RF/RMRS-00-341

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ROCKY FLATS ENVIRONMENTAL TECHNOLOGY SITE

AUTOMATED SURFACE-WATER MONITORING

FY00 WORK PLAN

AUGUST 2000

SW-A-004116

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RF/RMRS-00-341

ROCKY FLATS ENVIRONMENTAL TECHNOLOGY SITE
AUTOMATED SURFACE-WATER MONITORING
FY00 Work Plan

U.S. DEPARTMENT OF ENERGY

Rocky Flats Environmental Technology Site

Golden, Colorado

Prepared By:

RMRS Rocky Mountain Remediation Services, L.L.C.
... protecting the environment

Sitewide Surface Water

Approved By: George S. Spall IV 9/28/00
Project Manager (Date)

[signature] 9/28/00
Water Programs Manager (Date)

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1. PURPOSE

This work plan describes the automated surface-water monitoring program for implementation of the *Rocky Flats Cleanup Agreement* (RFCA, 1996a) at the Rocky Flats Environmental Technology Site (Site) in accordance with the *RFETS Integrated Monitoring Plan* (IMP) *and Background Document* (Kaiser-Hill, 1999a and 1999b) and the *Industrial Area Interim Measures/Interim Remedial Action Decision Document* (IA IM/IRA) (EG&G, 1994). The IMP provides a framework for monitoring in support of transition activities at the Site. This framework includes implementation of a high-resolution surface-water monitoring program that supports data-driven decisions determined by the IMP Data Quality Objectives (DQO) process. This monitoring program is intended to provide:

- Monitoring of multiple parameters for the safe and effective operation of the Site detention ponds;
- Monitoring of flows and contaminant levels in sub-drainages to allow for the location of contaminant sources;
- Monitoring of various surface-water parameters at various locations on an Ad Hoc basis in support of special projects and/or building operations;
- Monitoring of Pu and TSS values at various locations to determine a correlation between Pu and TSS;
- Detection of a release of contaminants from specific high-risk projects within the Industrial Area (IA);
- Detection of statistically significant increases of contaminants in runoff from within the IA in general;
- Detection of contaminants exceeding RFCA Action Levels in discharges entering Stream Segment 5 and the Site detention ponds;
- Detection of contaminants exceeding RFCA Standards in discharges entering Stream Segment 4;
- Monitoring of indicator parameters in discharges leaving the Site boundary as a prudent management action; and
- Monitoring of flows and water-quality in the Buffer Zone (BZ) for ecological and water rights issues, as well as supporting studies into the interaction between media.

This is a "living" document which will be updated annually, if needed, to ensure that it is current, complete, accurate, and applicable.

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2. SCOPE

This work plan includes:

- an identification of applicable regulatory and quality assurance requirements,
- an identification of organizational responsibilities including personnel qualifications and training,
- a description of the site automated surface-water monitoring program and monitoring network,
- a description of the specific monitoring tasks,
- a brief discussion of applicable health and safety requirements,
- a schedule for program activities and deliverables, and
- a brief overview of project funding.

3. SETTING

The Site is a government-owned, contractor-operated facility which is part of the DOE nuclear weapons complex, located in Golden, Colorado. The Site is owned by the U.S. Department of Energy (DOE), managed by the DOE Rocky Flats Field Office (DOE, RFFO), and operated by Kaiser-Hill, L.L.C. (K-H). The RFCA surface-water monitoring program is managed and implemented by Rocky Mountain Remediation Services, L.L.C. (RMRS), Water Programs / Surface Water (SW) Group, under contract to Kaiser-Hill.

This program will be implemented at multiple locations throughout the Site. The Site land area is functionally divided into two regions: the Industrial Area (IA; industrialized area inside the inner fence) and the Buffer Zone (BZ; the open space surrounding the IA but within the DOE property line). Figure 3-1 shows the locations of the automated surface-water monitoring locations.

Each surface-water monitoring location is equipped with automated environmental instrumentation capable of satisfying the location-specific data acquisition requirements. Precipitation data is also collected at additional locations as a prudent management practice. Section 6 gives details on the objectives for the automated surface-water monitoring program.

Figure 3-1. RFETS Automated Surface-Water Monitoring Locations and Precipitation Gages.

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4. WORK PLAN COMPLIANCE

Implementation of this work plan will comply with the requirements established by the RFCA for clean-up of the Site under the Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA) and the Superfund Amendments Reauthorization Act as specified in the RFETS IMP (FY2000). All work performed under this project will be controlled by Site Standard Operating Procedures (SOPs) and employ standard analytical methods. This section identifies and addresses the regulatory and quality assurance (QA) requirements that are applicable to the automated surface-water monitoring program.

4.1 REGULATORY REQUIREMENTS

The automated surface-water monitoring program will be conducted to satisfy the requirements detailed in the following regulatory documents:

- *Rocky Flats Cleanup Agreement (RFCA)* (RFCA, 1996a)
- *Industrial Area Interim Measure/Interim Remedial Action Decision Document (IM/IRA)* (EG&G, 1994)
- *RFETS Integrated Monitoring Plan (IMP)* (Kaiser-Hill 1999a and 1999b) (required by RFCA)

4.2 HEALTH AND SAFETY REQUIREMENTS

Health an safety requirements for the automated surface-water monitoring program are detailed in the following document:

- *Health and Safety Plan for Automated Surface-Water Monitoring in Support of the Rocky Flats Clean-up Agreement and the Industrial Area IM/IRA* (Doc# RF/RMRS-97SWHSP.01; Revision 0; 8-15-97).

4.3 QUALITY ASSURANCE REQUIREMENTS

Quality assurance requirements contained in the *RMRS Quality Assurance Program Plan (QAPD)* (RMRS, 1998b) are applicable to the work activities described herein. The RMRS QAPD stipulates project-specific QA requirements to be addressed in project implementation documents. The specific QA document for this project is the *Quality Assurance Program Plan for the Automated Surface-Water Monitoring Program (QAPP)* (RMRS, 2000a).

When required, work shall be performed in accordance with Site SOPs. Log books shall be kept in accordance with Site procedure to document equipment installation, calibration, maintenance, and sample collection activities. Annual management assessments will be used to evaluate the effectiveness of the quality assurance program for the project.

5. ORGANIZATIONAL RESPONSIBILITIES AND PERSONNEL QUALIFICATIONS

5.1 ORGANIZATIONAL RESPONSIBILITIES

Kaiser-Hill L.L.C. under contract to the U.S. Department of Energy, is responsible for developing and implementing integrated environmental monitoring programs for all media (i.e., air, ecology, groundwater and surface water) at the Rocky Flats Environmental Technology Site (RFETS). K-H retains program integration and management responsibility and subcontracts for scientific, engineering, and technical support program implementation. For the surface water monitoring program, K-H has contracted with Rocky Mountain Remediation Services (RMRS) and International Engineering Corporation (IEC) for these services.

