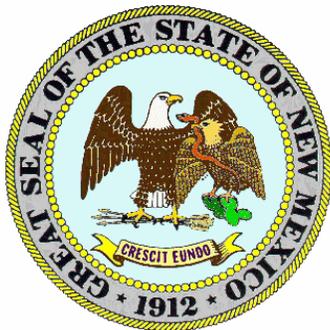


# QUALITY ASSURANCE PROJECT PLAN FOR SURFACE WATER MONITORING PROGRAMS

2006  
REVISION 1

DOE Oversight Bureau  
New Mexico Environment Department



2006

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**Quality Assurance Project Plan**

**For**

**Surface Water Monitoring**

**DOE Oversight Bureau  
New Mexico Environment**

Approvals:

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### **MISSION OF THE DOE OVERSIGHT BUREAU**

The mission of the New Mexico Environment Department DOE Oversight Bureau is to assure that activities at DOE facilities are managed and controlled in a manner that is protective of the public health and safety and the environment. The Bureau's activities are funded through a grant from the U.S. Department of Energy in accordance with the provisions set forth in the *Agreement-in-Principle between the State of New Mexico and the U.S. Department of Energy*.

The Oversight Program has four primary objectives:

- To assess whether activities at Department of Energy facilities in New Mexico are managed in a manner that is protective of the public health and environment.
- To provide input into the prioritization of cleanup and compliance activities at Department of Energy facilities.
- To develop and implement a program of independent monitoring and oversight.
- To increase public knowledge of environmental matters about the facilities, and coordinate with local and tribal governments.

## Table of Contents

1.	Problem Definition.....	1
1.1.	Background.....	1
1.2.	Project Description.....	2
1.2.1.	Storm Water Compliance Monitoring.....	2
1.2.2.	NPDES Compliance Monitoring (Industrial Point Source Permits).....	2
1.2.3.	Ambient Water Quality Monitoring.....	3
1.3.	Data Quality Objectives.....	4
1.3.1.	Special Training/Certificates.....	6
1.3.2.	Documentation and Records.....	6
1.3.3.	Compliance Monitoring.....	6
1.3.4.	Ambient Water Quality Monitoring.....	7
2.	Data Generation and Acquisition.....	7
2.1.	Sampling Process Design.....	7
2.2.	Data Analysis and Assessment.....	8
2.3.	Sample Collection, Preservation, and Analysis.....	10
2.4.	Sample Handling and Custody.....	10
2.5.	Quality Control.....	11
2.5.1.	Field Quality Control.....	11
2.5.2.	Laboratory Quality Control.....	12
2.6.	Database.....	16
2.7.	Instrument/Equipment Testing, Inspection and Maintenance.....	17
2.7.1.	Instrument/Equipment Calibration and Frequency.....	19
2.7.2.	Contract Laboratory Calibration Requirements.....	20
2.7.3.	Inspection/Acceptance of Supplies and Consumables.....	21
2.7.4.	Non-direct Measurements.....	21
3.	Assessment and Oversight.....	21
3.1.	Quality System Assessment and Response Actions.....	21
3.2.	Reports to Management.....	22
3.3.	Data Validation and Usability.....	22
3.4.	Data Review, Verification, and Validation.....	23
3.4.1.	Ambient Water Quality Monitoring.....	23
3.4.2.	Validation and Verification Methods.....	23
3.4.3.	Reconciliation with User Requirements.....	23
4.	References.....	26
	Appendix A. Forms.....	27
A.1.	Quality Assurance Checklist, DOE Oversight Bureau.....	28
A.2.	Result Verification Form DOE Oversight Bureau.....	29
A.4.	DOE Oversight Sampling Stations Form.....	28
	Appendix B. Quality Assurance Criteria.....	31
B1.0.	Introduction.....	33
B2.0.	Documentation Procedures.....	33
B3.0.	Analytical Methods and Quantitation Limits.....	33
B4.0.	Holding Times.....	35

B5.0. Quality Control Criteria .....	35
B5.1. Field Replicates .....	35
B5.2. Dissolved Metals Results Greater than Totals .....	36
B5.3. Field Equipment, and Trip Blanks .....	36
B5.4. Laboratory Matrix Spike and Matrix Spike Duplicate.....	37
B5.5. Surrogate and Internal Standards .....	37
B5.6. Laboratory Method Blank .....	38
B6.0. Completeness .....	38
B7.0. Corrective Actions.....	39
B8.0. References .....	39
B9.0. Analytical Lab Contractors .....	40
Appendix C. General Field Safety Manual.....	54
Appendix D. Rain Gauge Installation Protocol & ELS Installation SOP.....	68
Appendix E. ISCO® Flow Meter and Sampler Setup Procedure and RTD Use.....	72

### List of Tables

Table 1. List of Abbreviations .....	vii
Table 2. Project Organization .....	ix
Table 3. Format Of Electronic Data Deliverables (All Laboratories) .....	17
Table 4. Routine Equipment Testing, Inspection, and Maintenance .....	17
Table 5. Instrument Calibration Information .....	19
Table 6. DOE Oversight Bureau Data Validation Codes .....	24
Table B.1 Analytical Methods and Holding Times .....	41
Table B.2 Collection Frequencies for Routine Ambient Water Quality Samples .....	46
Table B.3 Control Limits on Field Replicate RPDs .....	46
Table B.4 Matrix Spike Recovery and Duplicate Control Limits .....	47
Table B.5 Surrogate and Internal Standard Recovery Control Limits.....	49
Table B.6 Volumes, Containers, Preservation, and Hold times.....	50

**Table 1. List of Abbreviations MDL, POC, SNL and WIPP**

AIP	Agreement-In-Principle
AOC	Area of Concern
AWWA	American Water Works Association
BMP	Best Management Practices
Ci	Curie
CFR	Code of Federal Regulations
CL	Control Limit
COD	Chemical Oxygen Demand
CWA	Clean Water Act
DI	Deionized Water
DO	Dissolved Oxygen
DOE	U.S. Department of Energy
DOE/OB	DOE Oversight Bureau
DQI	Data Quality Indicator
DQO	Data Quality Objective
ELS	Environmental Liquid Sampler
FFCA	Federal Facility Compliance Agreement
ft/sec	Feet per second
GC/MS	Gas Chromatography/Mass Spectrometry
GIS	Geographic Information System
GSD	General Services Department
HCl	Hydrochloric Acid
HNO <sub>3</sub>	Nitric Acid
H <sub>2</sub> SO <sub>4</sub>	Sulfuric Acid
HWB	Hazardous Waste Bureau
ICPMS	Inductively Coupled Plasma Mass Spectrometry
KCl	Potassium Chloride
Kg	Kilogram
mCi	Millicurie
MDL	Minimum Detectable Level
mg/L	Milligram(s) per liter
Mrem	Millirem
MQL	Minimum Quantitation Limit
MSGP	Multi-Sector General Permit
μCi/L	Microcurie per liter
LANL	Los Alamos National Laboratory
μmhos/cm	Microhos per centimeter
μsiemens	Microsiemens
N/A	Not Applicable
NIST	National Institute of Standards and Technology
NM	New Mexico
NMAC	New Mexico Administrative Code

Table 6. List of Abbreviations (CONTINUED)

NMED	New Mexico Environment Department
NMSA	New Mexico Statues Annotated
NPDES	National Pollutant Discharge Elimination System
NPS	Nonpoint source per 20.6.4.7(PP)
PARCC	Precision, Accuracy, Representativeness, Comparability, Completeness
pCi/l	Picocuries Per Liter
pCi/g	Picocuries per Gram
pg/g	Picrograms per gram
POC	Point of Contact
PRS	Potential Release Site
QA	Quality Assurance
QAPP	Quality Assurance Project Plan
QC	Quality Control
RBP	Rapid Bioassessment Protocol
RID	Request ID
RPD	Relative Percent Difference
SAP	Sampling and Analysis Plan
SNL	Sandia National Laboratory
SOP	Standard Operating Procedure
SWMUs	Solid Waste Management Unit
SWQB	Surface Water Quality Bureau
TDS	Total Dissolved Solids
TMDL	Total Maximum Daily Load
TSS	Total Suspended Solids
USEPA	U.S. Environmental Protection Agency
USGS	U.S. Geological Survey
WEF	Water Environment Federation
WIPP	Waste Isolation Pilot Project
WQA	Water Quality Act
WQCC	New Mexico Water Quality Control Commission
WS	Water Supply
WSAL	Water Screening Action Level
WWTP	Wastewater Treatment Plant

**Table 2. Project Organization**

Storm Water (Watershed) Monitoring	NPDES/SWMU Monitoring
Project Director Ralph Ford-Schmid (505) 476-6023	Project Director Steve Yanicak (505) 672-0448
Project Officer Dave Englert (505) 476-6022	Project Officer (LANL) Erik Galloway (505) 476-6024
QA Officer Barry Birch (505) 845-5933	QA Officer Barry Birch (505) 845-5933
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## 1. Problem Definition

### 1.1. Background

The Department of Energy Oversight Bureau (DOE/OB or Oversight Bureau) validates and verifies the methodologies used, actions taken and reported data produced by Department of Energy (DOE) facilities in New Mexico in order to assure compliance with all federal, state, and facility mandates of protecting the public health and environment of New Mexico. The Oversight Bureau does this by obtaining and analyzing data through implementation of a systematic approach to water quality monitoring through the use of automated and grab sample collection. All analytical values for compliance assessment are compared to either discharge permit limits, water screening action levels (wSALs), or the New Mexico Water Quality Control Commission's (WQCC) *Standards for Interstate and Intrastate Surface Waters* (20.6.4 NMAC).

The Oversight Bureau oversees DOE environmental monitoring programs at the following DOE facilities in New Mexico: Los Alamos National Laboratory (LANL), Sandia National Laboratory (SNL), and the Waste Isolation Pilot Plant (WIPP). These DOE facilities conduct weapons research and development and produce a wide range of waste products including, biological, chemical, radiological, and mixed waste. The Oversight Bureau assures that these products and their byproducts are being treated, disposed of, and handled in a safe and environmentally sound manner in order to preserve and protect New Mexico's environment and its citizens. LANL is the premier "pit" developer for the United States nuclear arsenal as well as performs other weapons and biological research. SNL also performs weapons research. WIPP is the only disposal facility in the country for low level, transuranic, and mixed nuclear waste.

LANL is covered under the National Pollutant Discharge Elimination System (NPDES) for both point source discharges and storm water discharges through the EPA Multi-Sector General Permit (MSGP). In addition, LANL has entered into a Federal Facility Compliance Agreement (FFCA), which regulates storm water discharges from Solid Waste Management Units (SWMUs) and Areas of Concern (AOCs). SNL holds five wastewater permits with the City of Albuquerque and all SNL effluent releases to the sewer system must meet the City of Albuquerque sewer and wastewater control ordinance requirements, in addition, SNL's storm water discharges are covered by a MSGP. WIPP is covered under the MSGP for storm water discharges.

The Oversight Bureau monitors:

- Storm water on a watershed-scale and site-specific basis downstream of SWMUs and AOCs;
- Effluent from numerous NPDES permitted outfalls located at DOE facilities; and
- Perennial reaches through ambient water quality monitoring and benthic macro-invertebrate community and habitat assessments.

The Oversight Bureau collects watershed storm water samples using ISCO® automated liquid samplers, environmental liquid samplers (ELs), and by dipping sample containers into flowing

streams, commonly referred to as grab samples. The Oversight Bureau collects samples at each location, usually within 15 minutes, and these samples are considered grab samples. Duplicate or split, grab samples are collected in conjunction with facility operators at NPDES permitted outfalls. All data are compared to applicable surface water quality standards (20. 6.4 NMAC) and appropriate permit limits, or, as in the case of LANL's FFCA, wSALs. If a data deviation or problem is noted, DOE and the Oversight Bureau will work cooperatively through the **Agreement-in-Principle** between the State of New Mexico and the U.S. Department of Energy to correct or mitigate the situation.

## **1.2. Project Description**

There are three primary categories of Oversight Bureau's surface water quality program: Federal Facility Compliance Agreement (FFCA) storm water compliance, NPDES Industrial Point Source compliance, and ambient surface water quality monitoring.

### **1.2.1. Storm Water Compliance Monitoring**

Compliance monitoring includes analysis of storm water collected at the following locations:

- Down gradient from SWMUs and AOCs; and
- Ambient receiving-stream water quality monitoring.

Samples of the receiving-stream above and below the SWMUs and AOCs are also collected in some instances to evaluate the actual chemical impact of the storm water discharge on the stream. Data from an event may be used to verify accuracy of the facility Discharge Monitoring Report (DMR) or as evidence in enforcement proceedings.

The Oversight Bureau's storm water program staff evaluates compliance with each facility's MSGP or FFCA and calculates pollutant loading for total maximum daily load (TMDL) development. DOE Oversight Bureau staff also independently collects storm water samples and determines if there is or has been a release or transport of a pollutant from an AOC or SWMU into surface water that could cause or contribute to a violation of an applicable surface water quality standard, including the anti-degradation policy. DOE Oversight Bureau's staff compares facility-generated and independently collected data to facility-specific water screening action levels (wSALs), MSGP benchmarks, and applicable water quality standards using the State of New Mexico's, *Surface Water Quality Assessment Protocol* (NMED/SWQB 2006a). The Bureau collects multiple samples from the same location during storm flow events. Evaluation of multiple samples collected along the stream hydrograph illustrates relationships between the magnitude of flow, suspended sediment concentration, and contaminant loading. The DOE Oversight Bureau also calculates contaminant and sediment concentrations, at any time during a flood event, and the mass transport inventory from these data.

### **1.2.2. NPDES Compliance Monitoring (Industrial Point Source Permits)**

The Oversight Bureau evaluation of NPDES industrial and storm water discharges is partially based on a review of records maintained by the facility. Permit compliance is also verified by collecting duplicate samples with a DOE facility at regulated sites. Records reviews vary by the

type of facility and/or storm water pollution prevention plan and may include: monitoring reports, previous inspection reports, permit applications, permits, and past or pending enforcement actions. Records in database files may include: laboratory records, equipment calibration records, operational records, facility design records, site self-inspection records, site stabilization records, employee training records, etc. These reviews are compared to records of major and minor (traditional and non-traditional) Permittees maintained electronically by the NMED Surface Water Quality Bureau (SWQB). The Oversight Bureau also evaluates modifications to NPDES permits as the individual permits come up for renewal.

The Oversight Bureau's NPDES point source monitoring program evaluates each facility's compliance with their NPDES permit and to determine whether discharges meet permit limits and applicable water quality standards. Bureau staff will usually collect samples from facility effluent streams and split them with DOE. The DOE Oversight Bureau compares facility-generated data and the Oversight Bureau's split sample data to permit limits and assesses the data using the State of New Mexico's, *Surface Water Quality Assessment Protocol* (NMED/SWQB 2006a).

### **1.2.3. Ambient Water Quality Monitoring**

The Oversight Bureau's ambient water quality monitoring program characterizes the hydrologic systems within and around DOE facilities in New Mexico. To do this, Bureau staff may measure stream geomorphology, stream hydraulics, and extent of perennial or intermittent conditions. The Oversight Bureau may assess the biological community and independently collect water quality samples. The Oversight Bureau evaluates facility generated and independently collected water quality data using the State of New Mexico's, *Surface Water Quality Assessment Protocol* (NMED/SWQB 2006a). Analytical results from water quality samples collected from ambient stream stations upstream and downstream from the effluent discharges are used to determine water quality standards attainment, the effects of the discharges on receiving waters and possible inclusion on the 303(d) list of impaired water bodies.

DOE Oversight Bureau staff will prepare project summaries for all water quality surveys, including streams, storm water discharges, and NPDES studies. After careful analysis, Oversight Bureau staff will summarize all data including water quality, habitat integrity, and biological conditions and standards compliance in project summary reports. Water quality investigations in response to spills or citizen complaints are not included in these publications. Summaries include a map of the study area, descriptions of the sampling stations, data evaluation, and conclusions. If macro-invertebrate data were collected during a survey, tables presenting the raw numbers and calculated Rapid Bioassessment Protocol (RBP) metrics are included as well as brief discussions of their significance.

### 1.3. Data Quality Objectives

The DQO process, based on EPA's *Guidance for the Data Quality Objectives Process (QA/G-5)* (EPA 2002), is a tactical, systematic process for planning data collection efforts. It helps answer the following questions:

- Why do we need data?
- What must the data represent?
- How will we use the data?
- How much uncertainty is tolerable?

Steps followed in the DQO Process are listed below:

1. State the Problem
2. Identify the Decision
3. Identify Inputs to the Decision
4. Define the Study Boundaries
5. Develop a Decision Rule
6. Specify Limits on Decision Errors
7. Optimize the Decision for Obtaining Data

The data quality objectives (DQOs) defined in this QAPP, are to be used for the development of the project specific sampling and analysis plans (SAPs). The SAPs will be approved by the Bureau Chief, Staff Manager and Project Leader and kept in the Bureau's Santa Fe office QA/QC library. These project SAPs will contain the following:

- Table of Contents,
- A brief overview of the project,
- Target Population,
- Sampling Unit,
- Sampling Frame,
- The DQO process,
- A sampling design including frequency and volume,
- Sampling Support,
- Measurement Protocol, and
- The description of the sampling methodology to be used for the study.

Achieving compliance with applicable environmental laws and regulations is crucial to the success of environmental programs. Several methods are used for assuring compliance with environmental laws and regulations. These include conducting compliance monitoring of storm water discharges and NPDES point source discharges to detect permit non-compliance. These samples will be collected from surface waters, storm waters, and effluent discharges within and around the borders of all DOE regulated facilities in New Mexico. The Oversight Bureau has no regulatory authority and works cooperatively with DOE and NMED regulatory Bureaus to correct any compliance issues that are discovered through the Oversight Bureau's monitoring program.

All data obtained by the Oversight Bureau is public information. The Oversight Bureau will provide the data to the USEPA, SWQB, HWB, and DOE. The data may be used to:

1. Determine compliance of effluent discharges with applicable NPDES permit limits,
2. Determine compliance with the *Standards for Interstate and Intrastate Surface Waters* (20.6.4 NMAC),
3. Determine compliance of storm water discharges from SWMUs and AOCs with FFCA water screening action levels
4. Assist in the development of proposed revisions to the *Standards for Interstate and Intrastate Surface Waters* (20.6.4 NMAC),
5. Support refinement of designated uses and specific criteria for water bodies,
6. Aid in assessing designated use attainment status of New Mexico's surface waters for the Integrated §303(d)/§305(b) list and report (NMED/SWQB 2004),
7. Determine water quality trends and identify potential "trouble spots",
8. Determine the effectiveness of Nonpoint Source (NPS) Best Management Practices (BMPs) at DOE facilities,
9. Assist in the development of use attainability analyses for water bodies,
10. Assist in the development of TMDL planning documents for water bodies contained on the State's Integrated §303(d)/§305(b) List of Impaired Waters, and
11. Provide public information.

DQOs are criteria used to evaluate the overall level of uncertainty that a decision-maker is willing to accept in results derived from environmental data. DQOs are defined in order to produce data of a known and verifiable quality and which are of quality sufficient to meet the overall objectives of the water quality environmental monitoring investigations. Data quality for all Oversight Bureau programs will be achieved by several means, with emphasis on establishing DQOs for analytical results, and a SAP for field sample collections and field measurement activities. DQOs include measures such as precision, accuracy, representativeness, completeness, and comparability of data.

The federal NPDES permit program is the principal mechanism used by New Mexico for the protection of its surface waters from pollution by point source discharges. Under this program, a permit specifies the amounts and concentrations of contaminants that a Permittee may discharge to a watercourse. In addition, various administrative and procedural requirements, and specific structural and non-structural pollution prevention measures and practices may be specified.

The Oversight Bureau can make data available for enforcement of the State of New Mexico, *Standards for Interstate and Intrastate Surface Waters* (20.6.4 NMAC) pursuant to the provisions of 74-6-10 NMSA 1978 of the New Mexico, *Water Quality Act*. Procedures for enforcement of the standards are contained in 20.6.4.12 NMAC, and specific procedures for

enforcement of human health criteria (listed in Subsection J of 20.6.4.900 NMAC) can be found in Work Element 10 of the State's *Water Quality Management Plan*.

### **1.3.1. Special Training/Certificates**

Although no special certification is required for compliance with this QAPP, proper training of field personnel represents a critical aspect of Quality Control (QC). Staff and/or interns within the Oversight Bureau undergo a period of apprenticeship and are accompanied by an experienced Project Leader or Oversight Bureau staff person when collecting samples or field measurements. In addition, NMED personnel are required to complete the National Safety Council Defensive Driving Course, which is made available through the General Services Department (GSD)/Transportation Services Division of the State of New Mexico. Employees are required to keep a copy of the Defensive Driving training certificate at all times while driving a state vehicle or must have a valid state drivers license while driving a federal vehicle. Additionally, in order to do much of the work, personnel are required to obtain a Q clearance, general Radworker II training and practical, Hazwopper 40 hour hazmat training, Integrated Work Management Training, and General Employee training, and keep them current in order to work at DOE facilities.

### **1.3.2. Documentation and Records**

This section discusses information concerning the management of documents and records, including this QAPP. Following management's approval, this document will be made available on the NMED Oversight Bureau web site at [http://www.nmenv.state.nm.us/DOE\\_oversight/](http://www.nmenv.state.nm.us/DOE_oversight/). In addition, electronic copies will be distributed to the appropriate project personnel. Management of additional Oversight Bureau documents and records that will be produced in 2005-2010 is discussed in the following sections.

### **1.3.3. Compliance Monitoring**

Each Project Leader conducting facility assessments keeps a bound sampling notebook. All field data, other than those entered on the field sheets, are entered into this notebook. Mistakes are lined out and then dated and initialed, entries are never erased nor pages removed. The Oversight Bureau Project Leader reviews all field notes and field sheets for completeness and clarity after each sampling event. All non-privileged or proprietary notes and information concerning a particular survey are kept in a survey file maintained by the Project Lead. A login sheet is prepared for all samples collected during a given sampling trip. The field notebook is used as the basis for preparing reports and to refresh the investigator's memory regarding the specifics of information gathered during the sampling event. Field notebooks are maintained for a minimum of three years after the sampling event date. Reports cover, in detail, all findings made during the sampling event and may include photographs taken during the collection. The sample collector reviews each report for accuracy and signs the report form.

### **1.3.4. Ambient Water Quality Monitoring**

The Oversight Bureau Project Leader reviews all field notes and field sheets for completeness and clarity after each sampling event. All non-privileged or proprietary notes and information concerning a particular survey are kept in a survey file maintained by the Project Lead. Field sheets used for surveys contain fields for the station location, date and time of sample collection, water temperature, specific conductance, dissolved oxygen, pH, salinity, and turbidity. The specific conductance is corrected to 25°C using correction tables or spreadsheets unless equipment used performs this correction automatically.

