TIR_DILUTION_FAC
 TIR_RSLT_UNIT
 TIR_RSLT_VAL

Entity: TIR_RSLT_QUAL
 Attrs: TIR_RSLT_QUAL_DTE
 Entity: TRUE_RESULT
 Attrs: TR_RSLT_UNIT
 TR_RSLT_VAL
 Entity: USGS_WEIR_FLOW
 Attrs: WEIR_STD_FLOW_VAL
 WEIR_FLOW_HGT_VAL
 WEIR_FLOW_REC_DTE
 WEIR_FLOW_REC_TIME
 WEIR_FLOW_VERF_FLG
 WEIR_FLOW_BADGE_NO
 Entity: VALID_RSLT_QUAL
 Attrs: VRQ_ASSGN_CODE
 VLD_RSLT_QUAL_CLS
 VLD_RSLT_QUAL
 VLD_RSLT_QUAL_DESC
 Entity: VLD_QUAL_REASON
 Attrs: VLD_QUAL_REAS_DESC
 VLD_QUAL_REAS_CODE
 Entity: WASTE_CODE
 Attrs: WASTE_CODE_ID
 WASTE_CODE_DESC
 Entity: WELL
 Attrs: WELL_USE
 WELL_TRNSMSVTY
 WELL_PERMIT_NO
 WELL_ROCK_DPTH
 WELL_INIT_WTR_DPTH
 WELL_TYP
 WELL_COMMENT
 WELL_GROUT
 WELL_CONSTR_DPTH
 WELL_GEO_UNIT
 WELL_UPRGT_MNT_FLG
 WELL_AQUIFIER
 Entity: WELL_COMPONENT
 Attrs: WELL_COMP_EVT_ID
 WELL_COMP_TOP_DPTH
 WELL_COMP_BOT_DPTH
 WELL_COMP_INS_DIAM
 WELL_COMP_OUT_DIAM
 WELL_COMP_SLOT_SIZ
 WELL_COMP_MFG_NAM
 WELL_COMP_REM_DTE
 Entity: WELL_DEV_EVENT
 Attrs: WELL_DEV_COMMENT
 WELL_DEV_METH

Entity: WELL_DEV_END_DTE
 Attrs: WI_MEAS_ELEV
 WI_EQUP_LOG_FLG
 WI_COMMENT
 WI_DEV_LOG_FLG
 WI_COMPL_DTE
 WI_CONST_CONTCCTR
 Entity: WELL_LOCATION
 Attrs: WELL_ALIAS
 WELL_SYMBOL
 WELL_SPC_TYPE
 WELL_LOC_CMNT
 WELL_COMMENT2
 WELL_COMMENT1
 WELL_STAT_CODE
 WELL_GND_ELEVATION
 WELL_NORTHING
 WELL_EASTING
 WELL_ID
 Entity: WELL_MOD_EVENT
 Attrs: WELL_MOD_ACT
 WELL_MOD_COMPL_DTE
 WELL_MOD_TYP
 WELL_MOD_COMMENT
 WELL_MOD_MEAS_ELEV

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