The K-H and subcontractor organizations and individuals directly involved with the implementation of surface water monitoring described herein are illustrated in Figure 5-1. RMRS scope includes program planning, implementation, equipment installation, operation, and management. RMRS provides cost estimation and project performance tracking support, and regulatory and programmatic guidance.

RMRS collects water quality samples and field data; performs data quality reviews, data compilation, data reduction and evaluation; and environment reporting. RMRS is also responsible for routine inspection and maintenance of the monitoring system including telemetry, automated samplers, flow meters, and water-quality monitoring equipment

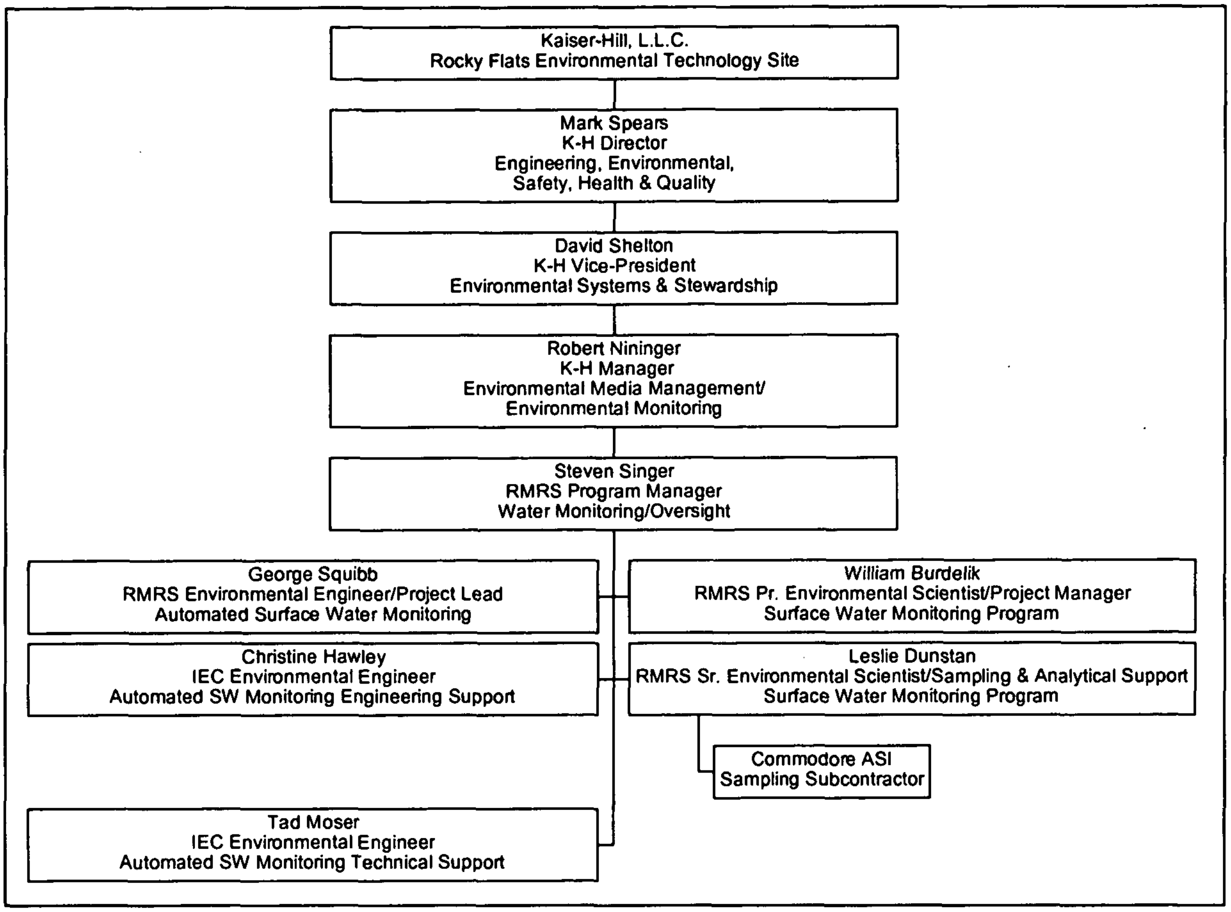

Figure 5-1. Automated Surface-Water Monitoring Organizational Chart.

Various other K-H Environmental Systems and Stewardship (ESS) and K-H Remediation, Industrial D&D, and Site Services (RISS) organizations are responsible for health and safety, quality assurance and control, radiological engineering, species and habitat surveys for compliance with the Threatened and Endangered Species Act, Section 404 of the Clean Water Act and Executive Order 11990 for protection of wetlands, the Migratory Bird Treaty Act, and other laws applicable to potential ecological impacts from the installation of the monitoring equipment. Other required services for construction, excavation (a.k.a. soil disturbance) permits, and hazardous waste determinations are provided by K-H and K-H subcontract organizations.

Finally, Commodore Advanced Sciences Inc. (CASI) provides sampling technical support for sample preparation, shipment, and tracking. RMRS personnel physically collect the composite surface-water samples from the field and deliver them to CASI. CASI splits the composite samples into separate bottles with appropriate preservatives for shipment to laboratories under contract with K-H Analytical Services for the required chemical analyses.

5.2 PERSONNEL QUALIFICATIONS AND TRAINING

The qualifications for the Project Lead include at least a M.S. degree in Civil/Environmental Engineering, or related discipline plus a minimum of five years of professional experience in surface-water data collection, compilation, and evaluation and/or project management. Training requirements shall include, current 40-hour OSHA in compliance with 40 CFR 1910.120, unclassified computer security, contract technical representative, electrical safety for non-electrical worker, and general employee radiological training (GERT). The project lead must be knowledgeable of Site SOPs, complete on-the-job training in stream gaging, water sampling, and the use of automated monitoring equipment, possess computer (PC) training/experience, and be familiar with regulatory documents and requirements.

Primary technical support personnel providing assistance to the Project Lead shall have at least five years experience in environmental project work (or an MS degree), including at least three years of field data collection experience. Training requirements for technical personnel include a basic understanding of the contents of this technical design document, training in applicable Site SOPs, 24-hour OSHA training, unclassified computer security, GERT, PC proficiency, and on-the-job training in the use of automated monitoring equipment and surface-water sample collection systems.

All subcontracted field and laboratory personnel shall be familiar with Site SOPs and laboratory procedures applicable to their assigned tasks. They shall also meet any qualification and additional training requirements listed by the procedures that they use.

6. PROGRAM MONITORING OBJECTIVES

The Site automated surface-water monitoring network is designed to meet the requirements documented in the Site IMP, which groups all Site surface-water monitoring objectives into five primary categories: Site-Wide, Industrial Area, Industrial Area Discharges to Ponds, Water Leaving the Site, and Off-Site. The ten objectives for FY00 to be accomplished through the automated monitoring detailed in this work plan are described in the following sections. The Site monitoring network currently consists of 45 monitoring stations (Figure 3-1) to achieve these objectives. Many of these locations include radio-telemetry[1] for data transmission. In some situations, the same location may serve multiple objectives. Monitoring tasks and data collection, compilation, evaluation, and reporting for each objective are detailed in Section 7.