## **2. Data Generation and Acquisition**

This section provides detailed information regarding sampling process design; sampling methods; sample handling; analytical methods; QC; instrument/equipment testing; inspection; and maintenance; instrument/equipment calibration and frequency; inspection/acceptance of supplies and consumables; non-direct measurements; and data management. The guidelines specified in this section were developed to ensure that data collected for each water quality study or inspection are appropriate and reliable.

Beginning in 2002, the Oversight Bureau and some contract laboratories began the electronic transfer of chemical analysis data. Samples are submitted to Oversight Bureau contract laboratories with Oversight Bureau chain of custody forms. These forms are provided in Appendix A and contain station identification information, applicable information on preservation techniques, and sample collection date and time. The database manager enters electronically transferred data into the Bureau's environmental data database. Data reported in hardcopy form is entered into the database under the supervision of the project leader or database manager.

### **2.1. Sampling Process Design**

Sampling process design will be developed based on the site-specific SAP to be utilized. This design will be based upon the type of sampling required, for example, automated, single stage, or grab samples or a combination of each.

#### **Automated Samplers**

When automatic samplers are used, they can be programmed to collect samples based on a pre-determined stream-level rise. Automated samplers are normally installed at perennial or ephemeral streams that generate frequent and regular flow increases of substantial proportions. These flows could be generated from storm events or effluent discharge.

The sampler can be programmed to collect multiple samples at variable time intervals. These programs include a sample array that can be used to characterize the entire hydrograph. Evaluation of previous hydrographs will determine the sample array and the stream stage that enables the program.

Sample suction lines should be located three to six inches above the stream bottom to minimize the collection of bed load sediment, which can cause the clogging of the suction line, and provide consistency in suspended sediment measurements. Samples collected into glass containers during the flood bore will be analyzed for organic compounds. Additional sample sets will be collected at time intervals during a flood event. Samples can be collected into plastic bottles and could be analyzed for radioactivity, radiochemistry, metals, and general and physical water quality parameters. The SAP will identify the stream stage, sample frequency, and analytical parameters needed to evaluate the stream discharge.

### Single Stage Samplers

Single stage samplers are passive sampling devices installed in water drainages, and are designed to collect a single water sample upon availability. The device is typically a 1-gallon glass or plastic container that has a float apparatus designed to close the sample inlet when filled. Single stage samplers are commonly used in watercourses or slopes that generate minimal flow over small time durations.

The device is implanted into the ground surface to a depth so that the sample inlet can collect a low flow water and suspended sediment sample. The height above the surface is dependant on the project purpose described in the SAP. The projects may include sediment transport from sheet, rivulet, or small channel flows. The limited sample volume is split into appropriate aliquots using a Dekaport® sample splitter. Organic analyses are contained in glass containers, while radiochemical, metal, and physical parameter analyses are contained in plastic.

The SAP will identify the water column height and analytical parameters necessary to evaluate sheet flow or low flow channel discharge.

### Grab Samples

Grab samples are collected from standing or flowing water by dipping an appropriate container into the water column. This method provides the most freedom in collection but requires greater diligence in field observation and notes. Large sample volumes can be collected from any water source for most projects and can be used to obtain more precise analytical measurements. Dates, times, locations, and stream conditions, such as flow rates, depths, and sampling methods must be thoroughly described. Grab samples are commonly used in conjunction with the methods previously described.

The SAP will identify the analytical parameters, collection methods, and appropriateness of this method for an individual project.

## **2.2. Data Analysis and Assessment**

The Oversight Bureau SOP XI: “Quality Assurance/Quality Control” will be applied when reviewing data derived from a project. After data has been reviewed, it will be submitted to the

Agreement in Principle (AIP) Point of Contact (POC), who will distribute the data as prescribed by AIP protocol. Following the data release, a written report and maps may be assembled and submitted to the AIP POC for distribution.

When sampled at or near surface water gage stations, DOE Oversight Bureau staff will correlate data with flow rates and calculate mass transport estimates from the analytical measurements, hydrographs, and stream geomorphology. When grab samples are to be collected for water quality assessment, DOE Oversight Bureau staff will compare analytical measurements to water quality standards using the *Surface Water Quality Assessment Protocol* (NMED/SWQB 2006).

Sampling locations are determined by a workgroup. First, all existing or potential pollution sources along the stream are determined using USGS topographical maps, historical data retrievals, facility PRS evaluations, and information from other agencies. Existing stations are reviewed to determine their continued relevance. Sampling stations are selected at locations that bracket perceived pollution sources, allow access to the water body, and represent each of the assessment units in the watershed.

If a USGS or facility gage station is located in the reach under study, it is commonly selected as one of the sampling stations. Long-term and current flow rates and water quality data are available for these stations. Future studies by NMED or other agencies will use established sampling stations as long as these meet requirements of the survey. Use of established stations enables the examination of trends. After all potential stations have been identified; the workgroup will eliminate stations of questionable value. The project SAP establishes the criteria for sample locations.

During stream surveys, including assessments of storm water and effluent discharge, applicable standards for appropriate water bodies determine the parameters to measure. Samples are also collected for possible standards development and development of site-wide baseline information. Stream samples that may be collected for the purposes of Total Maximum Daily Load (TMDL) determination are collected and assessed against appropriate criteria in the *Standards for Interstate and Intrastate Surface Waters* (20.6.4 NMAC).

Occasionally other projects are initiated that include fish sampling and stream bio-assessment.

Fish tissue is typically assessed for contaminants such as polychlorinated biphenyls (PCBs), pesticides and mercury. Contaminant assessments in fish are performed for the New Mexico Fish Consumption Advisory program. However, fish are also collected to develop baseline information for other metal contaminants (e.g., arsenic), organic contaminants (e.g., PBDEs, dioxin/furans) and radionuclides.

Stream bio-assessments are occasionally performed to assess riparian health and diversity, as well as channel stability. A modified version of the USEPA rapid bio-assessment protocol is followed (Barbour et al., 1999).

### **2.3. Sample Collection, Preservation, and Analysis**

All methods of sample collection, preservation, and analysis used in determining water quality, as a part of this QAPP, shall be in accordance with the following test procedures:

- (1) “Guidelines establishing test procedures for the analysis of pollutants under the Clean Water Act,” 40 CFR Part 136 or any test procedure approved or accepted by EPA using procedures provided in 40 CFR Parts 136.3(d), 136.4, and 136.5.
- (2) *Standard Methods for the Examination of Water and Wastewater*, latest edition, American Public Health Association,
- (3) *Methods for Chemical Analysis of Water and Waste*, and other methods published by EPA Office of Research and Development or Office of Water,
- (4) *Techniques of Water Resource Investigations* of the U.S. Geological Survey,
- (5) *Annual Book of ASTM Standards*. Volumes 11.01 and 11.02, Water (1) and (II), latest edition, ASTM International,
- (6) Federal Register, latest methods published for monitoring pursuant to Resource Conservation and Recovery Act regulations,
- (7) *National Handbook of Recommended Methods for Water-Data Acquisition*, latest edition, prepared cooperatively by agencies of the United States Government under the sponsorship of the U.S. Geological Survey,
- (8) Federal Register, latest methods published for monitoring pursuant to the Safe Drinking Water Act regulations, and/or
- (9) Other recognized scientific journals or organizations that describe performance based, defensible, new and currently evolving analytical techniques.

Detailed procedures for conducting field activities and obtaining representative samples for compliance monitoring and water quality surveys, including sampling procedures, frequencies, containers, preservatives, and holding times, are provided in the Oversight Bureau’s SOP and/or project SAPs. Site conditions, or project-specific data collection objectives, may necessitate the use of alternative field procedures not presented in this manual. The use of field methods other than those presented in the project SOP or SAP must be approved by the Project Leader and documented properly.

### **2.4. Sample Handling and Custody**

The details of the sample handling and custody procedures, and copies of all contract laboratory forms for compliance monitoring and water quality surveys are found in the Oversight Bureau’s SOP and project SAP. All samples are cooled to 4°C, properly preserved, stored, and

transported in ice chests to contract laboratories at the end of each sampling event. Field notes, chain of custody, and sample event forms are filed at each field office.

## **2.5. Quality Control**

### **2.5.1. Field Quality Control**

Newly hired DOE Oversight Bureau's field personnel and/or interns will learn sampling techniques through apprenticeship with experienced Oversight Bureau's or SWQB. When new Oversight Bureau's personnel and/or interns can take field measurements that consistently agree with field measurements taken by the Project Leader (within the limits of the instruments), the personnel will be approved for that measurement. New personnel will also collect grab samples for lab analysis—particularly QC samples—until their technique is consistently good. Only after an appropriate period of apprenticeship (usually about one year) will an individual be qualified to serve as a Project Leader and even then, experienced personnel will generally accompany them until they have served at least a year in that capacity.

The frequency required for replicate sampling and QC criteria are specified in the tables in Appendix B. Under both the storm water monitoring program and the NPDES water quality survey, replicate samples are submitted to the laboratory as blind samples. The location and other information given on the label do not reveal the sample as a replicate. The analytical results of replicate sampling are entered into the Oversight Bureau's water quality database and identified as QC duplicates.

The use of blanks is another important part of the continuing effort to improve data quality by improving collection techniques. Blank samples are prepared before an event and consist of certified clean samples, such as de-ionized water. The samples are carried throughout the entire event, from bottle preparation at the laboratory, to field sampling activities, to submittal to the contract laboratory. Chemical analyses of the blanks determine whether conditions or processes may have contaminated the field samples. The use, types, and frequency of blank samples are described in Appendix C.

Occasionally discrepancies arise in reported data. The Project Leader is responsible for contacting the QA Project Manager and the proper laboratory representatives to resolve the discrepancies. This data review process is described in detail in this QAPP. Corrective procedures are then initiated by Bureau and contract laboratory staff whenever predetermined limits of acceptability are exceeded. These limits and corrective measures are described in the contract laboratory QAPPs found in the Santa Fe DOE Oversight Office QA/QC library along with a summary of the analytical methods and equipment used by Oversight Bureau's contract laboratories. If a corrective action is indicated, results are not reported without proper annotation. Corrective actions include stopping the analysis, identifying the problem, and resolving the difficulty. All documents are reviewed and approved by an immediate supervisor once they are revalidated.

### **2.5.2. Laboratory Quality Control**

Laboratory QA/QC techniques for the analysis of environmental samples have become standardized, and currently accepted techniques are established in the latest USEPA-accepted edition of *Standard Methods for the Examination of Water and Wastewater, Methods for Chemical Analysis of Water and Wastes* (American Public Health Association [APHA], American Water Works Association [AWWA], and the Water Environment Federation [WEF] 1998) and in 40 Code of Federal Regulations (CFR) Part 136, *Guidelines Establishing Test Procedures for the Analysis of Pollutants under the Clean Water Act* (USEPA 2000).

Statistical criteria used by the contract laboratories for validating and expressing the variability of analytical results are derived from the standard deviation, coefficient of variation, range, 95-percent confidence limits, and control charts. Outliers are analytical results that fall outside of the limits of the control chart appropriate for the analysis being performed. If such a result is obtained the analysis is “out of control,” and immediate action is then taken to determine the cause of the outlying result. The analyses are then repeated after corrective action has been taken. Oversight Bureau’s contract laboratories’ QC methods for specific classes of analyses are summarized as follows:

#### **A. Inorganic Chemicals**

1. Precision and accuracy data are determined by analyzing aqueous solutions covering a wide range of concentrations. Standard curves are determined by using at least one concentration level and a blank. At least one standard concentration is used after every ten samples to verify the original curve. Analytical variability is calculated and recorded by instrument software.
2. The above method is used in the evaluation of daily performance as it refers to replicates, spikes, split samples, blanks, low and high concentration standards, reagents, and the preparation of quality control charts.
3. The method described in paragraph 1, is used for all inorganic methods, (including metals) and some organic methods that use titrimetry, specific ion electrodes, turbidimeters, automated Technicon, atomic absorption and flame emission spectroscopy, inductively coupled argon plasma spectroscopy, inductively coupled argon plasma spectrometry, and colorimetry.

#### **B. Organic Analyses**

1. Glassware used for organic analyses is Class A, and is properly calibrated and cleaned to be free of all trace organic contaminants.
2. Chemicals are of pesticide-analysis quality and stored according to manufacturers’ guidelines.
3. Reagents, stock solutions, and standard solutions are prepared and stored as required by the method used.
4. Finished water and solvents used are of a quality prescribed for water quality analyses.
5. Samples analyzed by gas chromatography are prepared according to the method involved and contain the proper replicates, standard controls, blanks, and reagent markers.

6. Methods used for liquid chromatography follow the required guidelines of the manufacturer and the quality control requirements of the published methodology.
7. Quality control comprises 15-20 percent of the analyst's output.
8. Acceptable performance is demonstrated by Oversight Bureau's contract laboratories routine participation in the USEPA administered, and NIST certified, Proficiency Testing Studies; formerly distributed directly by USEPA, but now 'privatized'.

### **C. Radiochemical Analyses**

1. This class of analyses requires rigorous attention to quality control procedures in order to produce valid results.
2. The laboratory is physically arranged such that the storage area, counting area, and preparation area are separated in order to prevent cross contamination.
3. The service utilities to the lab meet or exceed the requirements of the methodology guidelines, for example, finished water, compressed air, natural gas, and electrical services have been designed for use in a radio analytical lab.
4. The instrumentation is carefully calibrated and standardized routinely. Proper shielding and cleanliness minimize background count rates. Proper procurement of quality reagents, and their careful preparation, minimizes reagent interferences.
5. Sample handling follows the recommendations of the methodology.
6. A "routine check source" is used for each counting system to determine, monitor, and document instrument performance stability.
7. Instrument and analytical control charts are maintained to detect deviations from acceptable performance.
8. Reagents and chemicals are of the appropriate quality, and purified when necessary. Standards are obtained from NIST, or from NIST-traceable vendors, when ever possible.
9. Analyzing known compounds, duplicates, spiked samples, and blanks monitors internal quality control. Control charts for analytic performance are maintained.
10. All calculations are performed by vendor supplied software and/or custom Excel spreadsheets. Gaussian (normal) and Poisson statistical distribution methods are used to calculate limits of detection.

Daily lab performance is monitored by the use of spikes, duplicates, and concentration standards to verify standard curves. Precision, accuracy, representativeness, completeness, and comparability are data parameters that are calculated to verify and quantify laboratory performance. These parameters are discussed below. Detailed information regarding laboratory QC criteria is provided in Appendix B.

**Precision:** Precision is the agreement among a set of replicate measurements without assumption of knowledge of the true value. Precision is estimated by means of duplicate/replicate analyses. These samples should have analyte concentrations above the method detection limit (MDL) and may involve the use of matrix spikes (USEPA 1998).

Precision is expressed as the relative percent difference (RPD) between field duplicate measurements, which is calculated as follows (USEPA 1998):

$$RPD = \left( \frac{X_1 - X_2}{(X_1 + X_2)/2} \right) \times 100$$

Where,

RPD = Relative percent difference (%)

X<sub>1</sub> and X<sub>2</sub> = Duplicate measurements of the same sample

The smaller the RPD, the more precise are the measurements. The usability of duplicate measurements is assessed during data validation by comparing RPDs for field replicate measurements to establish control limits (CLs). Because measurements near the MDL (defined as less than two times the MDL) are extremely imprecise, ± 200 % is considered to be the best possible level of precision in practice (U.S. Fish and Wildlife Service 2003). Therefore, for near-detection limit analyses (defined as less than two times the MDL); CLs for precision range from zero (no difference between duplicate control samples) to ± 200 %. When analyte concentrations are greater than 2 to 10 times the MDL, the CLs for precision range from zero to ±20%, and when the analyte concentrations are greater than 10 times the MDL, the CLs for precision are zero to ±10% The QA Director at the contracting laboratories is responsible for establishing measurement criteria for precision and accuracy of the analytical procedures used in projects where water quality data are collected. Data for these QC procedures are obtained by analyses of replicate, split and spiked samples, and blanks.

**Duplicate Error Ratio (DER):** In the comparison of radiochemistry results the total propagated uncertainty, which includes the random and systematic uncertainties involved, must be evaluated with the results to determine the validity of the duplicate measurement. This is accomplished by evaluating the Duplicate Error Ratio (DER), which is defined as:

$$DER = \left( \frac{|S - D|}{2 * \sqrt{\sigma_s^2 + \sigma_D^2}} \right)$$

Where:

|S – D| = is the absolute value of the difference in the result from the sample minus the result of the duplicate:

$\sigma_s^2$  = is the square of the sample's sigma

$\sigma_D^2$  = is the square of the duplicate's sigma

This number gives the degree to which the sample and duplicate are comparable, with respect to the associated uncertainties.

The DOE Oversight Bureau evaluates the DER at the  $2\sigma$  confidence interval. A DER less than or equal to 1.42 indicates that the results, with their associated uncertainties, are statistically equivalent. A DER greater than 1.42 places the results in the  $2\sigma$  “warning” range. A DER greater than 2.13 places the results outside the  $3\sigma$  control range.

**Accuracy (or Percent Bias):** Accuracy is the closeness of agreement between an observed value and an accepted reference value. Bias is assessed by comparing a measured value to an accepted reference value in a sample of known concentration or by determining the recovery of a known concentration spiked into a sample (USEPA 1998). Bias due to matrix effects based on a matrix spike is calculated as:

$$\%R = \frac{100(x_s - x_u)}{K}$$

Where,

%R = Percent recovery

$x_s$  = Measured value for spiked sample

$x_u$  = Measured value for unspiked sample

K = Known value of the spike in the sample

This technique quantifies accuracy in terms of percent recovery of the added spike and takes into account matrix effects specific to a particular sample and should fall within 80-120%. USEPA (1998) stipulates those constituents appropriate for spiking and subsequent measurement, and defines the %R required for proper QA/QC to meet method requirements. The QA Project Director at the Oversight Bureau’s contract laboratories are responsible for establishing measurement criteria for precision and accuracy of the analytical procedures used in projects where water quality data are collected. Data for these QC procedures are obtained by analyses of replicate, split and spiked samples and blanks.

**Representativeness:** Representativeness expresses the degree to which data accurately and precisely represent the true condition of the assessment unit. The evaluation of representativeness is a qualitative procedure that addresses the overall design of a sampling program. Representativeness is improved by the selection and use of appropriate numbers of samples, sampling stations, and techniques proven to obtain samples reflective of the actual quality of a water body.

Sampling plans will be prepared by the Project Leaders for each survey and will be submitted to management for approval. The sampling plan will include a complete list of the sample stations along with the DQO process and a brief description of the reasons for the selection of each. During future surveys, additional stations may be added to bracket new potential points of contaminants or to delineate the contributions from several sources. The reasons behind the

selection of existing stations will be stated. The sampling plan will also include a list of the parameters to be studied at each station and the frequency of sampling.

Determination of the appropriate number of sample events (sampling frequency) is a function of the availability of storm water flows and NPDES discharges. Estimation of these events is challenging given that the variation associated with each of the measurements of interest has not been quantified, and given that this value changes as a function of flow. A sampling frequency is determined based on the application of attainment criteria and human and budget resource constraints.

Study design decisions for ambient water quality monitoring will be documented and provided in the project-sampling plans that contain narrative descriptions of the study designs. The placement of sampling stations with reference to known pollutant inputs and assessment units will be documented.

The QA Director at the contract laboratories is responsible for establishing measurement criteria for precision and accuracy of the analytical procedures used in projects where water quality data are collected. The completeness criteria are specified in Appendix C.

**Comparability:** Given that water quality investigations can involve different contractors or personnel, and often include new and currently evolving analytical techniques, the QA/QC standards necessary to ensure data comparability are a critical element in the designated work. Comparability of data is achieved by uniformity in sampling procedures, preservatives, and “standardization” among staff members. This standardization is achieved by periods of apprenticeship for new staff members and by strict adherence to SOPs and/or project SAPs. Detailed sample collection and handling procedures are specified in the Oversight Bureau’s SOP and/or project SAP. The consistent use of these procedures will ensure that data sets are comparable on the basis of field variables.

## **2.6. Database**

Beginning in 2002, the Oversight Bureau and some contracted laboratories began the electronic transfer of chemical analysis data. The database manager enters electronically transferred data into the Bureau’s environmental data database. Data reported in hardcopy form is entered into the database under the supervision of the project leader or database manager. The contract laboratories provide electronic data to the Bureau in the format presented in Table 3. Data reported to the Bureau in hardcopy are manually entered into an Excel<sup>®</sup> template for short-term assessment.

Samples are submitted to Oversight Bureau’s contract laboratories along with a Request ID (RID) and supporting location and date/time information. Electronic data deliverables are sent from the contract laboratories by e-mail to the Oversight Bureau database manager or project leader. The analytical data are uploaded to the Oversight Bureau database using the RID to match data to the appropriate sample event.

**Table 3. Format of Electronic Data Deliverables (All Laboratories)**

Station ID	Sample Request ID	Sample Date	Sample Time	Analysis Date	Analysis Time	Procedure C o d e	Analyte	Result	Units	L a b Qualifier Codes	Lab Number	Less Than	ML	MDL
( a )	( b )	( c )	( d )	( e )	( f )	( g )	( h )	( i )	( j )	( k )	( l )	( m )	( n )	( o )

Notes:

- (a) Oversight Bureau unique sample location ID (specific to location)
- (b) Oversight Bureau unique analysis/location ID (specific to both chemical group and location)
- (c) Date sample was collected
- (d) Time sample was collected
- (e) Date sample was analyzed
- (f) Time sample was analyzed
- (g) Analytical method
- (h) Analyte name
- (i) Concentration value
- (j) Concentration units
- (k) Qualifier codes pertaining to QA/QC problems encountered during laboratory analysis
- (l) Laboratory sample number
- (m) If result is less than the minimum quantitation limit (ML), TRUE; if result is greater than ML, FALSE
- (n) Minimum quantitation limit as defined by USEPA (2003). Value is 10 times the same standard deviation used to calculate the MDL (or 3.18 times the MDL)
- (o) Minimum Detection Limit

## 2.7. Instrument/Equipment Testing, Inspection and Maintenance

All field equipment must be inspected and serviced, as necessary, prior to each sampling event. A service log is maintained for each instrument. Results of inspections and maintenance will be noted in the equipment log. All deficiencies must be noted in the equipment log and reported immediately to the appropriate staff. Field staff, responsible for the equipment, will verify the problem and arrange for repair by the manufacturer, or for purchase of a replacement. The equipment will not be used if the working condition is in doubt.

Most field instruments used by Oversight Bureau are expensive and must be treated with care. Well-maintained field equipment is essential for acquiring high quality data. The major pieces of field equipment, owned by this Bureau, are listed below. Routine testing, inspection, and maintenance requirements are briefly outlined in Table 4.