The IMP used the Data Quality Objective (DQO) process to determine necessary and sufficient monitoring requirements. The process yielded 19 individual, data-driven, surface-water monitoring objectives (a.k.a. decision rules under the DQO process), a subset (9) of which is covered in this document. Some decisions need a higher priority than others, and some need greater confidence. The DQO process produced descriptions that expose the strengths and weaknesses of each data-driven decision and the value of the data (resources required) in making each decision. Management decisions often must be made on the basis of incomplete information. The individual DQO sections of the IMP document guide management in establishing funding priorities for surface-water monitoring objectives.

IMP automated surface-water monitoring objectives are organized in a roughly upstream-to-downstream direction, beginning with Performance monitoring within the IA and ending downstream at the Points of

[1] Telemetry is a valuable tool for the efficient operation of extensive automated monitoring networks by limiting time-consuming field visitation. Telemetry provides real-time information routinely used to manage systems such as the Site detention ponds. Similarly, telemetry provides the status of automated sampling equipment (the rate of sample collection is controlled by the weather; i.e. runoff volumes from precipitation events), thereby greatly reducing the need for field visitation.

For almost all data, telemetry is the secondary data collection platform. The vast majority of information collected under this program is downloaded (monthly or as needed) by laptop computer from the individual instruments in the field. Analytical data is received from the contracted laboratories.

Compliance at Indiana Street (Figure 6-1). These monitoring objectives, as well as sitewide objectives, are summarized in the following paragraphs and are discussed in detail in the remainder of this section.

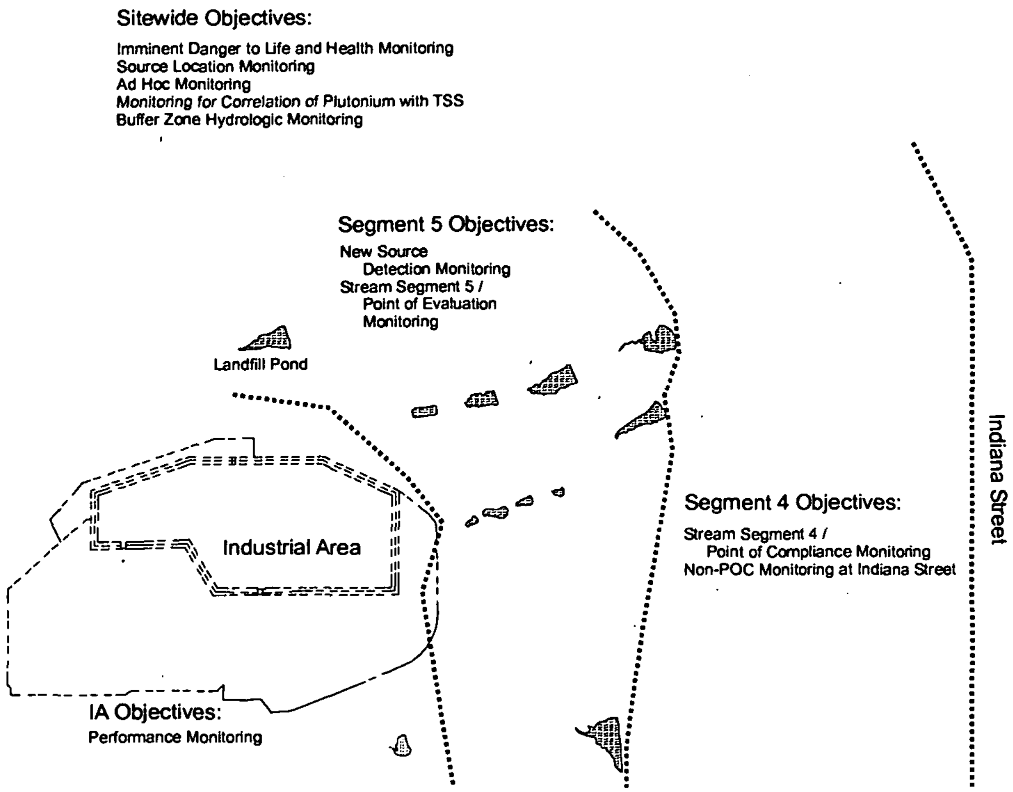

Figure 6-1. Conceptual Model of Site Automated Surface-Water Monitoring Objectives.

Monitoring objectives that do not fit into the upstream-to-downstream sequence are considered as Site-Wide Monitoring Objectives. For example, safe operation of the dams is dependent on some monitoring to avoid breaching a dam. This monitoring objective is placed first (see Section 6.1), in recognition of its unique importance in avoiding imminent danger to life and health (IDLH).

Another sitewide monitoring objective, Source Location monitoring (covered in Section 6.2), is designed to locate a source of contamination detected by other monitoring objectives. Source Location monitoring can take place anywhere in the area shown in Figure 6-1; therefore, it does not fall into the upstream-to-downstream order. Unplanned, special request monitoring activities are discussed as Ad Hoc monitoring in Section 6.2.1. For example, monitoring may be performed at various locations to evaluate alternatives for surface water management, such as controlled-detention pond management or re-routing of wastewater treatment plant (WWTP) effluent. Similarly, monitoring may need to be performed to provide data to special projects such as Actinide Migration Evaluation and the Site-Wide Water Balance.

In the first of the upstream-to-downstream monitoring category (IA Objectives), the IMP and the IA IM/IRA Decision Document require the Site to characterize significant surface-water releases within the IA. Within the IA [usually], individual high-risk projects will sometimes warrant Performance monitoring (Section 6.4.1) to detect a spill or release of contaminants specifically associated with that project.

In the next of the upstream-to-downstream monitoring category (IA Discharges to Ponds / Segment 5 Objectives), the IMP and the IM/IRA require the Site to identify and correct significant accidental or undetected releases of contaminants from the IA to the Site Detention Ponds (surface water leaving the IA and entering Segment 5). Sections 6.6 and 6.7 deal with discharges from the IA to the ponds.

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In order to decide whether a significant release has occurred, the Site shall perform New Source Detection (NSD) monitoring of IA runoff for significant increases in contaminants (see Section 6.6). Additionally, RFCA specifies monitoring for the upstream reaches of Site drainages (above the ponds) and specifies action levels for contaminants (Action Level Framework). This Stream Segment 5 / Point of Evaluation (POE) monitoring is addressed in Section 6.7.

The next, and perhaps most significant monitoring category, is Terminal Detention Pond Discharges and Water Leaving the Site (Segment 4 Objectives). The Site is required to monitor at Points of Compliance (POCs) below the terminal ponds to protect state stream standards in Segment 4 (Section 6.8), as specified in RFCA. In addition, there are RFCA POCs that are monitored at the Site boundary and Indiana Street (Section 6.8) for both Walnut and Woman Creeks.

Finally, Buffer Zone Hydrologic monitoring occurs at various locations across the Site and addresses the interfaces between surface water and other media: soil, groundwater, air, and ecology (Section 6.10). For example, groundwater and soil could conceivably contaminate surface water, and surface water could contaminate habitats of endangered species.

6.1 IDLH DECISION MONITORING

This IDLH section uses the term "action level" in reference to dam operations. This is an entirely different usage, unrelated to the RFCA Action Levels discussed elsewhere in this document and refers specifically to operational pond management decisions.

The Site has a network of detention ponds with earthen dams (Figure 3-1). Failure of an earthen dam would present an immediate danger to life and health. Safety and health professionals often refer to such conditions as IDLH conditions. The Site's detention ponds can only hold a limited amount of water safely. Water may be discharged from these ponds through the outlet works or by pumping. Water does not normally overtop the dams, which are all of earthen construction and would be damaged and could fail under those conditions. Heavy rain or snowmelt can challenge the capacity of the ponds faster than the ponds can be predischarge monitored and subsequently batch discharged.

If water levels rise above safety limits that preserve dam integrity, then ponds must be discharged to prevent overflow or breaching[2]. The risk to the public and environment is far greater from a dam breach than from the normally low levels of contaminants that might be found in pond waters.

The actual decision process for managing pond operations and conducting pond and dam monitoring activities is too complex to be treated in this document. Detailed information can be found in the *Pond Operations Plan* (POP; RMRS, 1996b) and the *Action Level Response Plan for Dams A-4, B-5, or C-2* (RMRS, 1998a). *Generalized decisions* must be made on a continuous basis for Ponds A-3, A-4, B-5, C-2, and the Landfill Pond based on the factors discussed in Section 6.1.1. A series of simultaneous equations are solved via an expert system framework to consider actions associated with modeled action levels.

This section deals solely with the *automated* monitoring required for the safe operation of the Site detention ponds.

6.1.1 Data Types, Frequency, and Collection Protocols

The decision factors include safe pond capacity, actual pond elevation, current and projected flow rates into and out of the ponds, and several indicators of dam integrity, such as piezometer readings, inclinometer readings, and cracks or sloughs of embankment material. The automated information needs are as follows:

[2] Maximum discharge rate for Site earthen dams is one foot per day to achieve drawdown without inducing sloughing of the saturated sides of the dam.

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- Pond inflow rates into Ponds A-3, A-4, B-5, and C-2 must be continuously monitored (average daily to hourly measurements with instantaneous capability).[3]
- Pond elevation must be monitored continuously (average daily to hourly measurements with instantaneous capability) for Ponds A-3, A-4, B-5, C-2, and Landfill.[3]
- Measurements from piezometers in selected dams are needed to indicate water pore pressure in dam structures (Ponds A-3, A-4, B-5, C-2, and Landfill; 8-hour average measurements with instantaneous capability).
- Discharge rates from Ponds A-3, A-4, B-5, and C-2 must be continuously monitored (pumped or released through outlets; average daily to hourly measurements with instantaneous capability).[3]

Flow in streams upgradient to Ponds A-3, A-4, B-5, and C-2 are used in decision making. Likewise, piezometers in each dam and the water volumes in each pond are included in decision making. The only dams that are normally operated to contain and/or release water offsite are A-4, B-5, and C-2 in the North Walnut Creek, South Walnut Creek, and Woman Creek drainages, respectively. Pond A-3 must also be included in the IDLH decision rule since it is routinely used to manage water in N. Walnut Creek before being discharged to Pond A-4. Similarly, the Landfill Pond is routinely managed for pump transfer to the A-Series Ponds.

Information may be collected at varying time intervals based on the pond conditions and rate of change of the specific parameter. Average hourly inflow rates, average hourly outflow rates, 8-hour average dam piezometer levels, and average hourly pond levels are all routinely transmitted by telemetry. Most decisions are made Monday through Friday on a daily basis; however, during a crisis situation, hourly decisions may be made seven days a week. The Site also maintains instantaneous measurement capability for all telemetry data.

Site personnel determine the frequency and type of automated monitoring, as appropriate, to identify any structural problems in a timely manner consistent with standard industry practices and applicable regulations.

6.1.2 FY00 Monitoring Scope

The following tables detail the planned IDLH monitoring scope for FY00.

Table 6-1. IDLH Monitoring Locations.

Monitoring Station ID Code	Location	Primary Flow Measurement Device	Telemetry
SW093	N. Walnut Cr. 1300' upstream from the A-1 Bypass; inflow to A-3	36" Sharp-Crested Suppressed Rectangular Weir	Yes
A3DM	Pond A-3; water elevation, piezometers	NA	Yes
GS12	Pond A-3 Outlet; inflow to A-4	30" Parshall Flume	Yes
A4DM	Pond A-4; water elevation, piezometers	NA	Yes
GS11	Pond A-4 Outlet; outflow to Walnut Creek	24" Parshall Flume	Yes

[3] Critical measurements, such as pond inflow rates and elevations, require hourly monitoring capability, even though daily monitoring may be adequate for a portion of the year. For example, during FY 1996 (FY96), hourly monitoring was actually used for 85 days during the year.

Monitoring Station ID Code	Location	Primary Flow Measurement Device	Telemetry
GS09	Pond B-4 Outlet; inflow to B-5	30" Sharp-Crested Contracted Rectangular Weir	Yes
B5DM	Pond B-5; water elevation, piezometers	NA	Yes
GS08	Pond B-5 Outlet; outflow to Walnut Creek	24" Parshall Flume	Yes
SW027	Pond C-2 Inlet on South Interceptor Ditch (SID); inflow to C-2	Dual 120° V-Notch Weirs	Yes
C2DM	Pond C-2; water elevation, piezometers	NA	Yes
GS31	Pond C-2 Outlet; outflow to Woman Creek	24" Parshall Flume	Yes
LFDM	Landfill Dam; water elevation, piezometers	NA	Yes