**Table 4. Routine Equipment Testing, Inspection, and Maintenance**

Equipment	Testing, Inspection, and Maintenance Procedures
GeoTech GeoPump II	Wipe off outside of GeoPump with a damp cloth; check pump head and power cords; recharge batteries after each field use.

<b>Equipment</b>	<b>Testing, Inspection, and Maintenance Procedures</b>
ISCO® Automatic Sampler	At the beginning of a monitoring season (May – Oct) replace peristaltic pump tubing and check program for compliance with SAP. Prior to deployment, charge battery if needed. Replace paper in flow meter if needed. Replace suction line at each deployment. Taking a spare ISCO®, flow meter, and battery is advised. After a sampling trip, thoroughly clean (and acid rinse) the sample bottles, and peristaltic pump tubing of the ISCO® and allow to air dry. If repair is required new parts will be ordered and replaced. Upon retrieval from field in fall or when changing locations decontaminate sampler and do winter maintenance for the next deployment. Follow the ISCO® instruction manual and decontamination procedures in SOP.
Laser Level and Sensors	Charge Level battery prior to field use. Check batteries in sensors, and carry spares. Check accuracy, precision, and reproducibility by closing a survey loop back to an initial benchmark. After use, clean instrument, repack it in carrying case and carefully secure in the vehicle.
Environmental Liquid Samplers (ELs)	<p>Two Types of Inspections:</p> <ol style="list-style-type: none"> <li>1) In Use; clean off debris using paper towel, rinse with distilled water until clean of debris, inspect sampling port operation, and replace with clean ELS if not opening or closing properly.</li> <li>2) In-House maintenance (for replaced, and or post – sampling ELs): Rinse off debris with tap water, soak overnight in solution of ALCONOX, DO NOT USE ACID TO CLEAN, Disassemble ELs individually and rewash in ALCONOX (do not mix ELS parts). Rinse in distilled water 3X, set FLS parts out to air dry. Inspect ELS springs, and washer before reassembling. Test each ELS to assure that the sampling port works properly. Use ELS inspection manual for troubleshooting or for telephone # of manufacturer. Store in plastic bag.</li> </ol>
Dekaport® Sample Splitter	<p>During use and after each sample. Check ports for debris. Flush out body and Teflon tubes with tap water 3X followed by distilled water 3X. Check ports, pat dry with paper towel, reuse or prep for storage.</p> <p>For Storage: Check ports for debris, remove Teflon tubes, soak, and wash body and tubes in ALCONOX, rinse 3X with distilled water, air dry, store in box.</p>

If there are any questions concerning operation or maintenance of equipment, check with staff designated to care for that equipment.

### 2.7.1. Instrument/Equipment Calibration and Frequency

Calibration requirements for some frequently used instruments are provided in this Section. The requirements given here are examples and are not meant to be exhaustive procedures—always refer to the manufacturer’s instruction manual for each instrument.

Complete procedures for operating, maintaining and calibrating instruments used in field environmental measurements are contained in the manufacturer’s instruction manual for each instrument. Oversight Bureau personnel using field instruments are expected to read and be thoroughly familiar with all procedures detailed in these manuals. In particular, project leaders and lead samplers shall meticulously follow the calibration procedures given by the instrument manufacturer. A calibration log shall be kept for each instrument. DOE Oversight Bureau’s staff shall routinely enter dates of calibration, calibration methods used, and any other pertinent data, e.g., erratic instrument behavior, in the logbook.

Additional calibration and instrument information can be found in the Oversight Bureau’s SOP and/or project SAP for storm water, stream, and NPDES monitoring.

**Table 5. Instrument Calibration Information**

Equipment	Calibration Procedures
YSI Conductivity Meter Model 30 T-L-CYSI Probe Model 3050	This meter and probe can only be recalibrated at the factory. Check against two or more other meters and probes or compare to a 1,000- $\mu$ mhos/cm standard (conductivity) or circulating ice bath (temperature) before each sample season to determine accuracy
Orion Model SA 230/290pH/ISE Meter (used as a backup)	This meter auto calibrates. If an error condition is indicated, refer to manual to correct. If correction cannot be made, meter must be returned to the manufacturer. To calibrate pH probe, see instructions given under below.
Orion Ross pH Electrode (used as a backup)	Perform two-buffer calibration daily; use pH 7 and pH 10 buffers when readings are expected to be near or above pH 7, and use pH 7 and pH 4 buffers if samples are expected to be below pH 7. Carefully follow the directions in the probe manual. Do not turn meter off between measurements. The meter must always be recalibrated after replacement of batteries

Equipment	Calibration Procedures
Orion Gel-Filled Combination pH Electrode (used as a backup)	Perform two-buffer calibration every two hours; use pH 7 and pH 10 buffers when readings are expected to be near or above pH 7; if samples are expected to be below pH 7, use pH 7 and pH 4 buffers. Carefully follow the directions in the probe manual. Do not turn meter off between measurements; if batteries must be replaced, the meter must always be recalibrated
Hach® Turbidimeter Model 2100P	Check the turbidity of the Gelex secondary standard closest to the expected range daily. If the reading varies by more than $\pm 5$ percent, recalibrate with primary formazin standards. Instrument must be recalibrated with primary formazin standards every three months or after battery replacement if calibration is lost. Refer to manual for formazin-standard preparation. After calibration, read each of the Gelex secondary standards in the kit and mark the lids with the proper reading. These secondary standards must always be re-read after formazin calibration of the meter
Hach® Pocket Colorimeter	The instrument is factory calibrated and is ready for use. Test the accuracy of the meter by using a chlorine voluette ampoule standard solution at least once a quarter. Refer to the manual for proper procedures. If there are any discrepancies, contact the manufacturer.
ISCO® Automatic Sampler	When in use, check periodically to assure that the aliquot bottles, pumps are in working order, sample and bubble tube are free of debris, the battery has enough power to run the next sample cycle, each aliquot is filling properly and that a new aliquot is automatically collected at the lapsed time selected, replace pump tubing as needed.

### 2.7.2. Contract Laboratory Calibration Requirements

All contract laboratory instruments and equipment are calibrated prior to each batch using manufacturer's recommended procedures and the guidelines provided in the *Handbook for Analytical Quality Control* (USEPA 1979) and their laboratory specific QAPPs and SOPs.

Class-S or better weights are used in calibrating analytical balances. Specific-ion electrodes are calibrated with appropriate standard solutions. Spectrophotometric and turbidimetric instruments are calibrated with appropriate standard solutions and spectral devices. Heating and cooling devices are calibrated with a National Institute of Standards and Technology certified thermometer. Automated instruments are calibrated by generating at least a seven-point standard curve and a blank with each new batch of samples and checked with a standard concentration every tenth sample.

### **2.7.3. Inspection/Acceptance of Supplies and Consumables**

All supplies and consumables upon receipt will be verified with shipping/receiving documents, and purchase orders to verify quantity ordered equals quantity received. Incorrect quantity shipments will be reported to the purchasing agent for resolution with the supplier. Incorrect items will be evaluated by receiving entity for suitability of use.

### **2.7.4. Non-direct Measurements**

Existing data from entities such as DOE, other Departmental Bureaus, and other Agencies can be evaluated and considered. Computer databases, spreadsheets, programs and literature files are used whenever they meet Oversight Bureau inspection and QA analysis.

## **3. Assessment and Oversight**

### **3.1. Quality System Assessment and Response Actions**

Oversight Bureau field sampling and measurement techniques are continually undergoing review and modification. It is envisioned that all Oversight Bureau procedures will continue to evolve and to be refined. Techniques will never be considered “final,” but will always be examined for possible improvements. The findings of procedural evaluations should be shared and discussed with other Oversight Bureau field personnel, Project Leaders, and Staff Managers. Decisions will be made by Project Leaders and Staff Managers, with input from field staff, whether to continue with existing methods and techniques, switch to new methods and techniques or to use combinations of both. Any changes to procedures covered by this QAPP will be reflected by changes in the SOP/SAP documents.

Procedural changes may be made by staff during the field season with concurrence of the appropriate Staff Manager and Project Leaders, when the need arises, and subsequently will be documented in the next year’s QAPP. The collection of high-quality data is the most important consideration. All techniques and procedures used must be consistent with or yield results equal to or better than those techniques and procedures listed in or referenced by 40 CFR 136, the EPA publication for SW-846 methods, entitled *Test Methods for Evaluating Solid Waste, Physical/Chemical Methods*, or those methods published by EPA Office of Research and Development or Office of Water.

At the end of each field season QA results are validated by the Oversight Bureau Project Lead to determine variability and data usability. Problem areas will be identified through this process

and the QA Project Manager, the contract laboratory coordinator, and appropriate Project Leaders will work to take corrective actions. Since analytical methods are continuously becoming more sensitive, this communication process is vital and must be on-going.

It is important that all Oversight Bureau technical staff communicate throughout the entire survey process, from initial planning to final report publication. Various Oversight Bureau field personnel will accompany Project Leaders on sampling trips to ensure standardization of procedures among staff. At the beginning of each field sampling season, the Santa Fe office will ensure that the field offices are following standard procedures described in the SOP and project SAPs. Additional standardization efforts between the four offices will be made if procedures change significantly or if needed for some other reason. Staff from other offices and Santa Fe should conduct fieldwork together whenever possible. Strict adherence to operating procedures described in the SOPs and/or SAPs will ensure data collected by all four offices will be of comparable quality.

### **3.2. Reports to Management**

The Project Leader is responsible for keeping the Staff Manager, Bureau Chief, and QA Project Manager informed concerning the progress and problems or anomalies encountered during a project. The Staff Manager and Project Leaders prepare reports summarizing the status of all outstanding projects. These reports are distributed to the other sections and Bureaus in the NMED, the public, the Bureau Chief, USEPA Region 6 and DOE. Any QA problem noted by the Oversight Bureau staff during the year will be conveyed to the QA Project Manager. Oversight Bureau technical personnel, QA Project Manager and the Bureau Chief will determine corrective actions to be taken. Any adopted changes will be subsequently reflected as changes to this QAPP.

Project reports will be prepared for most water quality surveys completed by Oversight Bureau. The findings of these reports may eventually be incorporated into the Integrated §303(d)/§305(b) biennial report to Congress. Upon request, these project reports will also be posted in the “Library” and on the NMED Oversight Bureau web page at: [http://www.nmenv.state.nm.us/DOE\\_oversight](http://www.nmenv.state.nm.us/DOE_oversight), and copies are sent to interested state and federal agencies and members of the public.

### **3.3. Data Validation and Usability**

Project Leaders will rigorously review all storm water quality and NPDES data received from the laboratories using their best professional judgment and knowledge of facility operations and stream chemistry. Any anomalous results will be reported to the appropriate section at the contract laboratory for a full review of the QA results of the relevant run, consisting of spikes, duplicates, and concentration standards used to verify standard curves. The Project Leader may request that the sample be rerun or that a second sample be collected. The Project Leader will note and initial the results of this contact on the QA checklist (Appendix A).

For water quality surveys, the type of qualifier attached to certain data indicates how that data should be used in an assessment. For example, most of the laboratory qualifiers for both inorganic chemical data and organic chemical data indicate uncertainty in the reported concentration of the chemical, but not in its assigned identity. Therefore, these data may be used just as positive data with no qualifiers or codes. In general, data with qualifiers that indicate uncertainties in concentrations but not in identification may be used for assessments. All qualified data are considered unusable for compliance monitoring.

### **3.4. Data Review, Verification, and Validation**

#### **3.4.1. Ambient Water Quality Monitoring**

The data validation process, conducted for water quality data collected under the water quality surveys, is presented in Appendix B, Quality Assurance Criteria.

#### **3.4.2. Validation and Verification Methods**

Statistical criteria used by the contract laboratories for validating and expressing the variability of analytical results are the standard deviation, coefficient of variation, range, 95-percent confidence limits and control charts. Outliers are analytical results that fall outside of the limits of the control chart appropriate for the analysis being performed. If such a result is obtained, the analysis is “out of control.” Immediate action is then taken by the contract laboratory to determine the cause of the outlying result. The analyses are repeated after corrective action has been taken. Pentium-based personal computers running Microsoft Excel<sup>®</sup> and other statistical packages are used to calculate test results, generate calibration curves, perform precision and accuracy determinations, and update control charts.

The QA checklist serves as the data validation summary for data collected under the Oversight Bureau’s sampling program. Errors in electronic files received from the laboratories will be addressed as described in Appendix B and will be summarized on the “Result Verification Form” (Appendix A), which should be attached to the QA checklist and included in the survey file. This form serves as a record for the Project Leader, who will resolve any data quality issues with the contract laboratory. All correspondence should be documented and included in the project file.

#### **3.4.3. Reconciliation with User Requirements**

EPA Method 1631 for mercury (in addition to EPA Methods 1632, 1636, 1637, 1638, 1639, 1640) requires the collection of field blanks and the rejection of results for regulatory compliance purposes if contamination is demonstrated. If a permit requires the use of this method, such results would be qualified and considered unusable.

When any Oversight Bureau data do not comply with applicable QA requirements, the details of the limitations will be discussed in the assessment or inspection report. Oversight Bureau water

quality data not complying with applicable QA requirements will not be used for comparison with existing NPDES permit limits, or for development of NPDES permit limits for new or reissued permits.

All storm water and NPDES water quality data received from Oversight Bureau's contract laboratories will be rigorously reviewed by the Project Leader using best professional judgment and knowledge of facility operations and stream chemistry. Any anomalous results will be reported to the appropriate section at contract laboratory for a full review of the QA results of the relevant run, consisting of spikes, duplicates, and concentration standards used to verify standard curves. The Project Leader may request that the sample be rerun or that a second sample be collected. The Project Leader will note and initial the results of this contact on the QA checklist (Appendix A). For water quality surveys, the type of qualifier attached to certain data indicates how that data should be used in an assessment. For example, most of the laboratory qualifiers for both inorganic chemical data and organic chemical data indicate uncertainty in the reported concentration of the chemical, but not in its assigned identity. Therefore, these data may be used just as positive data with no qualifiers or codes. In general, data with qualifiers that indicate uncertainties in concentrations but not identification may be used for assessments. All qualified data are considered unusable for compliance monitoring unless not meeting holding times. Table 5 lists the data qualifiers used by the Bureau.

**Table 6. DOE Oversight Bureau Data Validation Codes**

LAB QUAL CODE	LAB QUALIFIER DESCRIPTION
UJ	(Inorganic) - The material was analyzed for, but was not detected. The associated value is an estimate and may be inaccurate or imprecise. (Organic) -The material was analyzed for, but was not detected. Quantitation limit is an estimated quantity.
BE	Low surrogate recovery; analyzed twice
BN	Ignites but does not sustain ignition
E	(Inorganic) Paragon- Reported value is estimated because of the presence of interference. GEL- Percent difference between the parent sample and its serial dilution's concentration exceeds 10%. (Organic) - Analyte concentration exceeded the upper level of detection.
UN	(Inorganic) - Compound was analyzed for, but was not detected. - Spiked sample recovery not within control limits.
UN*	(Inorganic) - Compound was analyzed for, but was not detected. - Spiked sample recovery not within control limits. - Duplicate Analysis not within control limits.
J*	(Inorganic) -The associated numerical value is an estimated quantity. - Duplicate Analysis not within control limits.
*	(Inorganic)- Duplicate analysis not within control limits. (Organic) - Spike recovery is equal to or outside the control criteria used. STL - Surrogate recovery is outside stated control limits.
+	(Inorganic) GEL- Correlation coefficient the Method of Standard Addition (MSA) is less than 0.095. Paragon- no meaning (Organic) - Duplicate Analysis (relative percent difference) not within control limits.
B	(Inorganic) - Reported value was obtained from a reading that was less than the Contract Required Detection Limit (CRDL) but greater than or equal to the Instrument Detection Limit (IDL). (Organic) - Analyte present in the blank and the sample.
J	(Inorganic) -The associated numerical value is an estimated quantity. (Organic) - The associated numerical value is an estimated quantity.

N	(Inorganic) - Spiked sample recovery not within control limits. (Organic) -Presumptive evidence based on a mass spectral library search to make a tentative identification of the analyte.
NJ	(Organic) -Analyte has been tentatively identified and the associated numerical value is estimated based upon 1:1 response factor to the nearest eluting internal standard
R	(Inorganic) -The data are not useable. (Organic) -The data are unusable (compound may or may not be present.) Re-sampling and reanalysis is necessary for verification.
U	(Inorganic) -The material was analyzed for, but was not detected above the level of the associated numeric value. The associated numerical value is either the sample quantitation limit or the sample detection limit. (Organic) -The material was analyzed for, but was not detected.
P	(Organic) - > 25% difference for detected concentrations between two columns. (Paragon) - LCS recovery within control limits.
JB	(Inorganic)-The associated numeric value is an estimated quantity. The reported value was obtained from a reading that was less the Contract Required Detection Limit.
EB	(Organic)--Analyte concentration exceeded the upper level of calibration range of the instrument. Analyte present in the blank and the sample.
U*	(Inorganic) - Compound was analyzed for, but was not detected. Duplicate analysis not within control limits.
D	(Organic) - Analytes analyzed at a secondary dilution. NMSSL - Spike recovery < 80% or > 120%.
JD	(Organic) - Estimated value. Analytes analyzed at a secondary dilution.
UE	(Inorganic) - Compound was analyzed for, but was not detected. Reported value is estimated because of the presence of interference.
B*N	(Inorganic) - Reported value < CRDL and > IDL. Duplicate Analysis not within control limits. Spiked sample recovery not within control limits.
N*	(Inorganic) - Spiked sample recovery not within control limits. Duplicate analysis not within control limits.
**	(Inorganic) and (Organic) GEL- Laboratory Control Sample recovery outside of acceptance limit.
B*	(Inorganic) - Reported value was obtained from a reading that was less than the Contract Required Detection Limit (CRDL) but greater than or equal to the Instrument Detection Limit (IDL). (Inorganic)- Duplicate analysis not within control limits.
JP	(Organic) - The associated numerical value is an estimated quantity. > 25% difference for detected concentrations between two columns.
X	Reported concentration is a false positive
BE*	(Inorganic) - Concatenation of B, E, and *.
BEN	(Inorganic) - Concatenation of B, E, and N.
EN	(Inorganic) - Concatenation of E and N.
UEN	(Inorganic) - Concatenation of U, E, and N.
Q	(Severn Trent) - Elevated reporting limit. The reporting limit is elevated due to high analyte levels.
LT	(Paragon) - Result is less than requested MDC and greater than sample specific MDC.
SQ	(Paragon) - Spectral interference prevents accurate quantitation.
Y2	(Paragon) - Chemical yield outside default limits
K	AXYS - Peak detected but did not meet quantification criteria
C	AXYS - Co-eluting congener. NMSSL - Spike recovery between 80% and 120%.
H	NMSSL - Sample analyzed in duplicate. GEL - Analytical holding time exceeded.
h	GEL- Sample preparation or preservation holding time exceeded.
UI	Denotes uncertain identification for gamma spectroscopy
NC	(Paragon) - RPD Not Calculated

#### 4. References

American Public Health Association, American Water Works Association, and Water Environment Federation. 1998. *Standard Methods for the Examination of Water and Wastewater*, 20<sup>th</sup> Edition.

Barbour, Michael T., Jeroen Gerritsen, Blaine D. Snyder, and James B. Stribling. 1999. Rapid Bioassessment Protocols for Use in Streams and Wadeable Rivers: Periphyton, Benthic Macroinvertebrates, and Fish. Second Edition. EPA 841/B-99/002. Office of Water, Washington, DC.

EPA 2001. *EPA Requirements for Quality Assurance Project Plans*, EPA QA/R-5. EPA/240/B-01/003. Office of Environmental Information, Washington, DC. March.

New Mexico Administrative Code (NMAC). 2002a. *State of New Mexico Standards for Interstate and Intrastate Streams*. 20.6.4. New Mexico Water Quality Control Commission. October 11.

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———. 2006. *Procedures for Assessing Standards Attainment for the Integrated CWA §303(d)/§305(b) Water Quality Monitoring and Assessment Report*. January 24, 2006

New Mexico Statutes Annotated. 1978. *New Mexico Water Quality Act*.

New Mexico Water Quality Control Commission (WQCC). 2003. *State of New Mexico Statewide Water Quality Management Plan*. Work Element 10: Determination of Compliance with Water Quality Standards for the Protection of Human Health Criteria.

———. 2006. *State of New Mexico Standards for Interstate and Intrastate Surface Waters*. (20.6.4 NMAC). February 16

## **Appendix A. Forms**

A.1. Quality Assurance Checklist, DOE Oversight Bureau

Study Name \_\_\_\_\_

Date(s) of Sampling Event(s) \_\_\_\_\_

Study Lead \_\_\_\_\_

**Checklist of Items Reviewed**

1. *Presence of Identical Records or Possible Outliers*-Export data: Sort records by parameter, location, date ads result; Scan through data (conduct qualitative review) for identical records and potential outliers. If value appears to be an outlier, conduct the Q-test in accordance with QAPP Provide database manager with list of identical records ( i.e. .same RID, analyte, date/time result)

Action Required

No Action Required

2. *Field Duplicates within Control Limits*-Following this sequence of events in the DOE/OB database will produce the relative percent difference (RPD) report for field duplicates: From the opening screen, "Review Data," "Select Study," "Reports to Evaluate Data Quality," "Duplicate comparison."

Action Required

No Action Required

3. *Total Metals versus Dissolved Metals*- Following this sequence of events in the Oversight Bureau database will produce the RPD between total and dissolved results when dissolved is greater than total: From the opening screen, Review Data," "Select Study," "Reports to Evaluate Data Quality," "Diss-Tot Metals Comparison"

Action Required

No Action Required

**QUALITY ASSURANCE SUMMARY:**

Based on the quality assurance review, data for the above samples are:

Acceptable for use

Acceptable as qualified

Unacceptable for use

Is action required on any QA items?