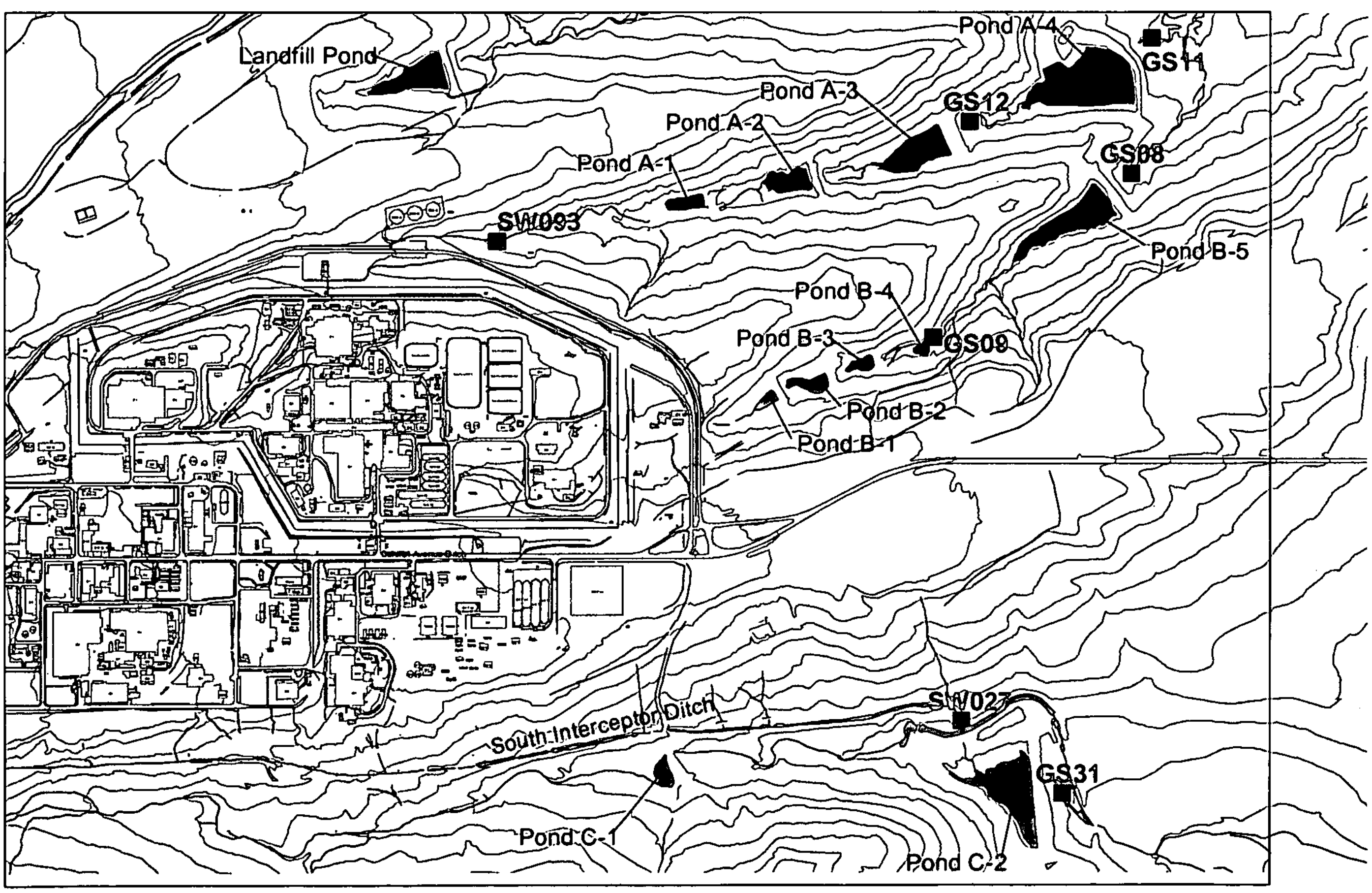

Figure 6-2. Map Showing IDLH Monitoring Locations.

Table 6-2. Monitoring Targets (Number of Measurements) for Safe Operation of Dams.

	Pond				
Data Types Monitored	**A-3**	**A-4**	**B-5**	**C-2**	**Landfill**
Inflow Rate	hourly average (1-min. measurements) [SW093]	hourly average (1-min. measurements) [GS12]	hourly average (1-min. measurements) [GS09]	hourly average (1-min. measurements) [SW027]	None
Outflow Rate	hourly average (1-min. measurements) [GS12]	hourly average (1-min. measurements) [GS11]	hourly average (1-min. measurements) [GS08]	hourly average (1-min. measurements) [GS31]	None
Pond Elevation	hourly average (1-min. measurements) [A3DM]	hourly average (1-min. measurements) [A4DM]	hourly average (1-min. measurements) [B5DM]	hourly average (1-min. measurements) [C2DM]	hourly average (1-min. measurements) [LFDM]
Piezometers	1-hour average transmitted every 8 hours (5-min. measurements) [A3DM]	1-hour average transmitted every 8 hours (5-min. measurements) [A4DM]	1-hour average transmitted every 8 hours (5-min. measurements) [B5DM]	1-hour average transmitted every 8 hours (5-min. measurements) [C2DM]	1-hour average transmitted every 8 hours (5-min. measurements) [LFDM]

Notes: Telemetry is the primary data collection platform for pond elevations and piezometer levels.
Instantaneous measurement capability exists for all telemetry data.
Specific automated monitoring location codes shown as: [GS12] for example.

6.1.3 Data Analysis

The actual decision process for managing pond operations and conducting pond and dam monitoring activities is too complex to be treated in this document. Detailed information can be found in the POP (RMRS, 1996b) and the *Action Level Response Plan for Dams A-4, B-5, or C-2* (RMRS, 1998a). IDLH data collected by the automated monitoring system is used to support the decision process. These data are used by an expert system to consider actions associated with modeled action levels.

6.2 SOURCE LOCATION MONITORING

As used in this section a "source" is a contaminant source. The term "new source" as used in this section means any source that has not previously been located, halted, mitigated, quantified, or corrected.

When new contaminant sources are detected by surface-water monitoring at New Source Detection locations, Points of Evaluation, Points of Compliance, or in the downstream reservoirs, additional monitoring may be required to identify[4] the source and evaluate for corrective actions pursuant to the RFCA Action Level Framework (ALF). The Source Location monitoring objective is intended to locate the source of contamination when a new source of contamination is detected.[5]

[4] Note that the term "identify" is used here to mean "locate." Characterization is also implied.

[5] The various monitoring objectives might "detect" a new source through an increase in baseline or exceedance of an action level, standard, permit limitation, etc., depending on the monitoring objective under which the potential new source was detected.

6.2.1 Data Types, Frequency, and Collection Protocols

Source Location monitoring may be implemented anywhere within the Site surface water drainage area (especially within the IA) that a new contaminant source or exceedance is detected. The distribution of monitoring points is determined by the details of the specific source evaluation to quickly determine source location and to efficiently utilize resources. For example, if monitoring (just outside the IA) through New Source Detection suggests a new source within the IA, then portable sampling equipment may be installed within the IA, to locate the source. And if monitoring for compliance in Segment 4 (POC) suggests a new source, then monitoring to identify the source may begin in Segment 5.

Source location monitoring is intended to begin as soon as practicable after initial source detection and continue until the source is identified and/or evaluated or is no longer detected. The number of samples will be based on the status of the source evaluation, taking into account, but not limited to, weather conditions, water availability, and process knowledge.

Analyte suites under this monitoring objective are determined based on the detected contaminant of current concern, or related indicators. The information types are entirely dependent on the results of other monitoring objectives under which the source was detected. The analyte suites are limited to parameters which will aid in the identification and evaluation of a contaminant source.

Flow data should be collected, where possible, to allow for contaminant loading analysis. Samples collected should be continuous flow-paced composites to facilitate comparison to POCs and POEs and allow for continuous contaminant loading analysis. Collection of real-time water-quality data may be initiated if such data would facilitate the specific source evaluation.

Detailed sampling and analysis plans (SAPs) are completed for specific source evaluation projects. For example, the *Sampling and Analysis Plan for Automated Synoptic Surface-Water and Sediment Sampling for the GS10 Source Investigation* (RMRS, 2000b) details the operation of the synoptic samplers at SW021, SW022, SW023, SW060, SW132, and SW100100, discussed in the following section. As part of this project, the analyte suite at GS10 will be temporarily (4/1/00 – 9/30/00) expanded to include additional contituents. Additional samples at GS10 will not be collected, but the samples collected under the POE decision rule will be analyzed for the additional analytes, as summarized in Table 6-6.

6.2.2 FY00 Monitoring Scope

The following tables detail the planned Source Location monitoring scope for FY00.

Table 6-3. Source Location Monitoring Locations

ID Code	Location	Primary Flow Measurement Device	Telemetry	Notes
GS10	S. Walnut Cr. upstream from the B-1 Bypass	9" Parshall Flume	Yes	Samples collected under the POE decision rule will be analyzed for additional contituents
GS27	Small ditch NW of B884	2" Cutthroat Flume	Yes	Supports source eval. for GS10; also supports D&D of B889 and watershed improvements evaluation
GS32	Corrugated metal pipe (cmp; 1.5') north of Solar Ponds in PA draining B779 area	NA[a]	Yes	Supports source eval. for SW093; also supports D&D of B779

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ID Code	Location	Primary Flow Measurement Device	Telemetry	Notes
GS33	No Name Gulch at confluence with Walnut Creek	9.5" Parshall Flume	Yes	Supports source eval. for GS03
GS34	Walnut Creek above confluence with McKay Ditch	1.5' Parshall Flume	Yes	Supports source eval. for GS03
GS35	McKay Ditch at confluence with Walnut Creek	36" Sharp-Crested Rectangular Weir with End Contractions	Yes	Supports source eval. for GS03
GS38	Central Ave. Ditch NW of Building 889	9.5" Parshall Flume	Yes	Supports source eval. for GS10
GS39	Ditch NW of 904 Pad	1' H-Flume	Yes	Supports source eval. for GS10; also supports 903 Pad remediation activities
GS40	Outfall E of Tenth St., E of 750 Pad	1' Parshall Flume	Yes	Supports source eval. for GS10; also supports 700 Area D&D activities
GS43	Drainage ditch NE of T886A	0.5' H-flume	Yes	Performance monitoring location for B886 D&D activities; also supports source eval. for GS10
GS44	cmp between T771F and T771L	1' H Flume	Yes	Performance monitoring location for B771/774 D&D activities; also supports source eval. for SW093
SW021	Reinforced concrete pipe (rcp) just east of PA draining B991 area	None	No	Synoptic sampling location in support of GS10 source eval.
SW022	Central Avenue Ditch at inner east fence	9.5" Parshall Flume	Yes	Dual samplers: both support source eval. for GS10; one is a synoptic sampling location
SW023	S. Walnut Cr. Above B-1 bypass; co-located with GS10	9.5" Parshall Flume	Yes	Synoptic sampling location in support of GS10 source eval.
SW060	cmp just east of PA draining Portal 1 parking areas and 500 Area outside PA	None	No	Synoptic sampling location in support of GS10 source eval.
SW118	N. Walnut Creek W of Portal 3	169.5° V-Notch Weir	Yes	Supports source eval. for SW093
SW120	Ditch north of Solar Ponds inside PA	4" Cutthroat flume	Yes	Performance monitoring location for B771/774 D&D activities; also supports source eval. for SW093
SW132	cmp south of B995 draining area between 750 Pad and B991 (from SW100100)	None	No	Synoptic sampling location in support of GS10 source eval.
SW100100	cmp west of B991 draining area between 750 Pad and B991 (flows to SW132)	None	No	Synoptic sampling location in support of GS10 source eval.

Notes: [a] Due to the current configuration of in-place stormwater culverts, flow measurement at this location is not possible without significant construction modifications.

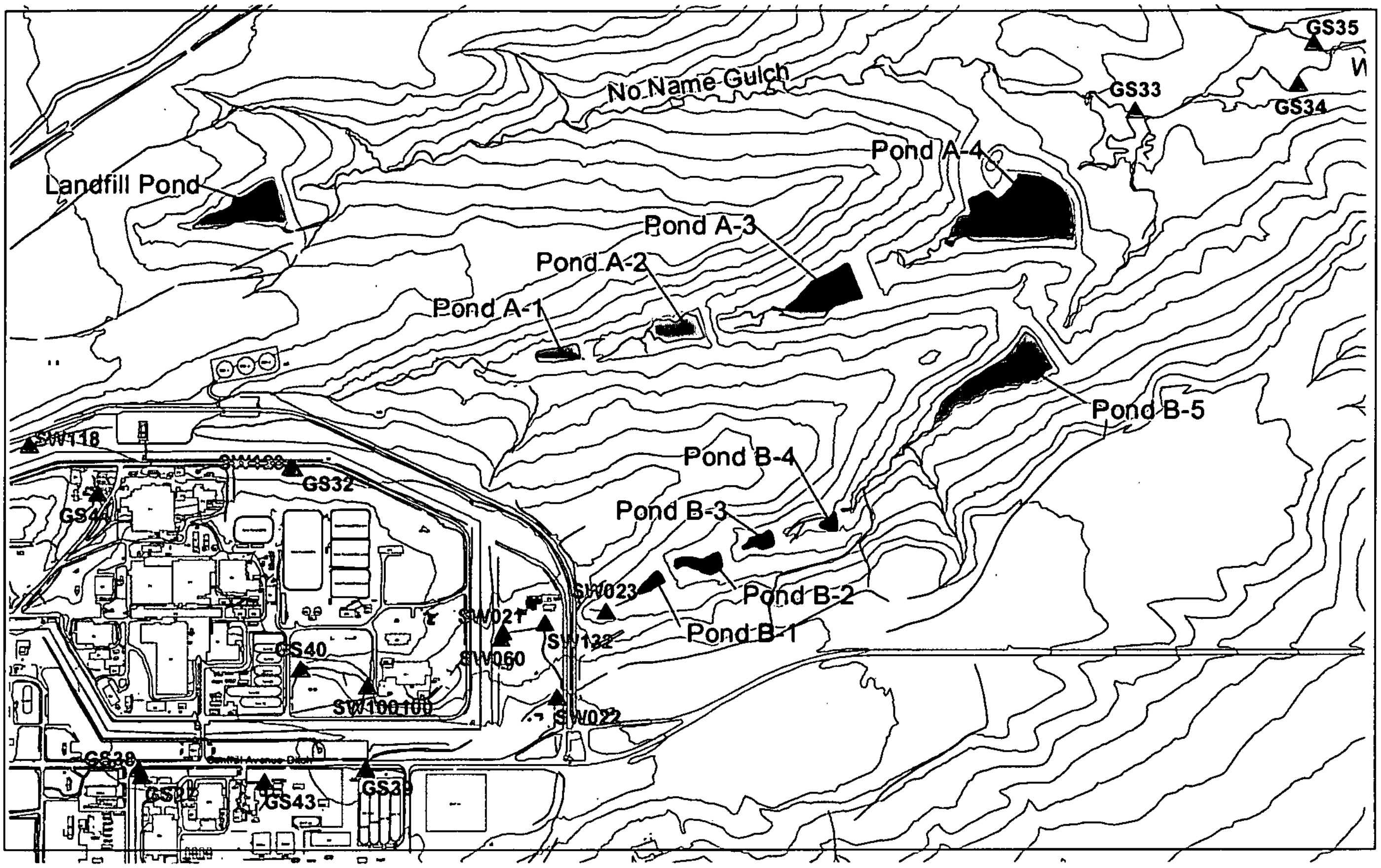

Figure 6-3. Map Showing Source Location Monitoring Locations.