Yes

No

Explain:

Initial QA Reviewer (Study Lead): \_\_\_\_\_ Date: \_\_\_\_\_

Database Editor: \_\_\_\_\_ Date: \_\_\_\_\_

QA Project Manager Reviewer \_\_\_\_\_ Date \_\_\_\_\_



A 3. Sample Chain of Custody Form (COC)

Laboratory Used: Paragon Analytics, Inc.		Chain of Custody		Date:	Page: __1__ of __1__													
PAI Project Manager: Lance Steere		ANALYSIS REQUEST																
<b>Laboratory Address:</b> Paragon Analytics, Inc. 225 Commerce Drive Fort Collins, Colorado 80524 (800) 443-1511 Fax (970) 490-1522		<b>Authorized by/ Attn: Project leader</b> CLIENT: NMED DOE OB ADDRESS: 2905 Rodeo park Drive East, Building 1 CITY: Santa Fe; STATE: New Mexico; ZIP: 87506 (505) 428-2560 Fax (505)428-2567																
SAMPLE ID	DATE	TIME	MATRIX	LAB ID	Suspended Sediment Concentration (Line # 90-940)	Total TAL Metals plus total U (Line Item #34b)	Acid digestion for total metals (CP) (Line Item 40)	Dissolved TAL Metals plus total U (Line Item 34b)	Acid digestion for total metals (CP) (Line Item 40)	Total Gross Alpha/Beta (Line Item 133)	Isotopic Americium (Line Item 110)	Isotopic Plutonium (Line Item 112)	Isotopic Uranium (Line Item 113)	Strontium 89/90 (Line Item 137)	Total <sup>235</sup> uranium? Gamma Spec Low Level (Line Item 129a)	\$1,275.00	NUMBER OF CONTAINERS	Project Cost
					40	200	15	200	15	55	165	155	170	105				\$0.00
						\$0.00	\$0.00	\$0.00	\$0.00	\$0.00	\$0.00	\$0.00	\$0.00	\$0.00	\$0.00			\$0.00
PROJECT INFORMATION					SAMPLE RECEIPT					SAMPLES SENT TO			RELINQUISHED BY: 2					
PROJECT #:		Total Number of Containers			0								Signature:					
PROJ. NAME:		Chain of Custody Seals											Printed Name:					
QC LEVEL: STD. IV		Received Intact?																
QC REQUIRED: MS MSD BLANK		Received Good Cond./Cold																
TAT: STANDARD		LAB NUMBER:																
NOTES										RECEIVED BY: 2								
DUE DATE:													Signature:					
RUSH SURCHARGE:																		
CLIENT DISCOUNT:													Printed Name:					
SPECIAL CERTIFICATION:																		
REQUIRED: YES NO													Company:					

A.4. DOE Oversight Sampling Stations Form

## DOE Oversight Sampling Stations Form

Use this form to add new sample stations to the DOE Oversight database.  
(Print out and fill in or click inside boxes to enter data)

Required items:

Water body Segment (Assessment Unit):

Station Description:  
(Location, access,  
Etc.)

**Required Location Data:**

**Latitude:**  
(31 to 37 degrees)

**Location Datum:**  
(Check one)

NAD 83

WGS 84

**Longitude:**  
(-103 to 109 degrees):

NAD 27

Other

**Elevation (Feet):**

Unknown

**Location Method:**  
(Check one)

G1-(GPS)

(Interpolation Map)

UN-(Unknown)

OT-(Other)

Additional Information: (Optional)

Old Sampling stations ID:

Watershed Size (square miles):

Driving Directions:

Site Rationale:

New Sample Station ID:

(This ID will be assigned by the database administrator. After the station has been entered in the database this form will be returned to you with this ID field filled in. Please use this ID in all future references to this station.)

## **Appendix B. Quality Assurance Criteria**

**(Note: For Laboratory Specific QAPP(s), see Oversight Bureau's QAPP Library)**

## LIST OF ABBREVIATIONS

AMU	Atomic Mass Unit
CFR	Code of Federal Regulations
DOE	Department of Energy
GC/MS	Gas Chromatography/Mass Spectrometry
ICP-MS	Inductively Couple Plasma-Mass Spectrometry
IDL	Instrument Detection Limit
LC	Liquid Chromatology
MDL	Method Detection Limit
mg/L	Milligrams per Liter
ML	Minimum Quantitation Level
pCi/L	Picocuries per Liter
pCi/μg	Picocuries per microgram
QA	Quality Assurance
QAPO	Quality Assurance Project Officer
QAPP	Quality Assurance Project Plan
QC	Quality Control
RPD	Relative Percent Difference
SWQB	Surface Water Quality Bureau
USEPA	U.S. Environmental Protection Agency
VOC	Volatile Organic Compound
μg/mg	Micrograms per Milligram

## B1.0. Introduction

This Appendix provides a set of criteria that comprises the means by which data generated by various analytical and field methods are deemed acceptable for reporting. Laboratory performance is evaluated through analysis of holding times, calibration procedures, blanks, and laboratory duplicates and spikes. The level of quality associated with field procedures is evaluated through analysis of field replicate samples (i.e., split samples) and blanks.

## B2.0. Documentation Procedures

All data results for ambient stream sampling, storm water and NPDES sampling are documented by the Oversight Bureau's contract laboratories and kept on file for 10 years. Results of the Oversight Bureau's data validation process are documented through a Quality Assurance (QA) checklist and report.

The Oversight Bureau's contract laboratories have developed a QA program designed to control and monitor the quality of data generated. In addition, this appendix describes a data validation process to evaluate the quality of data used for assessment purposes and for the Oversight Bureau's contract laboratories database upload. When quality control (QC) deficiencies are identified through the data review process, Oversight Bureau's contract laboratories document the deficiencies by assigning data qualifiers to sample results.

## B3.0. Analytical Methods and Quantitation Limits

All methods of sample collection, preservation, and analysis used in determining water quality, as a part of this QAPP, shall be in accordance with the following test procedures:

(1) "Guidelines establishing test procedures for the analysis of pollutants under the Clean Water Act," 40 CFR Part 136 or any test procedure approved or accepted by EPA using procedures provided in 40 CFR Parts 136.3(d), 136.4, and 136.5.

(2) *Standard Methods for the Examination of Water and Wastewater*, latest edition, American Public Health Association,

(3) *Methods for Chemical Analysis of Water and Waste*, and other methods published by EPA Office of Research and Development or Office of Water,

(4) *Techniques of Water Resource Investigations* of the U.S. Geological Survey,

(5) *Annual Book of ASTM Standards*. Volumes 11.01 and 11.02, Water (1) and (II), latest edition, ASTM International,

(6) Federal Register, latest methods published for monitoring pursuant to Resource Conservation and Recovery Act regulations,

(7) *National Handbook of Recommended Methods for Water-Data Acquisition*, latest edition, prepared cooperatively by agencies of the United States Government under the sponsorship of the U.S. Geological Survey,

(8) Federal Register, latest methods published for monitoring pursuant to the Safe Drinking Water Act regulations, and/or

(9) Other recognized scientific journals or organizations that describe performance based, defensible, new and currently evolving analytical techniques.

In order to determine an exceedance of the water quality criterion for gross alpha, the value reported by Oversight Bureau's contract laboratories for "gross alpha (U natural reference)" is used. If the result exceeds the applicable criterion (15 picocuries per liter [pCi/L]), total uranium is subtracted from the total result for gross alpha. To do this, the reported total uranium value (if mass spectrometry is used) must first be converted to pCi/L. If the value is reported in µg/L, the value must be multiplied by 0.67 picocuries per microgram (pCi/µg) to convert from µg/L to pCi/L. If the value is reported in mg/L, the value must be multiplied by 0.67 pCi/µg and 1,000 micrograms per milligram (µg /mg) to convert from milligrams per liter (mg/L) to pCi/L. If uranium alpha spectrometry is used, sum the values for U-234, U-235, and U-238. If there is data available on any source, special, or byproduct material then this should be also subtracted from the adjusted gross alpha value.

#### MDL Determination:

The minimum detection level (MDL) used for surface water monitoring and compliance data is the concentration value that corresponds to an instrument signal/noise ratio in the range of 2.5 to 5, the concentration equivalent of three times the standard deviation of replicate instrumental measurements of the analyte in reagent water, that region of the standard curve where there is a significant change in sensitivity (i.e., a break in the slope of the standard curve), or the instrumental limitations.

If the measurements indicate the sample is in the correct range, the MDL is computed as follows:

$$MDL = t_{(n-1, 1-\alpha=0.99)}$$

Where,

$t_{(n-1, 1-\alpha=0.99)}$  = the students' t-value appropriate for a 99 percent confidence level and a standard deviation estimate with n-1 degrees of freedom (corresponds to 3.143 for seven replicates)

The quantitation limit used for surface water monitoring and compliance data is the minimum level of quantitation (ML), which is defined by USEPA (2003) as "*the lowest level at which the entire analytical system must give a recognizable signal and acceptable calibration point for the analyte.*" The ML is considered a compliance evaluation threshold and is estimated as 10 times the same standard deviation of the seven replicates used to estimate the MDL, or 3.18 times the

MDL. The ML is rounded to the whole number nearest to (1, 2, or 5) times  $10^n$  where n is an integer (USEPA 2003).

#### MDC Determination:

The MDC is a conversion in radiometric measurements used to estimate the detection limit using a simple statistical analysis. Unless otherwise specified in documentation of specific analytical method, instrumentation software, or client requirements, the MDC shall be estimated as:

$$\text{MDC} = \frac{(4.65 \times \sigma_b)}{T * K} + 2.73$$

MDC = Minimum Detection Concentration

$\Sigma_b$  = Standard deviation of the measurement background

T = Sample count time

K = Factor for incorporating efficiency, abundance, aliquot yield, in-growth and decay, and activity conversion factors.

#### B4.0. Holding Times

Oversight Bureau's contract laboratories water quality data not meeting required holding times specified in 40 CFR 136 or other USEPA or DOE accepted methods (Table B.1), will still be entered. Extreme violations of holding times may result in the rejection of analytical results based on professional judgment. Holding times are evaluated at the time of laboratory analysis. Samples that were analyzed outside the prescribed holding time may be assessed as estimates.

#### B5.0. Quality Control Criteria

The following subsections describe the criteria examined by the Oversight Bureau's contract laboratories to control and monitor the quality of data generated under the Oversight Bureau's water quality monitoring program.

##### B5.1. Field Replicates

QA replicates (i.e., split samples) for all chemical and microbiological parameters are collected at one or more of the normal sampling sites at the frequencies specified in Table B.2. Replicate samples are submitted to Oversight Bureau's contract laboratories as blind samples (i.e., the location and other information given on the label does not reveal that the sample is a replicate). The analytical results of replicate sampling are entered into the Oversight Bureau's in-house water quality database and identified as QA replicates.

The relative percent difference (RPD) between field replicate results is estimated to quantify the level of precision associated with the entire sample collection and measurement process. Field duplicates should not be used as a measure of laboratory performance. A comparison of the RPD between replicates is conducted during the data validation process. After validation is completed, qualifiers are assigned to the data points that are outside control limits. To the data user, qualifiers indicate that the analyte concentrations may be unusable or estimated because of QC deficiencies that reduce confidence in the results. If precision is poor (i.e., outside control limits), positive results are qualified as estimated (i.e., assigned a validation code of, which indicates the results are estimated based on RPDs outside control limits).

Control limits on replicate RPDs are based on information from the U.S. Fish and Wildlife Service, Patuxent Analytical Control Facility, Laurel, Maryland and are presented in Table B.3.

#### B5.2. Dissolved Metals Results Greater than Totals

Relative percent differences between dissolved metals concentrations greater than the associated total metals concentrations are calculated in Step 2d of the data validation process described here. The control limits for RPDs are based on limits defined by USGS (1996) to identify chemicals that do not vary appreciably in concentration. The control limit for dissolved metals results greater than total results is 20 percent if the concentrations are both greater than 10 times the method detection limit. If either concentration is less than 10 times the method detection limit, the control limit is 50 percent (USGS 1996).

#### B5.3. Field Equipment, and Trip Blanks

The use of blanks is an important part of the continuing effort to improve the quality of the resultant data by improving the collection techniques. Table B.2 lists the collection frequencies for routine ambient water quality samples. A blank is a water sample that is intended to be free of the analytes of interest. Blank samples are analyzed to test for contamination of environmental samples by the analytes of interest during any stage of sample collection, processing, and analysis. A field blank is prepared in the field and used to demonstrate that: Equipment has been adequately cleaned to remove any pre-existing contamination, and Sample collection and processing have not resulted in contamination.

In addition, because the field blank is treated like an environmental sample at the laboratory, it includes potential contamination introduced during laboratory handling and analysis. To prepare a field blank, an aliquot of reagent water is placed in a clean sample container during the field trip. Field blanks are treated as regular samples in all respects, including contact with the sampling devices and exposure to sampling-station conditions, storage, preservation and filtration, if applicable. The purpose of these blanks is to determine if any of these conditions or processes have caused sample contamination, and, if so, to what extent.

Equipment blanks are a subset of field blanks used to demonstrate that sample-collection and sample-processing equipment are not introducing contamination. Equipment blanks can be

prepared using individual pieces of collection and processing equipment. Typically, equipment blanks are only prepared to assure non-contamination of samples during the filtration process.

A trip blank is a sample of analyte-free water that is prepared in the laboratory. It is transported, unopened, to the field with other sample containers and is shipped to the laboratory for analysis with the collected samples. Trip blanks are used to identify contamination that might occur during sample transport and analysis rather than because of sample collection and processing in the field. Trip blanks are normally prepared only for volatile organic chemicals (VOCs).

An analysis of blank data is conducted during the data validation process. After validation is completed, qualifiers are assigned to the data points that may have been contaminated. To the data user, qualifiers indicate that chemicals were detected in the associated blank, and the concentrations in the sample may be potentially contaminated. If a chemical is detected in a blank sample, analytical results (for the same chemical(s) detected in the blank) from the monitoring samples collected during the same sample event as the contaminated blank, will be assigned a validation code.

#### B5.4. Laboratory Matrix Spike and Matrix Spike Duplicate

A matrix spike, also known as a spike, is the addition of an aliquot of method analyte(s) of known concentration to a solution. The results are used to assess the analysts' ability to spike samples, to evaluate any loss of method analyte(s) through the digestion procedure and assess any matrix effect on the quantitated analyte. The spike is added to both a volume of reagent water and carried through the entire digestion process (called a Reagent Blank Spike), and to a control solution which has a concentration of method analytes at or near the detection limit (called the Low Control Spike or Laboratory Fortified Blank). Control limits on the matrix spike and matrix spike duplicate are provided in Table B.4.

#### B5.5. Surrogate and Internal Standards

Surrogates and internal standards are compounds that have properties similar to the target analyte(s) that a particular analytical method is designed to identify and measure. The compounds are not expected to be present in an environmental field sample and should not interfere with the identification or quantification of the target analytes. They are added to each sample aliquot in known amounts before extraction and are measured with the same procedures used to measure other sample components. By demonstrating that the compounds can be recovered from the sample matrix with reasonable efficiency, they perform a QC function on the ability of the laboratory to execute the analytical method with reasonable proficiency. If the compound is not recovered, an analyte of concern also may not be recovered. The Air & Heavy Metals Sections of Oversight Bureau's contract laboratories use internal standards to monitor method performance, while the Organic Chemistry Sections of Oversight Bureau's contract laboratories uses surrogate spikes.

The Organic Chemistry Sections at the Oversight Bureau's contract laboratories uses surrogates to measure extraction efficiency. The compound(s) is spiked into the sample before the

extraction, and then measured in the resulting extract to evaluate the robustness (efficiency) and/or the analyst competency of the extraction procedure. Samples with surrogate recoveries outside control limits are never adjusted to compensate for the poor recovery. The control limits on surrogate recoveries are presented in Table B.5.

In the Air & Heavy Metals Sections of Oversight Bureau's contract laboratories, five to six elements are added to each sample that undergoes Inductively Couple Plasma-Mass Spectrometry (ICP-MS) analysis immediately before analysis. If a sample is digested, the internal standards are not added until sometime after the digestion. The instrument software uses the internal standard recoveries to adjust the analyte concentrations as the internal standards change (if they change). The purpose is to compensate analyte values for instrument drift over time and/or difficult matrices. Several analytes are "grouped" to a given internal standard, according to mass. The internal standards cover the entire mass spectrum (6-210 atomic mass units [AMU]).

According to USEPA Method 200.8, data that have internal standard recoveries greater than 125% or less than 60% are not usable (Table B.5). When this happens, the only course of action is to dilute the sample. When the analyte is positively detected at the dilution, it has no practical effect on the sample. That is, the value and the dilution factor are reported with no qualifier. When the analyte is less than detection limit, the detection limit is multiplied by the dilution factor and the results are assigned a data qualifier.

#### B5.6. Laboratory Method Blank

A reagent blank consists of a sample of laboratory prepared water treated with an appropriate amount of one of the preservatives used during the sampling effort. Reagent blanks assure non-contamination of samples by preservatives. In the absence of a suspected contamination event, one reagent blank per preservative type per sampling effort is adequate. If contamination is suspected to have occurred, e.g. blowing dust, further reagent blanks may be prepared. Oversight Bureau's contract laboratory assigns a data qualifier to sample results with associated laboratory blank contamination.

#### B6.0. Completeness

Completeness is a measure of the amount of valid data obtained from a measurement system compared to the amount expected under normal conditions. For example, data may become unusable due to laboratory error, holding time violations, or errors in field collection procedures (e.g., incorrect sample preservation). Completeness of Oversight Bureau project data will be determined by comparing all valid data obtained for a study with the number of results expected. To be considered complete, the data set must contain all QC check analyses verifying precision and accuracy for the analytical protocol. Completeness is then determined by the following formula:

$$\% \text{ Completeness} = \frac{\text{Number of Valid Measurements}}{\text{Total Number of Measurements Planned}} \times 100$$

The QA Director at the Oversight Bureau's contract laboratories is responsible for establishing measurement criteria for precision and accuracy of the analytical procedures used in projects where water quality data are collected. Because seasonal variability is a concern in water quality monitoring programs, it is important that a complete analytical record be obtained during each study. Therefore, the measurement quality objective for completeness is set at 90 percent.

#### B7.0. Corrective Actions

There are various degrees of personnel involvement in corrective activities at the Oversight Bureau's contract laboratories, depending on the seriousness or potential consequences of the problem. These range from problems which affect only a single data batch, usually evidenced by daily QC/QA, to long term undetected problems which require more intervention by the supervisor of the section, the Chemistry Laboratory Chief, or QA Officer Project Manager (QAPM). A good measure of the efficiency of a lab's QC/QA program is how often problems require Bureau Chief or QAPM intervention and this occurs infrequently at Oversight Bureau's contract laboratories.

At the Oversight Bureau's contract laboratories, most problems are detected early because of the high percentage of QC that is done for each sample and the multiple reviewing and crosschecking that takes place in the labs. In addition to these procedures, blind sampling activities implemented by the QAPM aid in monitoring quality of daily lab data and early problem detection.

In the event that a QC/QA issue requires high-level action, communication is immediately set up between lab personnel, supervisor(s) involved, the Chemistry Laboratory Chief, the QAPM and any field personnel directly involved. These interactions generally take place at the regularly scheduled chemistry supervisor meetings, unless the urgency of the problem requires more immediate action. One instance, which requires upper level management intervention, is a missed proficiency. When this occurs, the QAPM, together with the supervisor of the section and the Chemistry Laboratory Chief investigate the problem to determine the cause. The results of the investigation and actions taken to remedy the problem are then documented and submitted to the QC Office.

#### B8.0. References

U.S. Environmental Protection Agency (USEPA). 2003. *Technical Support Document for the Assessment of Detection and Quantitation Approaches*. EPA-821-R-03-005. Office of Water, Washington, DC. February.

U.S. Geological Survey (USGS). 1996. *Quality Assurance Project Plan for the Data Collection Activities of the Sacramento River Metals Transport Study, Appendix 1*. Prepared by the USGS for the Sacramento Regional County Sanitation District. November.

## B9.0. Analytical Lab Contractors

Paragon Analytics  
225 Commerce Dr.  
Fort Collins, CO 80524  
800.443.1511  
970.490.1511  
Lance Steere – Project Manager

Assagai Analytical Laboratories  
4301 Masthead NM  
Albuquerque, New Mexico 87109  
505.345.7259  
Contact: John Morris

Transwest Geochem/Columbia Analytical Services, Inc.  
3725 E. Atlanta Ave  
Phoenix, AZ 85040  
602.437.0330  
800.927.5183  
Contact: Beth Proffitt

**Table B.1 Analytical Methods and Holding Times**

Please see specific Laboratory QAPP in the DOE Oversight Bureau’s QAPP Library for Analytical Methods and holding times.

Below is an example of what can be found.

Sample Type	Extraction/ Cleanup	Sample Holding Time	Analytical Method	
<b>Standard Laboratory Methods</b>				
<b>Surface Water<sup>(1)</sup></b>	Volatile Organics		14 days	<b>USEPA 8260B (1996):</b> <i>Volatile Organic Compounds by Gas Chromatography/Mass Spectrometry (GC/MS)</i>
	Semivolatile Organics		7 days	<b>USEPA 8270D (1998):</b> <i>Determination Semivolatile Organic Compounds by Gas Chromatography/Mass Spectrometry (GC/MS)</i>
	Pesticides/Herbicides/PCBs		14 days	<b>USEPA 508.1 (1995):</b> <i>Determination of Chlorinated Pesticides, Herbicides, and Organohalides by Liquid-Solid Extraction and Electron Capture Gas Chromatography;</i>
			7 days	<b>USEPA 608 (current):</b> <i>Organochlorine Pesticides and PCBs via GC with Electron Capture Detector (ECD);</i>
			7 days	<b>USEPA 8081B (2000):</b> <i>Analysis of Organochlorine Pesticides by GC-ECD</i>
	Polychlorinated Biphenyls		12 months	<b>USEPA 1668 Revision A (1999)</b> Chlorinated Biphenyl Congeners in Water, Soil, Sediment, and Tissue by HRGC/HRMS
	Dioxin/Furan		12 months	<b>USEPA 1613 (1994):</b> <i>Tetra- through Octa-Chlorinated Dioxins and Furans by Isotope Dilution HRGC/HRMS</i>
	Metals		6 months	<b>USEPA 200.7 (1994):</b> <i>Determination of Metals and Trace Elements in Water and Wastes by Inductively Coupled Plasma-Atomic Emission Spectrometry;</i>
			6 months (Hg is not analyzed by ICP-MS)	<b>USEPA 200.8 (1994):</b> <i>Determination of Trace Elements in Waters by Inductively Coupled Plasma - Mass Spectrometry;</i>
			6 months	<b>USEPA 202.1 (1978):</b> <i>Aluminum (Atomic Absorption, Direct Aspiration);</i>
		6 months	<b>USEPA 206.2 (1978):</b> <i>Arsenic (Atomic Absorption, Furnace Technique);</i>	

**Table B.1 Analytical Methods and Holding Times**

Please see specific Laboratory QAPP in the DOE Oversight Bureau’s QAPP Library for Analytical Methods and holding times.

Below is an example of what can be found.