Table 6-4. Source Location Field Data Collection: Parameters and Frequency.

ID Code	Parameter	
	Discharge	**Precipitation**
GS10	15-min continuous	None
GS27	15-min continuous	None
GS32	None	None
GS33	15-min continuous	None
GS34	15-min continuous	None
GS35	15-min continuous	None
GS38	15-min continuous	None
GS39	15-min continuous	None
GS40	15-min continuous	None
GS43	15-min continuous	None
GS44	15-min continuous	None
SW021	None	None
SW022	15-min continuous	15-min continuous
SW023	15-min continuous	None
SW060	None	None
SW118	15-min continuous	15-min continuous
SW120	15-min continuous	None
SW132	None	None
SW100100	None	None

Table 6-5. Source Location Sample Collection Protocols.

ID Code	Frequency	Type[b]
GS10	POE frequency; see Section 6.7	Continuous flow-paced composites
GS27	1 per month	Storm-event rising-limb flow-paced composites[c]
GS32	1 per month	Storm-event rising-limb flow-paced composites[c]
GS33	12 per year[a]	Continuous flow-paced composites
GS34	1 per Pond A-4 or B-5 discharge; 1 per intervening period between discharges	Continuous flow-paced composites
GS35	12 per year[a]	Continuous flow-paced composites
GS38	12 per year[a]	Continuous flow-paced composites
GS39	12 per year[a]	Continuous flow-paced composites
GS40	12 per year[a]	Continuous flow-paced composites
GS43	12 per year[a]	Continuous flow-paced composites
GS44	12 per year[a]	Continuous flow-paced composites
SW021	5 for synoptic sampling project	Storm-event rising-limb time-paced composites
SW022	12 per year[a], plus 5 for synoptic sampling project	Continuous flow-paced composites and storm-event rising-limb time-paced composites
SW023	5 for synoptic sampling project	Storm-event rising-limb time-paced composites
SW060	5 for synoptic sampling project	Storm-event rising-limb time-paced composites
SW118	12 per year[a]	Continuous flow-paced composites
SW120	12 per year[a]	Continuous flow-paced composites
SW132	5 for synoptic sampling project	Storm-event rising-limb time-paced composites
SW100100	5 for synoptic sampling project	Storm-event rising-limb time-paced composites

Notes: [a] Annual total samples is 12 per year. Frequency of collection is based on expected flow volumes such that each sample collects water representing similar stream discharge volumes; for example, more samples are collected in wet spring months than dry winter months.
[b] Sample types are defined in Section 7.2.2.2.
[c] Storm-event sampling at locations which are often dry and normally only receive stormwater runoff is opportunistic. Some locations may see flow only during wet months. Every attempt is made to achieve the target sample frequency; however, this is not always possible.

Table 6-6. Source Location Analytical Targets (Analyses per Year).

ID Code	TSS[a]	Pu, Am	CLP Metals	Hardness	Si, TOC, TDS, Maj. Anions
GS10			20		20
GS27	12	12			
GS32	12	12			
GS33	12	12			
GS34	12	12			
GS35	12	12			
GS38	12	12			
GS39	12	12			
GS40	12	12			
GS43	12	12			
GS44	12	12			
SW021	5	5	5	5	5
SW022[b]	17	17	5	5	5
SW023	5	5	5	5	5
SW060	5	5	5	5	5
SW118	12	12			
SW120	12	12			
SW132	5	5	5	5	5
SW100100	5	5	5	5	5

Notes: [a] Ideally, TSS would be analyzed for all samples collected at the above locations. However, continuous flow-paced sampling protocols often result in composite samples which are collected over periods exceeding the 7-day hold time for TSS analyses. Therefore, TSS can not be analyzed for all continuous flow-paced composite samples; TSS will be analyzed when possible.
[b] SW022 has dual samplers installed. One sampler collects continuous flow-paced samples for TSS, Pu, and Am (12 per year; NSD decision rule). The other sampler collects synoptic storm-event samples for all analytes given above (5 per year for GS10 Source Evaluation).

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Table 6-7. Source Location Telemetry Data Collection.

ID Code	Parameters
GS10	flow; current sample volume; expected sample volume based on flow[a]
GS27	flow; sampler status (full or waiting)
GS32	flow; sampler status (full or waiting)
GS33	flow; current sample volume; expected sample volume based on flow[a]
GS34	flow; current sample volume; expected sample volume based on flow[a]
GS35	flow; current sample volume; expected sample volume based on flow[a]
GS38	flow; current sample volume; expected sample volume based on flow[a]
GS39	flow; current sample volume; expected sample volume based on flow[a]
GS40	flow; current sample volume; expected sample volume based on flow[a]
GS43	flow; current sample volume; expected sample volume based on flow[a]
GS44	flow; current sample volume; expected sample volume based on flow[a]
SW022	flow; current sample volume; expected sample volume based on flow[a]
SW118	flow; current sample volume; expected sample volume based on flow[a]
SW120	flow; current sample volume; expected sample volume based on flow[a]

Notes: [a] Provides an indication of equipment malfunction.

6.2.3 Data Analysis

Data collected at Source Location monitoring locations are analyzed based on their intent to aid in a specific source evaluation. Specific evaluation detail is included in the applicable SAPs. These analyses include, but are not limited to, loading, fate and transport, correlations and trending, and statistical evaluation / inference. These analyses are performed based on established environmental engineering standards to achieve technical defensibility. Source evaluation analysis is not limited to data collected at Source Location monitoring locations.

6.3 AD HOC MONITORING

The Site often monitors surface waters on an *ad hoc* basis for a variety of reasons. This monitoring may be requested by DOE, RFFO, cities, agencies, building managers, and Site facility managers (e.g. the WWTP). It is anticipated that various parties will continue to request such *ad hoc* monitoring in the future, regardless of whether funding is allocated for that purpose. This monitoring will not always require sample analyses. In some cases, only flow or continuously recording water-quality monitoring will be needed. Examples of situations that may warrant *ad hoc* monitoring include:

- Major precipitation events that disrupt routine pond predischarge monitoring and discharge schedules,
- Community assurance monitoring at the request of downstream cities and the DOE, RFFO,
- Unanticipated changes in regulatory permits, agreements, or funding,
- Special projects such as Actinide Migration Evaluation and Site-Wide Water Balance,
- Anticipated but unfunded changes in permits or agreements,
- Construction projects,
- Spill events, and
- Operational monitoring (i.e. footing drains, septic lift stations).