Sample Type	Extraction/ Cleanup	Sample Holding Time	Analytical Method
<b>Standard Laboratory Methods</b>			
		6 months	<b>USEPA 213.2 (1978): Cadmium</b> (Atomic Absorption, Furnace Technique);
		6 months	<b>USEPA 220.1 (1978): Copper</b> (Atomic Absorption, Direct Aspiration);
		6 months	<b>USEPA 236.1 (1978): Iron</b> (Atomic Absorption, Direct Aspiration);
		6 months	<b>USEPA 239.2 (1978): Lead</b> (Atomic Absorption, Furnace Technique);
		28 days	<b>USEPA 245.1 (1994): Mercury</b> (Manual Cold Vapor AA Technique);
		6 months	<b>USEPA 270.2 (1978): Selenium</b> (Atomic Absorption, Furnace Technique)
Major Ions/Nutrients		7 days	<b>USEPA 160.1 (1971): Residue, Filterable</b> (Gravimetric, Dried at 180 °C);
		7 days	<b>USEPA 160.2 (1971): Residue, Non-Filterable</b> (Gravimetric, Dried at 103-105 °C);
		48 Hours (NO <sub>2</sub> -N, NO <sub>3</sub> -N, Ortho-P)	<b>USEPA 300.0 (1993): Determination of Inorganic Anions by Ion Chromatography;</b>
		14 days	<b>USEPA 310.1 (1978): Alkalinity</b> (Titrimetric, pH 4.5);
		28 days	<b>USEPA 340.2 (1974): Fluoride</b> (Potentiometric, Ion Selective Electrode);
		28 days	<b>USEPA 350.1 (1993): Nitrogen, Ammonia</b> (Colorimetric, Automated Phenate);
		28 days	<b>USEPA 351.2 (1978): Nitrogen, Kjeldahl Total</b> (Colorimetric, Semi-Automated Block Digester, AAI);

**Table B.1 Analytical Methods and Holding Times**

Please see specific Laboratory QAPP in the DOE Oversight Bureau's QAPP Library for Analytical Methods and holding times.

Below is an example of what can be found.

Sample Type	Extraction/ Cleanup	Sample Holding Time	Analytical Method
<b>Standard Laboratory Methods</b>			
		28 Days (NO <sub>2</sub> <sup>-</sup> + NO <sub>3</sub> <sup>-</sup> ); 48 hours (NO <sub>2</sub> <sup>-</sup> ); 48 hours (NO <sub>3</sub> <sup>-</sup> )	<b>USEPA 353.2 (1993):</b> Nitrogen, Nitrate-Nitrite (Colorimetric, Automated, Cadmium Reduction);
		48 hours (ortho-P, dissolved)	<b>USEPA 365.1 (1993):</b> Phosphorus, All Forms (Colorimetric, Automated, Ascorbic Acid);
		28 days (total-P)	<b>USEPA 365.4 (1974):</b> Phosphorus, Total (Colorimetric, Automated, Block Digester AA II);
		28 days	<b>USEPA 415.1 (1974):</b> Organic Carbon, Total (Combustion or Oxidation)
Cyanide, free		14 days	<b>SM 4500-CN F (20<sup>th</sup> Ed.):</b>
Radionuclides	N/A	Unspecified but taken to be 6 months	<b>USEPA 900 (1980):</b> Gross Alpha and Gross Beta Radioactivity in Drinking Water;
	N/A	Half-life of the shortest nuclide of interest when possible; else ASAP up to 10 half-lives	<b>USEPA 901.1 (1980):</b> Gamma Emitting Radionuclides;
Radionuclides	Pyrosulfate fusion if turbid	Unspecified, but taken to be 6 months	<b>USEPA 903.1 (1980):</b> Radium-226 in Drinking Water (Radon Emanation Technique);
	Pyrosulfate fusion if turbid	Unspecified, but taken to be 6 months	<b>USEPA 904.0 (1980):</b> Radium 228 using Radiochemical Methodology;
	Pyrosulfate fusion if turbid	Unspecified, but taken to be 6 months	Literature for U-234/8, Pu-238/9/40, and/or Am-241. <b>Lieberman, R. and A.A. Moghissi (1968),</b> Coprecipitation Technique for Alpha Spectroscopic Determination of Uranium, Thorium, and Plutonium, Health Phy. 15, 359-362;
		NR	<b>Sill, C.W. (1969),</b> Separation and Radiochemical Determination of Uranium and the Transuranium Elements Using Barium Sulfate, Health Phy. 17, 89-107;
		NR	<b>Sill, C.W. (1974),</b> Purification of Radioactive Tracers for Use In High

**Table B.1 Analytical Methods and Holding Times**

Please see specific Laboratory QAPP in the DOE Oversight Bureau's QAPP Library for Analytical Methods and holding times.

Below is an example of what can be found.

Sample Type	Extraction/ Cleanup	Sample Holding Time	Analytical Method
<b>Standard Laboratory Methods</b>			
			<i>Sensitivity Alpha Spectrometry</i> , Anal. Chem. 46, 1426-1431;
		NR	<b>Sill, C.W. and R.L. Williams (1981)</b> , <i>Preparation of Actinides for Alpha Spectrometry without Electrodeposition</i> , Anal. Chem. 53, 412-415
		NR	<b>Talvitie, N.A. (1971)</b> , <i>Radiochemical Determination of Plutonium in Environmental and Biological Samples by Ion Exchange</i> , Anal. Chem., 43, 1827-1830.
Perchlorate		28 days	<b>USEPA Method 314</b> Ion chromatography
		28 days	<b>USEPA 8321A Modified</b> LC/MS/MS
Bacteria		8 hours	<b>USEPA 1103.1 (2000)</b> : <i>Test method for Escherichia coli and enterococci in water by the membrane-filter procedure</i> ;
		8 hours	<b>SM 9222D (20<sup>th</sup> Ed.)</b> : <i>Membrane Filter Technique for Members of the Coliform Group</i>
Pharmaceuticals		Extracted within 24 hours	(Modified) <b>Barber, L.B., Brown, G.K., and Zaugg, S.D., (2000)</b> , <i>Potential endocrine disrupting organic chemicals in treated municipal wastewater and river water</i> : In Analysis of Environmental Endocrine Disruptors; Keith, L.H., Jones-Lepp, T.L., and Needham, L.L., eds.; ACS Symposium Series 747; American Chemical Society: Washington D.C., p. 97-123.

Notes:

<sup>(1)</sup> This table provides analytical methods used by Oversight Bureau's contract laboratories for the analysis of surface water. Sediment samples are currently analyzed by Oversight Bureau's contract laboratories for organic compounds using USEPA Methods 8270 (semivolatile organics, with holding time of 14 days) and 608 (pesticides/herbicides with holding time of 7 days). Sediment samples are analyzed for radionuclides by pyrosulfate fusion, using a dissolution

extraction (holding time is unspecified). Currently, Oversight Bureau's contract laboratories have not established methods for sediment analyses of nutrients.

N/A = Not applicable

NR = Not reported

**Table B.2 Collection Frequencies for Routine Ambient Water Quality Samples**

Constituent or Group	Number of quality control samples per total number of environmental samples at all surface stations each year			
	Field Blanks	Trip Blanks	Equipment Blanks <sup>(1)</sup>	Replicates (splits) <sup>(2)</sup>
Metals, dissolved	1 in 10 samples <sup>1</sup>	—	1 per trip	1 in 10 samples
Metals, total	—	—	—	1 in 10 samples
Anions/Cations	1 in 30 samples	—	—	1 in 10 samples
Nutrients	—	—	—	1 in 10 samples
Pesticides	—	—	—	1 in 20 samples
Volatile organic compounds	1 in 10 samples	1 in 20 samples	—	1 in 10 samples
Fecal coliform and <i>E. coli</i>	—	—	—	1 in 10 samples

<sup>(1)</sup> Equipment blanks should be subjected to the same conditions as the original sample.

<sup>(2)</sup> The principal investigator should choose sampling locations where the results are expected to be above the minimum quantitation limit; nondetect information will not provide the requisite information to estimate the magnitude of variation of the sample.

**Table B.3 Control Limits on Field Replicate RPDs**

Analyte Concentration <sup>(1)</sup> (multiples of method detection limit)	Maximum Acceptable RPD <sup>(2)</sup>
0 - 2	200%
>2 - 10	20%
> 10	10%

Notes:

<sup>(1)</sup> If each result falls into a different category (i.e., one result is 2 times the MDL and one is 5 times the MDL), use the larger control limit.

<sup>(2)</sup> Control limits based on information from the U.S. Fish and Wildlife Service, Patuxent Analytical Control Facility, Laurel, Maryland.

**Table B.4 Matrix Spike Recovery and Duplicate Control Limits**

Analytical Methods	Matrix Spike Compound	Recovery Control Limits for SW (%)	Duplicate Control Limits for SW (%)
<b>Metals:</b>			
USEPA 200.7	See USEPA method	100 ± 20%	10%
USEPA 200.8	See USEPA method	100 ± 20%	10%
USEPA 200.9	See USEPA method	100 ± 20%	10%
USEPA 202.1	See USEPA method	100 ± 20%	10%
USEPA 206.2	See USEPA method	100 ± 20%	10%
USEPA 213.2	See USEPA method	100 ± 20%	10%
USEPA 220.1	See USEPA method	100 ± 20%	10%
USEPA 236.1	See USEPA method	100 ± 20%	10%
USEPA 239.2	See USEPA method	100 ± 20%	10%
USEPA 245.1	See USEPA method	100 ± 20%	10%
USEPA 270.2	See USEPA method	100 ± 20%	10%
<b>Major Ions/Nutrients:</b>			
USEPA 160.1	See USEPA method	100 ± 20%	100 ± 30% <sup>(1)</sup>
USEPA 160.2	See USEPA method	100 ± 20%	
USEPA 300.0	See USEPA method	100 ± 20%	
USEPA 310.1	See USEPA method	100 ± 20%	
USEPA 340.2	See USEPA method	100 ± 20%	
USEPA 350.1	See USEPA method	100 ± 20%	
USEPA 351.2	See USEPA method	100 ± 20%	
USEPA 353.2	See USEPA method	100 ± 20%	
USEPA 365.1	See USEPA method	100 ± 20%	
USEPA 365.4	See USEPA method	100 ± 20%	
USEPA 415.1	See USEPA method	100 ± 20%	
SM 4500-CN-E	See USEPA method	100 ± 20%	
<b>Volatile Organics:</b>			
USEPA 8260	See USEPA method	100 ± 20%	20%
<b>Semivolatile Organics:</b>			
USEPA 8270	See USEPA method	± 2 SD	20%
<b>Pesticides/Herbicides/PCBs:</b>			
USEPA 508.1	See USEPA method	100 ± 30%	— <sup>(2)</sup>
USEPA 608	See USEPA method	Varies	30%
USEPA 8081A	See USEPA method	100 ± 30% <sup>(3)</sup>	30%

**Table B.4 Matrix Spike Recovery and Duplicate Control Limits**

Analytical Methods	Matrix Spike Compound	Recovery Control Limits for SW (%)	Duplicate Control Limits for SW (%)
<b>N-methylcarbamoylozimes/ates:</b>			
USEPA 531.1	See USEPA method	100 ± 30%	— <sup>(2)</sup>
<b>Glyphosate:</b>			
USEPA 547	See USEPA method	100 ± 30%	±30%
<b>Radionuclides:</b>			
USEPA 900	Gross α: Am-241 or U-nat Gross β: Sr/Y-90 or Cs-137 Both to pseudomatrix	+/- 3SD with warning for ± 2SD to ± 3SD ± 3SD with warning for ± 2SD to ± 3SD	± 3SD with warning for ± 2SD to ± 3SD ± 3SD with warning for ± 2SD to ± 3SD
USEPA 901.1	N/A	N/A	N/A
USEPA 903.1	Radium-226	20 %	15 %
USEPA 904.0	Radium-228	± 3SD with warning for ± 2SD to ± 3SD	± 3SD with warning for ± 2SD to ± 3SD
<b>Pharmaceuticals</b>			
(Modified) Barber et al. 2000		50 –130 %	

Notes:

<sup>(1)</sup> As a general rule, RPD control limits are not set values for these analytes.

<sup>(2)</sup> Precision assessment from batch to batch is not universal for the 500 methods. Four to five laboratory performance check (LPC) samples are analyzed annually in an initial demonstration of capability (IDC) study – the relative standard deviation (RSD) between duplicate samples must be 20% or less.

<sup>(3)</sup> From USEPA Method 8000B.

N/A = Not applicable

SW = Surface Water

SD = Standard deviation

USEPA = U.S. Environmental Protection Agency

**Table B.5 Surrogate and Internal Standard Recovery Control Limits**

Analytical Methods	Surrogate Compound	Recovery Control Limits for SW (%)
<b>Metals:</b>		
USEPA 200.7	N/A	N/A
USEPA 200.8	Li, Sc, Y, In, Tb, Bi	60 – 125%
USEPA 200.9	N/A	N/A
USEPA 202.1	N/A	N/A
USEPA 206.2	N/A	N/A
USEPA 213.2	N/A	N/A
USEPA 220.1	N/A	N/A
USEPA 236.1	N/A	N/A
USEPA 239.2	N/A	N/A
USEPA 245.1	N/A	N/A
USEPA 270.2	N/A	N/A
<b>Volatile Organics:</b>		
USEPA 8260	See USEPA method	100 ± 20%
<b>Semivolatile Organics:</b>		
USEPA 8270	Six compounds <sup>(1)</sup>	± 3 SD
<b>Pesticides/Herbicides/PCBs:</b>		
USEPA 508.1	See USEPA method	100 ± 20%
USEPA 608	See USEPA method	100 ± 20%
USEPA 8081B	See USEPA method	100 ± 20%
<b>N-methylcarbamoylozimes/ates:</b>		
USEPA 531.1	See USEPA method	100 ± 30 %
<b>Glyphosate:</b>		
USEPA 547	See USEPA method	100 ± 30 %
<b>Pharmaceuticals</b>		
(Modified) Barber et al. 2000	Three compounds	50 – 130 %

Notes:

N/A = Not applicable

PCB = Polychlorinated biphenyl

USEPA = U.S. Environmental Protection Agency

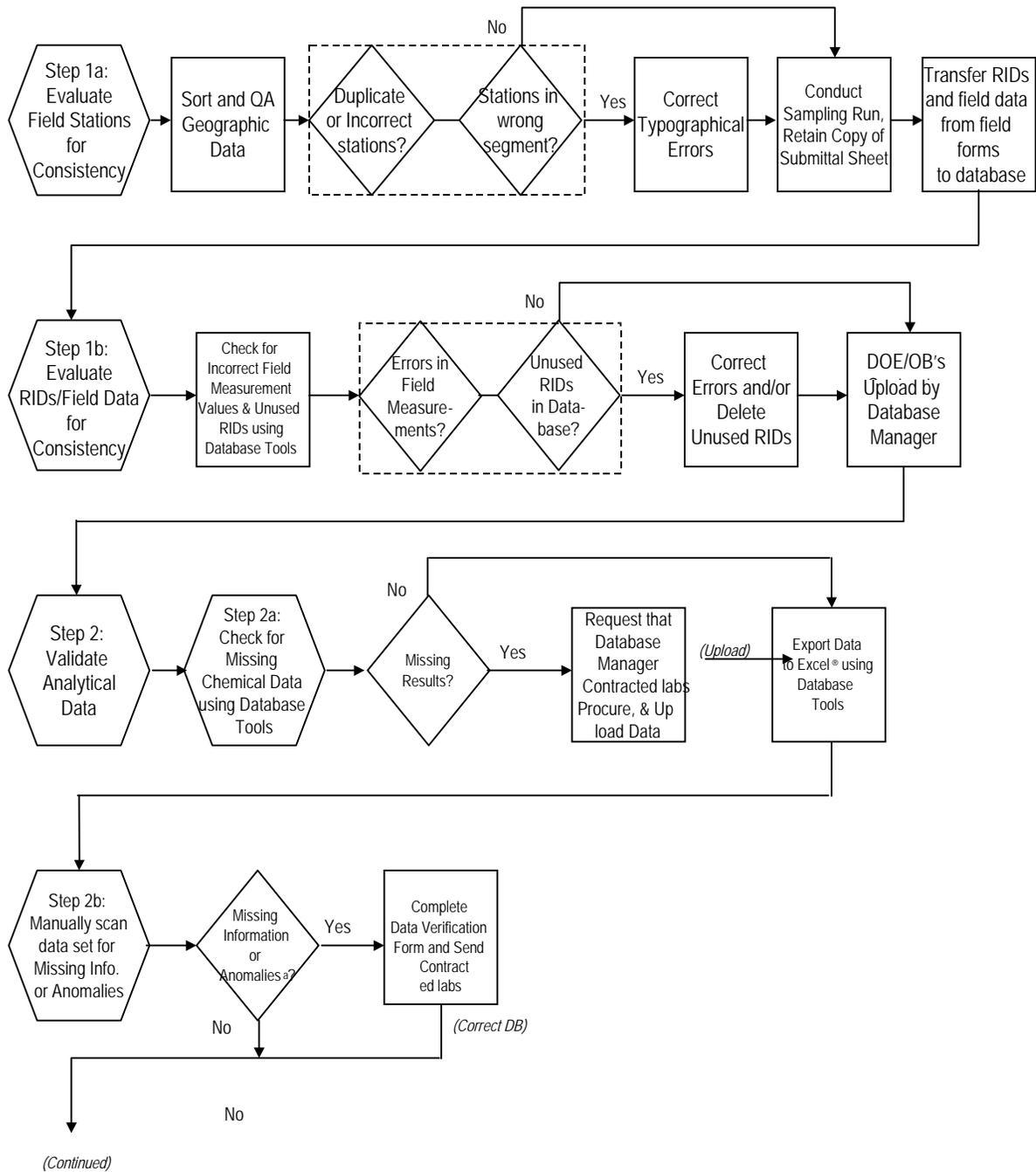
SD = Standard deviation

<sup>(1)</sup> USEPA recommends toluene-d<sub>8</sub>, 4-bromofluorobenzene, 1,2-dichloroethane-d<sub>4</sub>, and dibromofluoromethane

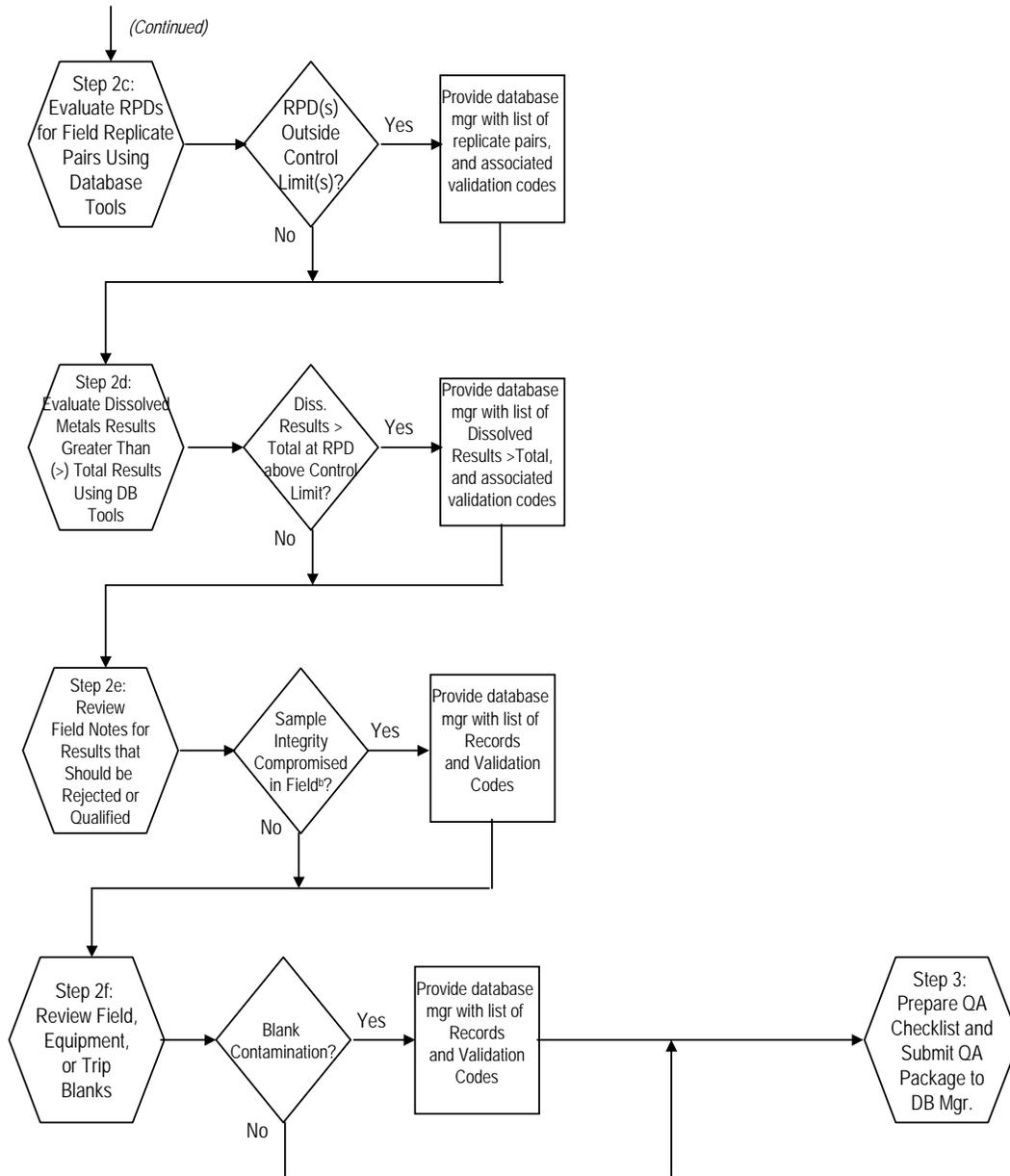
**Table B.6 Sample Volumes, Containers, Preservation, and Hold times**

Analytes	Amount required	Container type	Preservation	Hold time
Total Metals (except Hg) – Water	500 ml	Plastic	HNO-3 <2.0 pH, 4 <sup>0</sup> C	6 months
Dissolved Metals (except Hg) – Water	500 ml	Plastic	HNO-3 <2.0 pH, 4 <sup>0</sup> C	6 months
Mercury – Water	1 Liter	Plastic	HNO-3 <2.0 pH, 4 <sup>0</sup> C	28 days
Isotopic plutonium & Isotopic uranium – Water	1 liter	Plastic	HNO-3 <2.0 pH, 4 <sup>0</sup> C	6 months
Sr-90 – Water	1 liter	Plastic	HNO-3 <2.0 pH, 4 <sup>0</sup> C	6 months
Gross Alpha/Beta – Water	1 Liter	Plastic	4 <sup>0</sup> C HNO-3 <2.0 pH, 4 <sup>0</sup> C	6 months
Gamma Spec	1 liter	Plastic	HNO-3 <2.0 pH, 4 <sup>0</sup> C	6 months
SSC – Water	1 Liter	Plastic	4 <sup>0</sup> C	6 months
Isotopic plutonium - Suspended sediment	2 grams	Plastic	HNO-3 <2.0 pH, 4 <sup>0</sup> C	6 months
PCBs	2 Liters	Amber Glass	H2SO-4 >2.0 but < 3.0 pH, 4 <sup>0</sup> C	12 months
Dioxin/Furan	2 Liters	Amber Glass	If residual chlorine is present, add 80 mg sodium thiosulfate per liter of water. If sample pH is greater than 9, adjust to pH 7-9 with sulfuric acid, 4 <sup>0</sup> C	12 months

**Figure B.1 Quality Assurance Data Validation Protocol (Page 1 of 2)**



**Figure B.1 Quality Assurance Data Validation Protocol (Page 2 of 2)**



**Notes:**

<sup>a</sup>Missing information/anomalies may include missing detection limits, incorrect “less than” field, incorrect results, etc.

<sup>b</sup>Field notes may indicate that a sample was preserved improperly, or otherwise contaminated/altere. Data should be rejected if compromised

RID = Request identification

QA = Quality Assurance

CL = Control Limit

RPD = Relative Percent Difference

DB = Database

> = Greater than



## **Appendix C. General Field Safety Manual**

(Site Specific Health and Safety Plans need to be read and followed for specific sampling locations)

## **LIST OF ACRONYMS**

CFR	Code of Federal Regulations
CPR	Cardiopulmonary Resuscitation
GSD	General Services Department
HIV	Human Immunodeficiency Virus
mph	Miles per Hour
MSDS	Material Safety Data Sheet
NMAC	New Mexico Administrative Code
NMED	New Mexico Environment Department
OSHA	Occupational Safety and Health Administration
PFD	Personal Floatation Device
DOE OB	DOE Oversight Bureau
Td	Tetanus-diphtheria
TSD	Transportation Services Division
USGS	U.S. Geological Survey

## C1.0 Introduction

All New Mexico Environment Department (NMED) DOE Oversight Bureau employees are responsible for safety in the workplace, including performing fieldwork in a safe manner and reporting observed unsafe conditions to supervisors. It is therefore the responsibility of Project Leaders to ensure that the safety procedures and guidance prescribed in this document are followed. The following information is provided to assist field personnel in the safe performance of water quality data collection.

## C2.0 Safety Policies, Regulations, and Requirements

Although no special health and safety policies are in place for water quality data collection activities, NMED personnel are required to complete the National Safety Council Defensive Driving Course, which is made available through the General Services Department (GSD)/Transportation Services Division (TSD) of the State of New Mexico. Employees are required to keep a copy of the Defensive Driving training certificate and driver's license at all times while driving a federal vehicle. Additionally, in order to do much of the work needed, personnel are required to receive a Q, general Radworker training, Hazwopper training, and an Environmental, Safety and Health test, to work at DOE facilities.

Employees are provided with worker's compensation insurance to protect them in the event of injury or illness arising out of and in the course of their employment. In accordance with NMED policy (NMED Policy 1995a), all accidental injuries arising out of and in the course of employment, including occupational illness disease or injured disablement, no matter how minor, shall be reported to the supervisor immediately or at the earliest possible time by the injured employee, or by a witness if the injured employee is unable to do the reporting. Details of this policy and procedures to be followed are provided in the NMED Policy Number 02-37 (NMED Policy 1995a).

Also, while conducting business-related activities off NMED premises, no employee may use, possess, distribute, sell, or be under the influence of alcohol or illegal drugs. The legal use of prescribed drugs is permitted on the job only if it does not impair the employee's ability to perform the essential functions of the job effectively and in a safe manner that does not endanger other individuals in the workplace. Violations of this policy may lead to disciplinary action, up to and including termination. Such violations may also have legal consequences. Details of this policy are provided in the NMED Policy Number 02-38 (NMED Policy 1995b).

Equipment and vehicles essential in accomplishing job duties are expensive and may be difficult to replace. When using NMED property, employees are expected to exercise care, perform required maintenance, and follow all operating instructions, safety standards, and guidelines. Employees must notify the supervisor if any equipment, tools, or vehicles appear to be damaged, defective, or in need of repair. The improper, careless, negligent, destructive, or unsafe use or

operation of equipment or vehicles, as well as excessive or avoidable traffic and parking violations, can result in disciplinary action, up to and including dismissal. Details of this policy are provided in the NMED Policy Number 01-02, Section VI Use of Government Vehicles (NMED Policy 2005).

### C3.0 Transportation

#### **Road Vehicles**

Surface water monitoring activities require extensive periods of driving on a variety of road and, possibly, off-road surfaces. The employees engaged as drivers may be at risk from the following hazards:

- Faults in the vehicle due to inadequate servicing and maintenance;
- Refueling and roadside repairs;
- Long hours;
- Overloading;
- Falls of person or loads from vehicles;
- Speeding;
- Road and weather conditions; or
- Noise.

Santa Fe, Los Alamos National Laboratories, and Sandia National Laboratories Fleet Coordinators are responsible for contacting the vehicle service center (505) 827-1951 for all regular vehicle inspections and repairs. The federal General Services Administration (GSA) provides Fleet Coordinators with a schedule for maintenance, and Fleet Coordinators are contacted approximately one month before preventive maintenance is due. The Fleet Coordinators also maintain a sign-out sheet for staff requiring use of a vehicle. Fleet Coordinators for the OVERSIGHT BUREAU are:

Donald Sleeman (505) 845-5823

All vehicles must contain an owner's manual, registration, insurance waiver/incident report, vendor list, exemption of the mandatory financial responsibility act, and the automobile loss notice. Vehicles must be inspected every 5,000 miles of use or 4 months, whichever comes first. The vehicle mileage is monitored by means of a log, which is located within each vehicle. The driver should update the log after each use.

All drivers must wear a seat belt and have a responsible attitude towards the care and maintenance of government vehicles. Drivers are required to obey all traffic regulations. If vehicles are malfunctioning, they are not to be driven until reported defects are investigated and any malfunctioning parts have been repaired. Drivers involved in vehicle accidents resulting in

injury to another person (or animal) or damage to another vehicle (or property) must perform the following procedures:

1. Complete a police report/incident report immediately;
2. Notify Fleet Coordinator or Marcia Washington at Risk Management, (505) 827-0457;
3. Submit all original documents to Marcia Washington and copies to the TSD Agency Coordinators.

The Oversight Bureau's Fleet Coordinator should be contacted with any questions about the above procedures.

### C3.2 Watercraft

This section applies to DOE Oversight Bureau employees that use any type watercraft. Oversight Bureau watercraft shall be operated in compliance with U.S. Coast Guard Boating Safety Regulations and Standards (<http://www.uscgboating.org/safety.htm>) and Federal Requirements. Watercraft will be operated at all times with safety as the primary requirement and in accordance with recognized Federal, state, and local laws and standards. All accidents and incidents involving watercraft must be reported and investigated. There are four conditions that require a boating accident report (United States Coast Guard 2003):

- A life is lost due to the accident;
- Someone is injured and requires medical attention beyond first aid;
- There is damage by or to the vessel and other property; and
- Any person on board a vessel disappears (under circumstances indicating possible death or injury).

Boating accidents include capsizing falls, overboard collisions, sinking/flooding, explosions, disappearance, fire. All serious injuries and loss of life must be reported to local authorities immediately. Reports must be filed within:

1. 48 hours of the occurrence if a person dies within one day (24 hours of the accident),
2. 48 hours if a person is injured and medical treatment beyond first aid is required, and
3. 10 days if there is only damage to the vessel and/or property (United States Coast Guard 2003).

Watercraft operators should know the boats capacity, which includes the combined weight of passengers and gear. The air compartments should be checked for leaks, and the condition of the raft should be inspected and weather conditions and air compartment levels checked before departure. The operator should always carry a radio or cellular telephone, and boating should be done in pairs. Safety equipment onboard should include:

- Boat plugs;

- Air pump;
- Emergency paddles;
- First aid kit;
- Fire extinguisher;
- Flashlight;
- Air horn;
- Rain gear;
- Personal floatation devices;
- Radio or cell phone; and
- Throw rope.

In 2002, approximately 70 percent of all boating fatalities were drowning, and nearly 85 percent of the victims who drowned were not wearing a life vest (United States Coast Guard 2002). Life vests should be the right size for the person's weight and chest size.

#### C4.0 Surface-Water Activities

##### C4.1 Wading

The following information was taken from the *National Field Manual for the Collection of Water-Quality Data*, Chapter A9, "Safety in Field" (U.S. Geological Survey [USGS] 1997):

"Examine the section of a stream or river you plan to wade. Check the field folder for information relating to safety, including maximum depths in relation to stage, wading-section anomalies such as slippery conditions and drop-offs or holes (a wading rod can be used to help assess streambed conditions), and velocity curves for determining wadeable stages. Do not attempt to wade a stream for which values of depth multiplied by velocity equal or exceed 10 square feet per second (ft<sup>2</sup>/s). For example, a stream only 2 feet deep but with velocities of 5 feet per second (ft/s) or more can be dangerous to wade.

- Wear a personal flotation device (PFD) during wading activities.
  - *Approved PFDs for wading include the standard jacket type and the suspender type. The PFD must fit properly, be rated for your weight, and be in good condition.*
  - *The PFD should be dried and kept indoors between trips.*
- Wear hip boots or chest waders. Boots and waders provide protection from cold and pollutants, as well as from underwater objects. Be aware of the possibility of slipping and going underwater (feet up, head down) while wearing them. Practice wearing hip boots and waders in a controlled, group-training situation before using for field work. The following recommendations are the result of experiments with boots (Joseph, 1957) and field experience.

- *Hip boots with a strap at the top are better than boots that are open. The strap should be pulled closed. This allows air to be trapped in the boot in case you are submerged. The air cushion can be used as a partial mechanism for flotation until you reach shore or are rescued.*
  - *Avoid hip boots with tight ankles. These are difficult to remove in an emergency situation.*
  - *Avoid chest waders that are tight fitting at the top. Like tight-ankle hip boots, they are difficult to remove in an emergency situation. Whenever chest waders are worn, a PFD also must be worn.*
  - *Chest waders should cinch at the waist or be worn with a tight belt to avoid complete filling of waders with water if staff accidentally slip and fall.*
- Be aware of surrounding conditions.
- *Watch for debris floating downstream, such as logs, aquatic vegetation, or "rafts" of animals seeking higher ground.*
  - *Watch for sand channels that can shift under foot and become quicksand.*
  - *Watch the stream stage, especially when it could rise rapidly.*
  - *When wading below a dam or control structure, contact the gate operator before entering the stream."*

#### C4.2 Working On Bridges

Employees working from bridges should wear high-visibility vests with reflective tape. Other safety equipment should include orange safety cones. If a vehicle is to be parked on the shoulder, cones should be placed beginning 40 feet before the vehicle, where the speed limit is 30 miles per hour (mph) or less, and up to 250 feet before the vehicle where the speed limit is 70 mph. If the field vehicle is parked on the bridge, the employee should not stand in front of it while sampling. Sampling should be conducted away from the vehicle where traffic can be monitored.

#### C4.3 Working From Boats

See Section C3.2 of this Appendix.

#### C4.4 Working From Cableways

In the event that a cableway is to be used to collect water quality data, the employee should contact USGS and refer to USGS Memorandum No. 92.42, "*Plan for Insuring the Safety of Cableways*" (USGS 1991).

#### C5.0 Chemicals

Material Safety Data Sheets (MSDSs) for all chemicals used on a trip should be made available to employees involved in the sampling activity. MSDSs are required by Occupational Safety and Health Administration (OSHA) 29 Code of Federal Regulations (CFR) 1910.1200 (hazard communication) and are shipped with chemicals when purchased. All chemicals should be secured in the field vehicle in a container that will resist and contain the material in the event of an accident. A spill kit should be available to contain and neutralize agents in the event of a leak or spill. The following precautions should be taken when working with chemicals in the field (USGS 1997):

- Avoid unnecessary exposures and spills. Never place chemical containers where they can be knocked over;
- Work with adequate ventilation when working with hazardous or reactive chemicals and gases;
- Keep eye wash kits readily accessible while working with chemicals;
- Handle and mix chemicals and compounds appropriately (check the MSDS).

Bottles should be labeled as to their contents and chemical wastes should not be allowed to accumulate in a vehicle. Disposal of chemicals should be in accordance federal regulations.

#### C6.0 Contaminated Water

The following information was taken from the *National Field Manual for the Collection of Water-Quality Data*, Chapter A9, "Safety in Field" (USGS 1997):

"Water being sampled could be contaminated with pathogens and hazardous chemicals. Use caution and extra protection when working with water known or suspected to contain high concentrations of pathogens. Sample containers, shipping containers, and paperwork must indicate the type and severity of the contamination. This alerts personnel to the appropriate personal protective equipment and procedures needed. Communicate known or suspected contamination to all personnel who could come in contact with the sample.

Waterborne, disease-causing organisms (pathogens) are found in nearly all surface-water systems, and occur in some ground-water systems as well. Most pathogens originate from the body fluids and feces of animals and humans. Pathogens enter surface-water resources primarily through sewage discharges and spills, storm and agricultural runoff, and direct contact. Microorganisms also are transported on small particles such as dust or aerosols (gaseous suspension of very fine particles). Pathogens enter ground water through infiltration from septic tank effluent, leachate from fields and ponds, and from faulty well seals and casings. Bacteria,

viruses, and other pathogenic organisms can occur in the most pristine environments. Never drink sample water, no matter how pristine the environment appears.

To minimize exposures to and effects from contaminated water:

- Receive required inoculations.
- Use personal protective equipment, including respiratory equipment (certification required) when working over turbulent, polluted flows, and in shelters containing evidence of excrement. Pathogens can enter your body through many openings such as your mouth, eyes, nose, cuts, scrapes, or chapped skin.
- Wear rubber boots, coveralls or aprons, gloves, and splash protection (a disposable dust mask offers splash and dust protection at a very low cost).
- Do not ingest pathogens or other contaminants. Never eat or drink while sampling or put pencils or other items in your mouth, and do not store food or drink in sample coolers.
- Carry antibacterial soap; wash before leaving the site. Remember to wash again after unloading supplies.
- Disinfect all contaminated surfaces as soon as possible.

Employees should consider the possibility that any water being sampled may be contaminated with pathogens; however, the above precautions should always be observed when working in areas with known or suspected contamination.”

Because the Human Immunodeficiency Virus (HIV) and Hepatitis B are not transmitted by the fecal-oral route, risk of transmission through sewage and wastewater is very low (State of California 1998). There are no state immunization requirements for field personnel who contact wastewater; however, staff regularly sampling in surface waters and wastewater are advised to receive the following immunizations:

- Tetanus-diphtheria (Td)
- No other immunizations are routinely recommended

There is currently no evidence of significant occupational risk for sewage workers from HIV, Hepatitis A, or Hepatitis B (State of California 1998).

#### C7.0. Environmental Conditions

The following information was taken from the *National Field Manual for the Collection of Water-Quality Data*, Chapter A9, "Safety in Field" (USGS 1997):

"Extremes of air temperature occur in all parts of the country. The ideal comfort range for humans is between 16 to 32°C (60 to 90°F). Hypothermia and hyperthermia normally occur in temperatures outside this range. Hypothermia is a condition of reduced body temperature caused by exposure to cold, and aggravated by wet clothes, wind, hunger, and exhaustion. Hypothermia in extremities can lead to frostbite. Hypothermia can occur with air temperature above 16°C (60°F) under wet and (or) windy conditions. The best way to avoid hypothermia is to dress warm and stay dry. "

"The warning signals of hypothermia are uncontrollable fits of shivering, incoherence, listlessness, fumbling hands, frequent stumbling, drowsiness, and inability to get up after resting. Victims of hypothermia must be treated immediately by removing them from exposure to the elements, replacing wet clothes with dry ones, and giving them warm, non-alcoholic drinks. Seek emergency facilities as soon as possible.

**To prevent hypothermia:**

- Put on rain gear before it starts to rain or snow.
- Put on additional clothes before starting to shiver.
- Seek shelter immediately if conditions become severe.

Hyperthermia is a condition of increased body temperature caused by exposure to excessive heat. Contributing factors are physical exertion, clothing, humidity, lack of air movement, and temperature, but the most important factor is body hydration. The normal body requirement for fluids in temperate regions is 2 1/2 quarts per day; desert conditions require more fluid. Early warning symptoms of hyperthermia are chilling, a throbbing pressure in the head, unsteadiness, dizziness, nausea, dry skin (either hot and red or cool and pale), rapid pulse, and muscle pains and spasms.

Persons suffering from hyperthermia should seek medical attention immediately. First aid involves cooling down and rehydrating.

**To avoid hyperthermia:**

- Drink water in moderate amounts on a scheduled basis---do not wait until you are thirsty.
- Avoid alcohol, caffeine, and soda---these liquids are not water substitutes.
- Wear lightweight clothing and a wide-brimmed hat.
- Schedule activities that require the most exertion in early morning or late afternoon, if possible, and not when air temperature is at its highest.

Sun exposure can have painful and dangerous short-term and long-term effects. Regardless of the region in which you are working, take the proper precautions to protect your skin and eyes from excessive sun exposure.

To prevent excessive sun exposure:

- Wear sunscreen on all exposed skin to avoid burning and skin cancer.
- Wear sunglasses with polarized lenses to protect eyes, reduce glare, and improve vision, especially when working on water or snow.

Thunderstorms, which can be accompanied by hail, are common throughout the United States. Some are predicted by weather forecasters. Others can move into an area with almost no advance warning. Watch the sky for signs of thunderstorms, and seek shelter before the weather deteriorates. Lightning is extremely dangerous and should be respected.

To protect yourself during thunderstorms, heed the following advice from Lockhart (1988):

- Seek shelter inside a vehicle or building; keep away from open doors and windows, plugged in appliances, and metal. Avoid contact with metal objects in a vehicle.
- Do not use a telephone.
- If outside, do not congregate. In case of a lightning strike, someone must be able to begin revival techniques immediately, such as cardiopulmonary resuscitation (CPR).
- Put on rubber boots or rubber-soled shoes.
- Do not work on electrical lines, pipes, cableways, or steel structures.
- Do not use metal objects such as wading rods, bridge cranes, and well-logging equipment.
- If caught in the open, crouch down low, but do not lie flat on the ground.
- Avoid standing near isolated trees.
- Avoid working on streams and lakes.
- Seek lower elevations such as valleys or canyons---avoid being on peaks or ridges.
- If you feel your hair standing on end and your skin tingling, this is a sign that lightning might be about to strike---crouch immediately (feet together, hands on knees).

Tornadoes sometimes accompany thunderstorms. Tornadoes are violently rotating columns of air that descend from the clouds in a funnel formation. A weather channel or weather-band radio will sometimes provide advance warning of possible tornadoes.

To protect yourself during a tornado, heed the following advice from Lockhart (1988):

- Seek shelter immediately if there is a sudden, violent change in weather involving wind, rain, hail, or funnel-shaped clouds.
- Avoid occupying vehicles or mobile homes.
- If you are caught outside, find a ravine, ditch, or culvert and lie flat.

- If inside, go to the basement or lowest interior reinforced part of the structure, such as a closet or bathroom. Stay away from windows.

Rain can fall at a rate of several inches per hour and rapidly create dangerous flash flood conditions, either in the area where you are working or several miles away. Weather forecasts will be helpful in planning your activities accordingly to ensure your safety. Maintain an updated copy of your district flood plan. Always be aware of rapidly rising stages in rivers and creeks. Beware of dry creek beds that can become raging rivers in a short period of time.

Fire can spread out of control rapidly--call 911 if you notice a brush fire or other type of threatening fire or smoke. Working inside your field vehicle or outside at your field site requires fire prevention measures. Do not smoke. Keep matches stored in a metal container. Keep fire extinguishers visible and accessible.

- Know how to operate fire extinguishers.
- Know the type of fire for which an extinguisher is designed (extinguishers are different for ordinary combustibles, flammable liquids, and electrical equipment).
- Never point an extinguisher at a person's face.

Recharge fire extinguishers according to the schedule provided with the extinguisher.

Snow and ice are dynamic mediums that change quickly in structure and strength. Snow and ice can accumulate rapidly, hiding hazards, and creating slippery conditions. Heavy snowfall (white-outs) can be disorienting and can produce avalanche conditions in steep terrain. Working on ice requires experience, training, and knowledge of the water body over which the ice has formed. Wear layers of appropriate clothing and work in teams.”

## C8.0 Checklists for Standard Safety Equipment

Field Sampling Equipment Checklist for:

### **General**

Plastic sample bottles (for pH and  
Cubitainers (liters, gallons)  
Fecal bottles (and forms)  
Organics sample bottles  
Pipette tips  
Water carboy (w/DI water)  
Wash bottles  
Kemwipes  
Rubber (nitrile) gloves  
Trash bags  
Calculator  
Extra batteries (AA, C, 9 volt)  
Cell phone  
Camera (digital or film)

### **Sample Preservation**

Coolers  
Ice  
  
Pipettes (and repair  
  
NaOH (for cyanide)  
Nitric acid  
Sulfuric acid  
Geo pump  
Tubing  
Cartridge filters

## Field Sampling Equipment Checklist for: (continued)

Maps

Clipboard

Tool box

First aid kit

Flashlight

Access authorization documents

Replacement flow meter tape

### **Meters.**

Extra ISCO® and Flow meter

Extra battery for ISCO®

Conductivity meter

Conductivity standard

pH meter

pH buffers and storage solution

Turbidity meter (and

D.O. meter

D.O. probe repair kit

Digital thermometer

Binoculars/Field guides

### **Data/notes**

Pencils/pens

Sharpies

Field sheets

Lab forms

RID stickers

### **Miscellaneous**

Site list/directions

Basin

Rain gear, Boots/waders

Lunch/water

Neoprene gloves

Hat/sun protection

Sunglasses/polarized glasses

Field notebook

NMED ID/business cards

Phone card

## C9 REFERENCES

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**Appendix D. Rain Gauge Installation Protocol & ELS Installation SOP**

### **Rain Gauge Installation Protocol**

Rain gauges will be installed at selected sites. The following items are needed for installation: one rain gauge, one rebar, a hammer, a pin flag with the site identification number on it, and duct tape.

Install the rain gauge in an area within view of the sampling location and that is not under canopy cover. Hammer the rebar into the ground while making sure that it goes in deep enough to be standing solidly and level. Tape the bottom part of the rain gauge to the top of the rebar. Position the rain gauge so that the numbered side is easily viewed. Insert the red disk into the rain gauge, and then place the collection port on top of the gauge. Tape the pin flag onto the rebar at the base of the gauge. Bend the flag slightly to prevent it from interfering with the collection of rainfall.

When reading the rain gauge, squat so that the disk is at eye level when viewed. Take the rain measurement reading from the bottom of the disk and record this number (in inches) in the field notebook. Insects may be present in the rain gauge at the time of the reading. Note this in the field notebook and make appropriate adjustments.

Empty the rain gauge by carefully pulling it from the holder so that the calibration numbers are not scraped off. Remove as much moisture from the gauge as possible; dry the red disk; if present, carefully remove insects; reinstall the gauge onto the holder. Be certain that the rain gauge is as level as possible.

### **ELS Installation Standard Operating Procedure**

Check the RED FLAG fire rating and road or site closures before going out to set any ELS. The information can be found on the facility specific homepage, for example: (<http://int.lanl.gov>). Bring a field notebook, all required badges and ID's, and keys. Refer to Attachment 1, Supply List for ELS Installation, for additional equipment needed before entering the field. Prior to ELS installation, make sure that all activities are in compliance with NEPA requirements or facility specific permits and regulations (e.g., excavation permits).

ELS's can be co-located with other facility specific samplers or placed at NMED DOE OB independently selected sites. In either case ELS's are placed in the best drainage channel, as close as practical to the furthest downstream BMP, to maximize chances of collecting a storm water sample. If a rain gauge is to be installed at the site, refer to Attachment 2, Rain Gauge Installation Protocol.

To determine the appropriate excavation location within the drainage channel, take a rebar and hammer it into the floor of the channel. Find a location with enough soil depth to install the sampling jar. Two sampling jar sizes can be used: a two-liter plastic or a four-liter glass jar. If the rebar goes into the ground at least 12 to 15 inches and does not hit bedrock, then prepare for excavation. The primary tool used to excavate the hole is a posthole digger; however, if the soil is very sandy, the hole may also need to be excavated with a trowel and/or by glove protected hand.

Disposable gloves must be worn to protect from potential contaminants during the excavation process. A large, heavy-duty plastic bag with the site identification number on it will be used to contain the soil that is removed during the excavation. Excavate a hole that is deep enough so that the top of the sampling jar will be flush with the ground and wide enough so that there will be at least one inch of space around it. The hole must be deep enough so that, when the ELS is installed on the sampling jar, shallow sheet flow will be collected (if bedrock is encountered before this achieved, another sampling location may need to be found). Remove any rocks that could possibly damage the sampling jar and remove any loose soil with trowels. Place all of the soil in the marked bag. NOTE: The soil removed must be the same soil put back into the excavated hole when the project is completed. Pursuant to RCRA land disposal regulations or other specific regulations or permits no soil is to be casually disposed of at the site and in no cases is the soil to be disposed of in the watercourse (erosion channel) except to refill the excavated hole.

Once the hole has been excavated, take the sampling jar and place it in the excavated space. (What level should the cover of the jar (or neck) be in relation to the stream channel bottom? Refer to paragraph above) Never remove the lid of the sampling jar until the ELS is ready to be installed. Make sure that the sampling jar is placed in the hole so that it is centered, straight, and level. Carefully place some of the soil from the marked bag back into the space around the sampling jar. Fill the space until it reaches the neck of the sampling jar. If the ELS is ready to be installed, then tamp the soil around the sampling jar, and remove the lid and any soil from around the lip of the sampling jar. Be careful that no soil falls into the sampling jar once it is open. Removed jar lids must be placed in a separate plastic bag so that they can be decontaminated later.

The person who handles the ELS must be independent of the excavation process or have removed any contaminated gloves used in the excavation process. Open the sampling port of the ELS and set the trigger mechanism. Test the trigger mechanism to be certain it will close when a storm water sample is collected, and then reset it. Carefully place the ELS on the sampling jar and gently tighten it on. The tread of the ELS and the tread of the jar must be dry for proper attachment of ELS and jar. Be careful not to set off the mechanism while tightening, otherwise it must be set again. Once the ELS is set, the excavation site must be readied for completion.

A person wearing disposable gloves must carefully remove any materials that will interfere with the water flow or that may clog the ELS. Spread and firmly tamp the soil around the ELS to allow for unobstructed flow. The person who finishes the site needs to leave on his or her disposable gloves so that he or she can wipe debris from the equipment before leaving the site and assist with in the decontamination process. Put disposable gloves and all other trash in a marked bag to be removed from site.

To finish the excavation site, first place all equipment in one area away from the ELS. Hammer a rebar into the ground in a spot near the sampling location but where it will not interfere with the water flow. Take a yellow pin flag and write the site identification number on it; attach the pin flag to the rebar with duct tape.

Take the bag with the remaining excavated soil and put it in a safe spot that is easily identified; write this location down in the field book. From here on out, try not to walk upstream from ELS so that no excess erosion will occur. Take the equipment and trash back to vehicle. Do not place any contaminated equipment into vehicle until it is thoroughly decontaminated.

The person wearing disposable gloves will use a clean paper towel to wipe all surfaces of the tools that came in contact with the soil after it has been thoroughly rinsed with distilled water. Wipe surfaces dry with a clean paper towel, and then place equipment in vehicle. Dispose of paper towels and gloves in the marked trash bag. Before leaving the site, write the site identification number on a yellow pin flag or yellow tape and place it in a location that visibly identifies the sampling location.

Record the date, the people doing the installation, the site location identification number (this identification number will be used to identify the samples collected at that site), and make a notation in the field notebook if a rain gauge was installed. In addition, indicate in the field notebook other pertinent information (e.g., describe ELS location relative to BMPs at the site).

Upon returning to the office be mindful of the contaminants encountered while working at the site. To minimize spread of contaminants off site, rinse boots with water and wipe them dry with a paper towel. Clean up any water on the floor to prevent a slipping hazard. Dispose of used paper towels appropriately.

Once the first storm water sample has been successfully collected and no problems are anticipated at the sampling location, a GPS reading of the location can be taken. The GPS coordinates will be used as a point of reference for future samples collected at this location and for database entries.

**Appendix E. ISCO® Flow Meter and Sampler Setup Procedure and RTD Use**

## **ISCO® 3700 SAMPLER SETUP**

The following description provides the details for an initial set-up, and only 1 of many sample arrays possible. Adjustments to the program can easily be made, although review of the ISCO® technical manuals may be necessary. During subsequent field visits, most of the program options can be disregarded, and a condensed program version will be included at the end.

Chapter 4, (4.2.-1; pg. 4-20), of the 3700 Portable Sampler instruction manual has a more detailed description of each step in programming the sampler. This is a condensed version designed to take multiple non-uniform timed samples during a storm event. Variations of this sample array may be made to accommodate various sample volumes as required by analytical requirements.

Non-uniform timed samples are typically used in runoff studies. Preferably, sample intervals are short during the early stage of a runoff event, increasing during the later, trailing leg of the hydrograph.

### SET-UP:

1. The ISCO® carousal can accommodate 24 bottles. Load 6-350 ml glass bottles into slots 1 through 6. Fill the remaining slots with 18-1L plastic bottles. Sample water collected in the glass bottles will be used for organic analyses; the remaining water collected in the plastic bottles will be analyzed for inorganics.
2. Power the sampler from a 12v marine battery or other power source. Then connect the sampler to the flow meter with the 6-pin cable.
3. Install the ISCO® sampler, flow meter, and battery on relatively level ground above the flood plain, within 26 vertical feet of the channel, the maximum lift of the ISCO® pump at optimal conditions.
4. Attach a length of 3/8-inch diameter Teflon suction line to the ISCO® intake and anchor the other end to the channel bottom. The proper placement of the suction line assures the collection of representative samples. Slope the line from the sampler to the sample point in a continuous downhill fashion allowing water to drain between sample intervals. Orient the line intake upstream and anchor to the channel bottom in the main flow of the stream, not in an eddy or edge of the flow. Intake at the channel bottom may result in excess heavy solids, or bed load. Professional judgment determines the intake height above the channel bottom. For example; wide, low flowing channels may require locating the intake within 2 inches above the bottom, while a narrow, high flowing channel may allow placement of the intake higher in the water column.

5. Attach a length of ¼-inch diameter vinyl tubing to the ISCO® Flow Meter, at the nipple below the cable connectors, and anchor the end of the hose to the channel bottom near the ISCO® sampler intake. Be aware that stream channels we commonly monitor are unstable. They are often adjusting, aggrading and degrading, to changing flow regimes. Judgment is required in locating the ISCO® tube ends at a secure and appropriate location.

6. Program the ISCO® sampler first, place it in standby, and then program the flow meter. The remaining sections describe step-by-step procedures for programming the ISCO® sampler and then the ISCO® flow meter.

It is recommended that you walk through each step carefully and assure that all steps are programmed properly. After programming the sampler, installing the equipment in the field, or after recovering samples from an event and reloading bottles for another; press the START SAMPLING key.

***SAMPLER INHIBITED* will be displayed on the screen. This display is key in determining whether the ISCO® has been properly programmed.**

At each step you have the option to continue on to the next step or move backwards to a previous step by using arrow keys. Once programmed, this allows you to move through the program to a specific step for which you may wish to change settings. At each step the option highlighted on the ISCO® screen is listed here under the Option column in capitalized letters. Pressing the ENTER/PROGRAM key will put you into the step and enable you to program that portion. Once in a step, the arrow keys allow you to pick between choices, while the ENTER/PROGRAM key selects your choice. The ENTER/PROGRAM key will be referred to as the ENTER key during the remainder of this description.

### **Turn sampler on and press ENTER**

#### **Step/Option**

#### **Notes**

1) [*PROGRAM /CONFIGURE*]  
*SAMPLER*

Chose *CONFIGURE* first, you will do *PROGRAM* later. Use the arrow keys to move between *PROGRAM* and *CONFIGURE*, depress the ENTER key when the appropriate selection is flashing.

2) *SELECT OPTION: SET CLOCK*

Press ENTER to set clock and date. Synchronize the time and date between the sampler, flow meter, and appropriate station gage. Pressing the appropriate numbers on the keypad can change the flashing

3) *SELECT OPTION: BOTTLES AND BOTTLE SIZES*

*[PORTABLE, REFRIG]*

*[1,4,12, 24] BOTTLES*

*BOTTLE VOLUME IS #*

selection. Press ENTER if correct, or use the arrow keys to scroll through the remaining selections to the next program option.

Press ENTER, to reset the bottle number and size or use the arrow keys to move on to next program option

Select *PORTABLE*, then ENTER

Select *24 BOTTLES*, and then ENTER.

Change bottle volume to *1000* ml using the number keypad.

4) *SELECT OPTION: SUCTION LINE*

*SUCTION LINE I.D. IS [1/4, 3/8] INCH*

*Suction line is [vinyl, TEFLON]*

*SUCTION LINE LENGTH IS*

Press Enter, to reset the suction line size and length or use arrow to move on to next option

Select *3/8*, then ENTER.

Select *TEFLON*, and then ENTER.

Measure the length of the suction line, enter the length in feet using the number keypad, and then ENTER. The ISCO® will momentarily display “Calculating Pump Value Tables” as it computes the tubing volume.

5) *SELECT OPTION: LIQUID DETECTOR*

*[Enable, DISABLE} Liquid Detector*

*RINSE CYCLES*

Press Enter, to activate the liquid detector at the pump housing.

SELECT *Enable*, AND THEN Enter.

Select *2* with the number keypad, then ENTER. The rinse cycles condition the suction line and reduces the cross-contamination potential.

*Enter head manually [Yes /NO]*

*Select No, and then ENTER.*

*RETRY UP TO "#" TIMES WHEN  
SAMPLING*

Select 0, then ENTER. If multiple attempts are made and sampler collects partial samples, a risk exists that the bottles will overflow, finally causing the sample distributor to jam.

6) *SELECT OPTION:*

*Programming mode"*

PRESS ENTER\_

*[BASIC, EXTENDED] PROGRAMMING  
MODE*

Select EXTENDED, and then ENTER. This mode allows further "STORM" water programming to be achieved.

7) *SELECT OPTION: LOAD STORED*

Use the arrow key to pass this and the following selection "SAVE CURRENT PROGRAM". These selections allow the user to store and reuse individual sample programs. Circumstances may vary at each station and the programs are individualized.

8) *SELECT OPTION: FLOW MODE  
SAMPLING*

Press ENTER

*TAKE SAMPLE AT START TIME*

Select NO, then ENTER.

*TAKE SAMPLE AT SWITCH? [YES, NO]* Select NO, then ENTER

9) *SELECT OPTION: NONUNIFORM TIME*

Press Enter.

10) *ENTER INTERVALS IN [CLOCK  
TIME, MINUTES]*

Select MINUTES, then ENTER.

11) *SELECT OPTION: CALIBRATE  
SAMPLER*

Press ENTER.

- [ENABLE, DISABLE] CALIBRATE  
SAMPLER* Select ENABLE, then ENTER.
- 12) SELECT OPTION: SAMPLING STOP /  
RESUME Press ENTER
- [ENABLE, DISABLE] SAMPLING  
STOP / RESUME* Select DISABLE, then ENTER.
- 13) SELECT OPTION: START TIME DELAY Press ENTER
- # MINUTE DELAY TO START* Select 0 with the number keypad, then  
ENTER. The program will initiate when a  
signal is sent by the flow meter.
- 14) SELECT OPTION: ENABLE PIN Press ENTER.
- MASTER / SLAVE MODE [YES,  
NO]* Select NO, then ENTER.
- SAMPLE UPON DISABLE [YES /  
NO]* Select NO, then ENTER.
- SAMPLE UPON ENABLE [YES /  
NO]* Select YES, then ENTER. This allows the  
sample program to activate when a signal is  
provided by the flow meter.
- 15) RESET SAMPLE INTERVAL? [YES /  
NO] Select YES, then ENTER.
- 16) SELECT OPTION: EVENT MARK Press ENTER.
- [CONTINIUS SIGNAL, PULSE]* Select CONTINUOUS SIGNAL, then  
ENTER.
- DURING [PUMP CYCLE, FWD  
PUMPING ONLY]* Select FWD PUMPING ONLY, then  
ENTER.

17) *SELECT OPTION: PURGE  
COUNTS*

Press ENTER.

*# PRE-SAMPLE COUNTS*

Select 100 with the number keypad. This generally allows the pump to purge the sample tubing with a blast of air before sampling. Extraordinary long suction line may require additional pump strokes to clear the line.

*# POST-SAMPLE COUNTS*

Select 100 with the number keypad. This generally allows the pump to purge the sample tubing of sample water after sampling. Extraordinary long suction line may require additional pump strokes to clear the line.

18) *SELECT OPTION: TUBING LIFE*

Use arrow to skip to next step if you do not change out pump tubing. During pre-season maintenance pump tubing is changed and the pump counts are re-set to 0. A warning is provided at this option by the ISCO® sampler when counts approach 500 000, the recommended change condition.

19) *SELECT OPTION: PROGRAM  
LOCK*

*[ENABLE, DISABLE]*

Press ENTER.

Select DISABLE, then ENTER. Do not lock if you are sure no one will tamper with settings. If you enable the program lock, select 3700 as the pass code.

20) *SELECT OPTION: SAMPLER ID*

*SAMPLER ID NUMBER IS #*

Press ENTER.

Select an appropriate ID number with the keypad, then ENTER.

21) *SELECT OPTION: RUN  
DIAGNOSTICS*

*TEST DISTRIBUTOR [YES / NO]*

Press ENTER. The ISCO® will proceed through a number of self-tests. This will take a short time.

Select Yes, then ENTER. The ISCO® will proceed through the distributor test checking its pathway around the carousel. If the test fails, realign the bottles, check end of distributor hose that it does not extend below the distributor frame, and then retest.

22) *RE-INITIALIZE [YES / NO]*

If YES is selected, the sampler will re-set its program to the factory settings. **ALWAYS ENTER NO.**

23) *SELECT OPTION: EXIT  
CONFIGURATION*

Press ENTER.

**The sampler should go to "STANDBY" mode.**

This concludes the configure sequence. You should not have to enter configure again unless you wish to change settings or test the distributor. When samples are collected and bottles replaced, the distributor should be checked.

**Press ENTER to proceed to the program sequence.**

<b>Step Option</b>	<b>Notes</b>
1) <i>[PROGRAM, CONFIGURE] SAMPLER</i>	Select PROGRAM, then ENTER
2) <i>[TIME, FLOW, STORM] PACED SAMPLING</i>	Select <i>STORM</i> , then ENTER. The ISCO® will momentarily display “ <i>TIME MODE FIRST BOTTLE GROUP</i> ”.
<i># MINUTE DELAY TO FIRST GROUP SAMPLE</i>	Select <i>10</i> with the number keypad, and then ENTER. The flood bore is seldom instantaneous, and 10 minutes generally allows the sample to be collected at the hydrograph peak or shortly after. Review of historic gage data may provide additional insight of stage change rate for each watershed.
3) <i>TAKE # TIMED SAMPLE EVENTS</i>	Select 1 with the keypad, then ENTER. One event is selected for 6-350 ml glass bottles.
<i># BOTTLES PER SAMPLE EVENT</i>	Select 6 with the keypad, then ENTER.
<i>SAMPLE VOLUMES OF # ml</i>	Select 325 with the keypad, then ENTER. There is an approximate 10 % error while filling the bottle. By selecting 325 ml, the potential of overfilling the bottles is diminished.  The ISCO® will temporarily display “ <i>18 BOTTLES, 1800 ml AVAILABLE</i> ”.
<i>[TIME, FLOW] SECOND BOTTLE GROUP</i>	Select TIME, then ENTER.
<i># MINUTE DELAY TO SECOND BOTTLE GROUP SAMPLES</i>	Select <i>10</i> with the keypad, then ENTER. The ISCO® will begin to fill the plastic 1000 ml bottles immediately after the organic samples have been filled.

*SAMPLE INTERVALS OF # MINUTE*

*Select 90, then ENTER.*

**Review of watershed flow dynamics is required to determine an adequate multi-sample array. This program will collect multiple samples during the first 4 and half hours of a storm flow.**

4) # BOTTLES PER SAMPLE EVENT

Select 4, then ENTER. Four 4-liter samples will be collected at 90-minute intervals. In this sample array, 2 bottles will be surplus.

5) # *SAMPLES PER BOTTLE*

Select 1 with the keypad, then ENTER.

6) *SAMPLE VOLUMES OF # ml*

Select 950 with the keypad, then ENTER. Choosing 950 rather than 1000 will diminish the potential of overfilling the bottles.

7) CALIBRATE SAMPLE VOLUME?  
[YES / NO]

Select YES, then ENTER. Calibrating the sample is only necessary during initial deployment and will be disregarded during the regular field season, unless the samples are consistently over or under filled.

PRESS MANUAL SAMPLE KEY *WHEN  
READY*

Submerge intake of sample line into a container of distilled water. The container volume should be at least the same volume as the container being calibrated. Press the MANUAL SAMPLE key.

The ISCO® will run a routine of rinsing and then collecting 350 ml of water. When completed, the ISCO® screen will display “350 ml VOLUME DELIVERED”.

Remove Bottle 1, the bottle that received the water, and measure its contents with a graduated beaker. Enter that measurement into the ISCO® with the keypad and it will compute the calibration. Replace Bottle 1 into the ISCO® and repeat the process to

confirm the calibration, or until the appropriate volume is delivered.

Replace Bottle 1 with a new bottle and continue programming by selecting NO when asked to CALIBRATE SAMPLE VOLUME.

8) *ENTER START TIME [YES / NO]*

Select NO, and ENTER.

9) Programming sequence Complete

After displaying this the sampler will return to the **STANDBY STATE**.

**The ISCO® 3700 Sampler is now programmed to collect a 2-liter sample for PCBs, and 4 1-gallon samples that could be analyzed for metals, radionuclides, and other physical parameters. The PCB and the first 1-gallon sample would be collected 10 minutes after the stream level rises above the predicted storm stage. The remaining 3 1-gallon samples would then be collected every 90 minutes encompassing 4 and half hours of the flood.**

Now the flow meter must be programmed to activate the ISCO® sampler program at a prescribed stage, and record the stream hydrograph and sample history.

### **ISCO® MODEL 4230 BUBBLER FLOW METER PROGRAM INSTRUCTIONS**

**Turn on flow meter and press the "ENTER PROGRAM STEP" key**

#### **Step/Option**

#### **Notes**

1) SELECT OPTION [PROGRAM,  
SET-UP]

Select SET-UP, then ENTER.

A menu screen appears that includes all of the SET-UP options. Use the arrow key to scroll to individual options. When the desired option is flashing press the ENTER key and adjust the parameter. Adjustments are made using the number keypad and the ENTER key. When all SET-UP options are adjusted, or you desire to return to preceding screens, press the EXIT PROGRAM key.

2) SET CLOCK

Press ENTER, adjust the date and time using the number keypad and ENTER key. It should be synchronized with the ISCO® sampler.

3) SITE I.D. Synchronize with the site identification number used in the sampling program.

4) MEASUREMENT SETUP Press ENTER

A menu screen appears with 4 options: LEVEL READING INTERVAL, DO/PH READING, PURGE INTERVAL, and SUPERBUBBLER MODE. Adjust each option using the arrow and ENTER keys. The following are recommendations and field requirements may necessitate further adjustments. Some options require greater demands on the battery.

When these options are adjusted, select EXIT PROGRAM then ENTER to return to previous menu.

LEVEL READING INTERVAL Select CONTINUOUS, then ENTER.

DO/PH READING INTERVAL Disregard this option. Dissolved oxygen or pH meters are not available.

PURGE INTERVAL Select 30 MINUTES, and ENTER. Streams with large suspended sediment loads, contain large amounts of debris, or are aggrading may require purge intervals of greater frequency. In ephemeral streams the purge interval could be greater. Greater interval times conserve the battery life.

SUPPERBUBBLE MODE Select ON, then ENTER. This mode supplies an additional stronger blast of air to clear the air tube. It also requires additional demands on the battery.

5) STATUS Press ENTER. The flow meter will momentarily display model, revision #, and identification information, or press ENTER to proceed to the battery Status.

The SUPPLY VOLTAGE should approximate 12 volts (greater than 11.5 volts) and the PUMP DUTY CYCLE should be less than 2%. If either is out of conformity, field maintenance is required.

Replace the battery, investigate air supply problems, and/or replace the flow meter.

**This step should be made during each field visit.**

6) ENABLE/ALARM HYSTERESIS

Disregard this option. The telemetry requirements for this step are not available.

7) OPTIONAL OUTPUTS

Disregard this option. The telemetry requirements for this step are not available.

8) REPORT SETUP

Press ENTER.

A menu screen appears with 2 options, REPORT A and REPORT B. The following recommendation will provide a daily report and a weekly report. After Report A is revised, an option to revise Report B will be provided. First, select REPORT A and then Enter.

A menu screen appears with 4 options: FLOW, DO/PH, SAMPLE HISTORY, and FLOW METER HISTORY.

FLOW

Press ENTER and include LEVEL. Do not include FLOW RATE and RAINFALL in the report. The FLOW RATE will be developed from recorded level and channel dimensions by computer programs at the office. This increases the capacity of the data collection device. Rainfall gages are not available. These selections will provide a hydrograph.

PH OR DO IN REPORT

Press ENTER, select NO, and then ENTER again. A TEMPERATURE selection is then presented, select NO and press ENTER. Temperature, pH, and DO meters are not available.

SAMPLE HISTORY IN REPORT

Select YES, then ENTER. The sample history will include the bottle number, date, and time and failed attempts for each sample.

## FLOW METER HISTORY

Select YES, then ENTER. The flow meter history will include the program and date and time of each adjustment made to the flow meter.

When these options are adjusted, select EXIT PROGRAM then ENTER to return to previous menu. Select REPORT B and include the settings entered for REPORT A. The report frequencies will be entered later in the program.

### 9) LCD BACKLIGHT MODE

Select KEYPRESS TIMEOUT, then ENTER. This selection conserves the battery.

### 10) PROGRAM LOCK

Select NO, then Enter.

### 11) PROGRAM

Press ENTER. This selection returns the flow meter back to the original menu.

**This completes the Set-up options. The Flow Meter is now ready to be individually programmed specific to the site location.**

### 1) SELECT OPTION [PROGRAM, SET-UP]

Select PROGRAM, then ENTER.

### 2) LEVEL UNITS OF MEASURE

Select IN (inches), then ENTER.

### 3) FLOW RATE UNITS OF MEASURE

Select CFS (cubic feet per second), then ENTER.

### 4) TOTALIZED VOLUME UNITS OF MEASURE

Select CF (cubic feet), then ENTER.

### 5) RAINFALL UNITS OF MEASURE

Select NOT MEASURED, then ENTER.

### 6) pH UNITS OF MEASURE

Select NOT MEASURED, then ENTER.

### 7) DISSOLVE OXYGEN UNITS OF MEASURE

Select NOT MEASURED, then ENTER.

### 8) TEMPERATURE UNITS OF MEASURE

Select NOT MEASURED, then ENTER.

9) FLOW CONVERSION TYPE

Select MANNING, then ENTER.

10) MANNING CHANNEL –  
CHANNEL SHAPE

Select U-CHANNEL, then ENTER. If the ISCO® is deployed at a weir or flume select the appropriate shape.

11) MANNING U-CHANNEL

Two selections will be adjusted. The channel SLOPE, and its ROUGHNESS. Survey measurements are required for these and the following options, the channel width and maximum head. These values will subsequently be entered by the number keypad. For this exercise, select SLOPE, enter 0.015 (15%), and then ENTER. Enter 0.035 for ROUGHNESS and then ENTER.

12) MANNING U-CHANNEL WIDTH

Enter the measured channel width. For this exercise enter 96 inches (8 feet), and then ENTER.

13) MAXIMUM HEAD

Enter the measured maximum channel depth. For this exercise enter 12 inches (1 foot), and then ENTER.

A momentary pause will occur while the flow meter computes the maximum flow that will occur for these dimensions. Note this flow, approximately 14 cfs. It will be used later while adjusting the REPORTS option. Press ENTER.

14) PARAMETER TO ADJUST Select LEVEL, and the CURRENT LEVEL will be displayed. Water level measurements will be required for this adjustment. Enter the water level measured in inches above the air tube, and then ENTER. If the channel is dry enter 0, and then ENTER.

The screen will return to PARAMETER TO ADJUST, this time select NONE and then ENTER.

This adjustment is required during each visit to adjust for “drift”.

15) FLOW TOTALIZER: # CF

This is an information window screen and describes the total flow that has occurred since the flow meter totalizer was last reset. Press ENTER.

16) RESET FLOW TOTALIZER

Select YES, and ENTER.

17) ENABLE TOTALIZER

This flow is used for pulse generated sampling routines and can be disregarded. Press ENTER and adjust the following RESET condition to 0, or select NO and then ENTER.

18) SAMPLER PACING

Select DISABLE, then ENTER. This option is also for pulse-generated signals that could enable the sampling rate. Samples could be collected on flow volume. Due to the unpredictability of storm events this option has not been used.

19) SAMPLER ENABLE MODE

Select CONDITIONAL, then ENTER.

This option provides the logic command that will signal the sampler to begin its sampling program.

20) CONDITION

Select LEVEL, then ENTER.

21) LEVEL

Select GREATER THAN, then ENTER.

22) LEVEL GREATER THAN # IN

Use the number keypad to select a level rise for a predicted storm event. Select 5 and ENTER.

For many watersheds 5 inches will capture most storm events. The risk is missing a later, more significant flood. This is a judgment that will be developed with experience.

- 23) OPERATOR  
Select DONE, then Enter.
- 24) WHEN ENABLE CONDITION IS  
NO LONGER MET  
Select KEEP ENABLED, then ENTER.  
Allowing the sampler to remain enabled provides the opportunity to continue collecting at the trailing leg of the hydrograph.
- 25) **ENABLE CURRENTLY  
LATCHED, RESET?**  
Always chose YES. This will clear the enable signal to the sampler and prepare it to accept a new signal from rising water of the next storm event.  
  
This option occurs only if the sampler has been enabled, but failing to reset the latch is one of the most common and serious mistakes made while reprogramming the ISCO® sampling equipment.
- 26) PLOTTER ON/OFF WITH  
ENABLE  
Select YES, the ENTER.
- 27) ALARM DIALOUT  
Select DISABLE, then ENTER. The telemetry equipment for this option is not available.
- 28) PLOTTER SPEED  
Select ½ “/HR, then ENTER. Greater plotter speeds create unnecessary battery and plotter paper supply demands.
- 29) INPUT FOR PLOTTER LINE A  
Select LEVEL, then ENTER.
- 30) PLOTTER LINE A FULL SCALE  
Select 15inches, then ENTER.  
  
Select a value that is greater than the maximum head and retains a grid easily read on a paper scroll. For example the maximum head for this exercise is 12 inches, the grid contains 10 increments on

the paper scroll. Therefore, by selecting 15 inches each increment is equal to 1.5 inches.

31) INPUT FOR PLOTTER LINE B

Select FLOW RATE, then ENTER.

32) PLOTTER LINE B FULL SCALE

Select 15 cfs, then ENTER.

The maximum head for this exercise is approximately 14 cfs. Choosing 15 cfs generates a hydrograph with an appropriate scale that can be easily read.

33) INPUT FOR PLOTTER LINE C

Select OFF, then ENTER.

34) REPORT GENERATOR A

Select ON, then ENTER.

35) REPORT A DURATION TO BE IN

Select DAYS, then ENTER.

The following options generate reports on daily and weekly periods. Useful information regarding maximum, minimum, and average daily flows, sample history, and flow meter program adjustments are contained in these reports.

36) REPORT A DURATION

Select 1 day with the number keyboard, then ENTER.

37) PRINT FIRST REPORT A AT

Adjust the date and time the first daily report will be expected. Commonly the following day at midnight is selected.

38) REPORT GENERATOR B

Select ON, then ENTER.

39) REPORT B DURATION TO BE IN

Select DAYS, then ENTER.

40) REPORT B DURATION

Select 7 days with the number keyboard, then ENTER.

41) PRINT FIRST REPORT B AT

Adjust the date and time the first weekly report will be expected.

42) PRINT FLOW METER HISTORY                      Select NO, then Enter.

43) CLEAR HISTORY                                    Select NO, then ENTER.

This concludes the flow meter programming sequence. Return to the ISCO® sampler, it should be in STANDBY, and hit the START SAMPLING key. The sampler should display SAMPLER INHIBITED. You are ready for the next storm event.

### **PROCEDURE FOR COLLECTING SAMPLES AND RESETTING THE ISCO® AFTER A SAMPLE HAS BEEN TAKEN**

The sampler should display DONE, OR PROGRAM HALTED. Press the DISPLAY STATUS key. The following logic sequence provides the date and times of the enable signal, and for each attempted sample bottle collection. It also provides abbreviated messages describing potential failures. RECORD THIS DATA IN THE FIELD LOGBOOK.

LABEL EACH BOTTLE WITH SITE ID, BOTTLE NUMBER, AND DATE AND TIME. Cap with clean bottle lids. The lids are commonly stored in sealed containers stored within the ISCO® carousel. The bottles can now be replaced individually or by replacing a carousel loaded with clean sample bottles. Remove the lids and store them in a sealed container within or near the sampler

Review the RUN DIAGNAOSTICS option under the configure menu to test the computer Ram/Rom and distributor. Occasionally the bottles become misaligned and prevent the armature from rotating. Under CONFIGURE used the arrow keys to scroll directly to the RUN DIAGNOSTICS option, and then press ENTER.

If necessary, the ISCO® program may be adjusted by scrolling through its menu options. The times, volumes, and sample array may be adjusted. Enter the PROGRAM menu, press the ENTER key to pass through each option, or adjust each setting that is required.

When this is completed and the sampler is back in STANDBY, review the following flow meter program steps: the LEVEL ADJUSTMENT, RESET TOTALIZER, and SAMPLER ENABLE. These steps are listed on the front of the flow meter and can be quickly accessed by using the GO TO PROGRAM STEP key on the meter. Adjust the level if necessary, reset the totalizer, and most importantly RE-LATCH the ENABLE function. Under the SET-UP menu, got to the STATUS option. Check and record the battery and power supply status. When the flow meter has been inspected, return to the sampler and press the START SAMPLING key. The sampler should read 'SAMPLER INHIBITED". You are ready for the next storm event.

### **RAPID TRANSER DEVISE and FLOWLINK**

The Rapid Transfer Device (RTD) is a field data collection unit that can retrieve data from multiple ISCO® flow meters. The device then uploads that information to your office computer through the ISCO® Flowlink program. Flowlink can then generate individualized reports including stream hydrographs, flow, and sample history.

The RTD automatically collects the available data reports from multiple instruments in the field and saves each report separately. Back in the office, the RTD connects directly to your PC with its own power cable and ISCO® software. With a few keystrokes, the data collected from every new site will be uploaded to files on your PC's hard drive. When the data reports have been uploaded from the RTD at least once, the RTD is ready for use again in the field

## **RAPID TRANSFER DEVICE INSTRUCTIONS**

### **Collecting Data with the RTD**

The RTD has three colored indicators on one end. These lights report the status of the RTD and show the result of each data transfer.

To collect data:

1. Plug the RTD into the instrument's interrogator connector. The interrogator connector is labeled with the interrogator icon, a small computer icon.
2. While the RTD is operating, the yellow light will blink to indicate power, and then the green light will blink as the data reports are collected.
3. The green light will remain constant when the transfer is successfully completed. With this light constant, you can be sure that all the data has been collected and stored within the RTD.

A red light reports two other RTD conditions: *Memory Full* or *Transfer Error*.

A constant red light indicates a *Memory Full* condition. There is not enough RTD memory available to collect data reports from another instrument similar to the one now connected. Check the green light to see if the last transfer was successful. Uploading the data reports from the RTD to your PC files will allow the RTD to reuse the memory.

A blinking red light reports a *Transfer Error*. The RTD was unable to complete the transfer. Unplug the RTD, wait briefly, and repeat step 1. If that does not work after several tries, check the voltage level of the instrument's power supply, then make sure the connection between the RTD and the instrument is clean and dry. If this fails, call the ISCO® Customer Service Department.

### **Uploading Data to a PC**

You can upload the data collected by the RTD to your personal computer with ISCO® Flowlink™ software.

Flowlink 4 – uploads text reports and detailed data for management of your monitoring data. You control the data as site files in a database. It is used for analyzing, viewing, editing, and printing. In addition, you can produce custom graphs, summaries, and reports.

Your personal computer must have a serial RS-232 port and ISCO® 's Flowlink software installed. Connect the RTD to your PC with the RTD Power Cable. This cable powers the RTD through a wall- outlet connection, and links the RTD to the PC's serial port.

To upload data with ISCO® 's Flowlink 4: Refer to the instructions in the following Flowlink chapter, for more details refer to the Flowlink Tutorial.

### **RTD Data Capacity**

The RTD can collect data from a maximum of 255 ISCO® instruments, or until the maximum storage capacity of over 900,000 bytes is reached. When you reach either maximum value, the RTD will not accept more data until the data already collected is uploaded to a PC. After the data reports are successfully uploaded from the RTD, the storage space occupied by those reports is made available to collect new data from field instruments.

## **FLOWLINK INSTRUCTIONS**

### **General**

Flowlink 4 uses the intuitive *Windows* operating and graphics format. Pull-down menus and pop-up windows let you quickly make selections and move through program features. Convenient help windows provide step-by-step instruction for each aspect of the program. The software can generate data evaluation charts and graphs, and programs and set-up features for the ISCO® sampler and flow meter similar to described in the introductory chapters of this SOP.

- A. The software can set up and retrieve data from the memory of ISCO® 4200 Series Flow Meters, and 581 Rapid Transfer Devices.
- B. The software is compatible with Microsoft Windows 95, 98 and NT, and can run on an IBM PC or compatible computer. The software uses pull-down menus and pop-up windows, and includes a menu bar, toolbars, workspace, window and status bar.

- C. The software includes on-line, context sensitive help screens that provide specific guidance for each step of the program.
- D. The software stores all data in an industry standard Microsoft Access database. All sites and their associated data sets, graphs and tables, and schedules can be displayed in a workspace. The user has the capability to create folders to organize the workspace.

### **Site Setup and Data Retrieval**

The software allows the user to enter a new site name and clear the data storage in the flow meter when moved.

#### **A. Basic Information**

Upon connection to a flow meter, the software displays the site name, model number, sensor type, flow conversion, software revision, instrument ID, instrument date and time, and communication setup. The software can also display the type, voltage and remaining capacity of the battery.

#### **B. Measurements**

- 1. The software displays the level, flow rate, total flow, and the sampler enable status. The software also sets the flow stream level in the flow meter. The software can also display the sampler enabled flow for 4200 Series Flow Meters.
- 2. The software can include diagnostics that display status messages from a 4200 Series Flow Meter for power failed, paper out, printer jammed and printer power.

#### **C. Site Setup**

- 1. The software can set the site name, instrument date and time, and password for each flow meter, and zero the totalizer in the flow meter.
- 2. The software can display and save to a file the program, two summary reports, and history report from a 4200 Series Flow Meter.

#### **D. Data Storage**

- 1. The software can divide the memory in a 4200 Series Flow Meter into up to 12 memory partitions. Each partition can store level, flow rate, or sampler data. The interval for storing data in each partition other than

sampler partitions can be selectable from 1, 2, 5, 10, 15, 30, 60, or 120 minutes, and the time span for each partition can be entered in days and hours. For sampler partitions, the number of samples can be entered. Each partition can operate in rollover, slate, or triggered slate modes. The size, data storage interval, and data storage mode of each memory partition does not have to be the same. The reading type, reading interval, time span, and recording mode for each partition can be visible even when the computer is not connected to the flow meter.

- a. In rollover mode, readings can be stored in memory continuously. When the memory is full, the oldest reading can be replaced by the newest reading.
- b. In slate mode, readings can be stored until the memory is full, at which time storage can stop. The memory can hold these readings until it is restarted.
- c. In triggered slate mode, the memory can operate as a rollover partition until a triggering event occurs. Once the triggering event occurs, the memory can operate as a slate only partition and store readings until it is full. The memory can hold these readings until it is restarted. The triggering event can be an AND/OR combination of up to four conditions, where each condition can be either level, flow rate, volume, or time. Each condition other than time can be either greater than or equal to a set point, less than or equal to a set point, or a rate of change over a time period. A duration operator can be available to modify the condition. A time condition can include up to four start and stop time periods, where each time period can be either daily, weekly, Monday through Friday, or a specific time. A NOT operator can be available to modify any condition other than time. Parentheses can be available to group conditions.

2. Stored data retrieved from 4200 Series Flow Meters and 581 Rapid Transfer Devices are stored in an industry standard Microsoft Access database.

#### E. Primary Device

1. The software sets the primary device in the flow meter. Flow conversions can include weirs, flumes, and the Manning formula, equations, and data points. Weirs can include V-notch, rectangular with and without end

contractions, Cipolletti and ISCO® Flow Metering Inserts. Flumes can include Parcan, Palmer-Bowlus, Leopold-Lagco, HS, H, HL and trapezoidal. The Manning formula can include round, U-shaped, rectangular and trapezoidal channels with the slope and roughness coefficient. Equations can be a two term polynomial equation. Data points can include up to 50 pairs of points to convert level to flow rate or area. The software can store four sets of data points for the 4200 Series Flow Meters.

2. The software can retrieve the primary device from the flow meter for use in converting level into flow rate.

#### F. Sampler Setup

1. The software can program the flow meter to enable a connected sampler. The flow meter can enable the sampler continuously, disable it continuously, or enable it conditionally. The conditions for enabling a sampler with a 4100 Series Flow Logger or 4200 Series Flow Meter can be selectable from the same types of conditions that are used to trigger a triggered slate memory partition.
2. The software can program the method by which the flow meter can pace a connected sampler. A 4200 Series Flow Meter can either flow pace or trigger pace a sampler.
  - a. For flow pacing, the software can program the volumetric interval at which the flow meter can send a signal to a connected sampler.
  - b. For trigger pacing, the software can program a triggering condition and two time pacing intervals, one that is used if the triggering condition is true and one that is used if the triggering condition is false. The conditions for trigger pacing can be selectable from the same types of conditions that are used to trigger a triggered slate memory partition.

#### G. Units

The software can set the units of measure for level, flow rate, and total flow.

### Software Updates

- A. The software can update the flash memory in 4200 Series Flow Meters, and the 581 Rapid Transfer Devices with a new program without requiring the user to open the instrument enclosure. The software can also have the capability to reset the program to factory defaults.
- B. The software can import ASCII data from a spreadsheet file in comma separated value format. The software can import multiple columns of data from a spreadsheet file, and can identify the type of data, units of measure, resolution, and number of significant digits based on the header information in the spreadsheet file.

### **Editing Data**

The software can include capabilities for adjusting the times and values of stored readings. The software can display the original and edited data in a graph, and can display the edited data in a table. The software can save both the original and edited data, and can include the capability to restore the edited data to the original values. The software can include the capability to undo all editing since the last time changes were saved. The software can cut or copy data from one time period and paste the data into another time period. Types of reading adjustments can be constant, fixed, and proportional. A constant adjustment can set all selected readings to a constant value. A fixed adjustment can add or subtract a fixed value from all selected readings. A proportional adjustment can distribute a positive or negative value over all selected readings.

### **Graphs and Tables**

- A. The software can display and print graphs and tables of data from the database.
  - 1. The software can generate a line graph with the most recent data from a data set under a site in the database when the data set is double clicked. The graph can be automatically scaled based on the data that is graphed, the color for the line on the graph can be automatically selected, the label for the line can be automatically set to the label of the data set in the database, the time span of the graph can be a user selected default, and the total value of the data over the time span or the average value of the data over the time span can be displayed below the label. The software can add an additional pane to the graph with a line graph of the data from an additional data set under the same site or a different site in the database when the additional data set is dragged and dropped onto the graph. The second pane can be automatically scaled based on the data that is graphed, the color for the line on the graph can automatically be different from that of the line in the first pane, and the label and the total or average value can be automatically set in the same manner. The software can allow graphs with up to 4 panes to be generated in this manner.

2. The software can convert a graph into a table, and vice versa, with a single click. The average and total values of the data over the time span for flow rate and rainfall data, and the average value of the data over the time span for all other types of data can be displayed at the bottom of the table.
3. The time span for a graph or table can be any number of hours, days, weeks, months or years, and can begin with either the current or prior day, week, or month, a relative day and time, or an absolute date and time. Dates can be selected from a calendar.
4. The software can allow the user to enter a label for each line, select the type of each line to be a line graph, a bar graph or a point graph, and select the units of measure, pane, Y axis, color, line type and symbol for each line.
5. The software can generate graphs with up to 4 panes, with a user specified relative height for each pane.
6. The software can generate graphs with up to 4 Y-axes, with each Y axis either automatically or manually scaled.
7. The software can print graphs and tables in either portrait or landscape orientation.
8. The software can include the capability to scroll the graph or table 25% of the time span to the left and right, to scroll the graph or table to the previous and next time span, and to scroll the graph or table to the beginning and end of the data.
9. The software can display the date, time and value at a cursor on a graph when a location on the graph is clicked. The cursor can move to the left and right on the graph, and between the different lines on the graph, by using the arrows on the computer keyboard.
10. The software can zoom into a selected time span on a graph.
11. The software can allow the user to magnify the time scale on a graph, decreasing the time span that is displayed, and un-magnify the time scale on a graph, increasing the time span that is displayed.
12. The software can allow the user to specify that a line in a graph or table be generated using either original or edited data.

13. The software can allow the user to display date, time and bottle number of samples in graph and tables.
14. The software can have the capability to generate graphs and reports with data from more than one site.
15. The software can have the capability to convert level and velocity data into flow rate based on a variety of flow conversions, including those retrieved from instruments and those generated independent of the instruments.
16. The software can allow the user to enter a relative time shift, or an absolute date and time, for each data set so that data from more than one different time period can be compared.
17. The software can have the capability to generate graphs and tables that include addition, subtraction, multiplication and division of data.
18. The software can have the capability to generate graphs and tables that include average, minimum, maximum and total values calculated over a specified summary interval, and to include the date and time of the minimum and maximum values in tables.
19. The software can have the capability to create and save graph/table templates using data from any site, with all properties of the graph or table specified by the user. When a different site is dragged and dropped onto a template, the data from this site can be substituted for the template site, with all other properties of the graph or table remaining identical to that of the template. The software can then allow the user to save the new graph or table.
20. The software can include over 150 standard graph/table templates, including a variety of graphs and tables, with daily, weekly and monthly time spans, with one and more than one data types, with raw data and average, minimum, maximum and total data. When a site is dragged and dropped onto a template, the data from this site can be displayed on the template, with all other properties of the graph or table remaining identical to that of the template. The software can then allow the user to save the new graph or table. The software can allow the user to modify the standard templates and save the new templates.
21. The software can have the capability to save the data from the lines of a graph or the columns in a table as datasets in a new site, so that these calculated datasets can be included in other graphs and tables.

## **Exporting Data**

The software can export the data from any graph or table to an ASCII spreadsheet file in comma separated value format for analysis with other software. The file can include a header identifying the type of data, units of measure, resolution, and number of significant digits for each column in the file, followed by the date and time in the first column and one column for each line in the graph or table.

## **Object Linking and Embedding**

The software can support Object Linking and Embedding (OLE), allowing graphs and tables from the software to be embedded in and linked to Microsoft Word documents, Excel spreadsheets, and PowerPoint presentations. Selecting a graph or table embedded in or linked to a file in another application can activate the software, allowing access to the database from which the graph or table was embedded or to which it is linked. When a graph or table from the software is linked to a file in another application, the data in the graph or table can be automatically updated when the file to which it is linked is opened.

## **Data Backup, Archive and Transfer**

- A. The software can have the capability to back up the database. The software can compress the backup data and store it on a zip drive, floppy disks, or a network drive. The software can also have the capability to restore the database from backup.
- B. The software can have the capability to archive and transfer data from the database. Archiving data can remove the data from the database, while transferring data can make a copy of the data for transfer to another computer but cannot remove the data from the database. The software can have the option to compress the archived or transferred data, and can store the data on a zip drive, floppy disks, or a network drive. The software can also have the capability to restore data from archive.