The Ad Hoc monitoring details in Section 6.3.1 are based on Ad Hoc monitoring currently being performed, or expected to occur in FY00. Scope for Ad Hoc monitoring may change at any time as needs arise or terminate.

6.3.1 Data Types, Frequency, and Collection Protocols

The type of data collected depends exclusively on the predetermined intent of the specific Ad Hoc monitoring location. The collected data can then be processed to provide decision support or input to a technical analysis. In most cases, flow is the primary data collected. For example, the B371 footing drain locations provide real-time flow data to confirm the proper operation of the B371 footing drain systems.

6.3.2 FY00 Monitoring Scope

The following tables detail the planned Ad Hoc monitoring scope for FY00.

Table 6-8. Ad Hoc Monitoring Locations.

ID Code	Location	Primary Flow Measurement Device	Telemetry	Notes
B371BAS	Building 371 basement footing drain	11.4° V-Notch Weir	Yes	Data collection to confirm proper operation of footing drain systems; funded by SSOC, L.L.C.
B371SUBBAS	Building 371 sub-basement footing drain	11.4° V-Notch Weir	Yes	Data collection to confirm proper operation of footing drain systems; funded by SSOC, L.L.C.
GS22	Outfall from 400 Area at SID	1.5' H Flume	No	Data collection for Site Water Balance
GS41	Sub-drainage SW of GS03; drains to Walnut Creek	0.5' H Flume	Yes	Data collection for Actinide Migration Evaluation; partially funded by EPA
GS42	Sub-drainage north of SW027; drains to SID	3" Parshall Flume	Yes	Data collection for Actinide Migration Evaluation; partially funded by EPA
GS45	Upper Church Ditch east of Site fenceline	9.5" Parshall Flume	No	Data collection for Site Water Balance
GS46	McKay Ditch east of Site fenceline	9.5" Parshall Flume	No	Data collection for Site Water Balance
GS47	West Diversion Ditch north of B131 and west of B371	Area-Velocity flow meter in ditch of known geometry	No	Data collection for Site Water Balance
GS48	McKay Bypass Canal north of Landfill Pond	Area-Velocity flow meter in ditch of known geometry	No	Data collection for Site Water Balance
SW009	McKay Bypass Canal upstream of confluence with West Diversion Ditch	1' Parshall Flume	No	Data collection for Site Water Balance

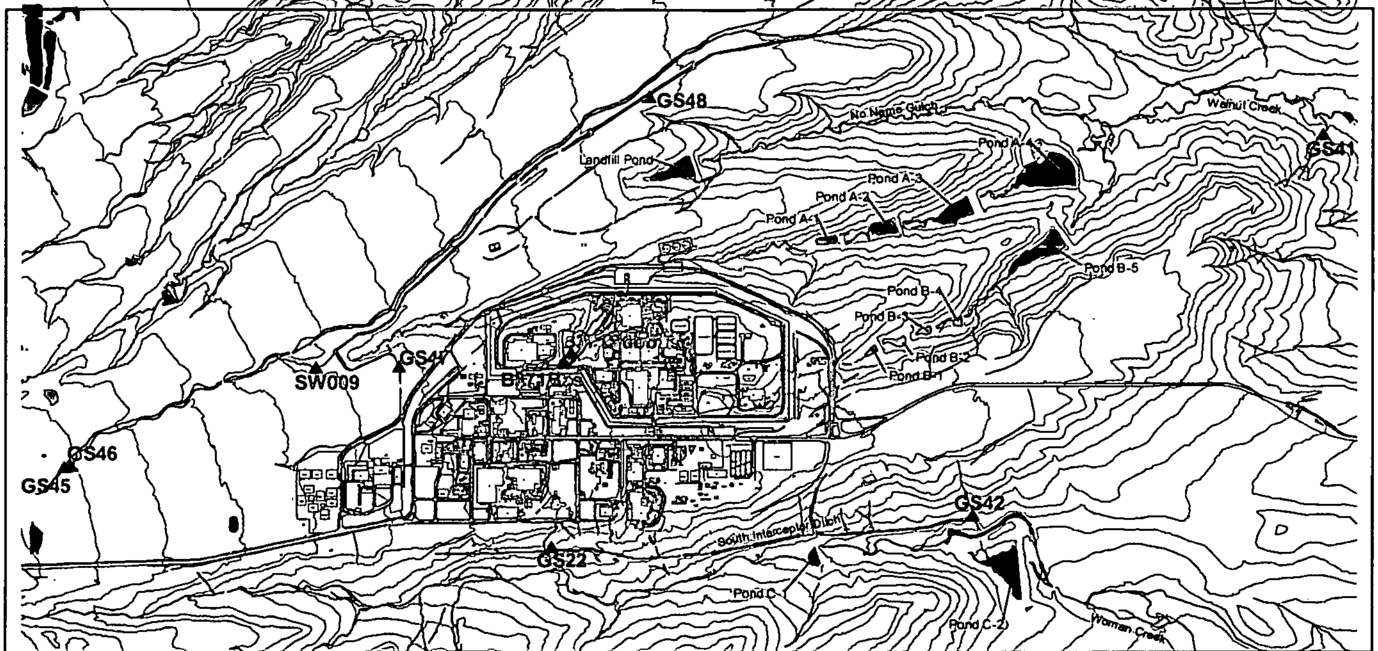

Figure 6-4. Map Showing Ad Hoc Monitoring Locations.

Table 6-9. Ad Hoc Field Data Collection: Parameters and Frequency.

ID Code	Parameter Discharge
B371BAS	hourly averages of 1-min. measurements
B371SUBBAS	hourly averages of 1-min. measurements
GS22	15-min continuous
GS41	15-min continuous
GS42	15-min continuous
GS45	15-min continuous
GS46	15-min continuous
GS47	15-min continuous
GS48	15-min continuous
SW009	15-min continuous

Table 6-10. Ad Hoc Sample Collection Protocols.

ID Code	Frequency	Type[b]
B371BAS	None	NA
B371SUBBAS	None	NA
GS22	None	NA
GS41	10-12 as available[a]	Storm-event flow-paced composites
GS42	10-12 as available[a]	Storm-event flow-paced composites
GS45	None	NA
GS46	None	NA
GS47	None	NA
GS48	None	NA
SW009	None	NA

Notes: [a] Target for the project is 10-12. Frequency of collection is based on opportunistic availability of precipitation runoff; these locations are dry much of the time.
[b] Sample types are defined in Section 7.2.2.2.

Table 6-11. Ad Hoc Analytical Targets (Analyses per Year).

ID Code	TSS	Pu, Am
GS41	10-12	10-12
GS42	10-12	10-12

Table 6-12. Ad Hoc Telemetry Data Collection.

ID Code	Parameters
B371BAS	flow; alarm on no flow condition
B371SUBBAS	flow; alarm on no flow condition
GS22	None
GS41	flow; sampler status (full or waiting);
GS42	flow; sampler status (full or waiting);
GS45	None
GS46	None
GS47	None
GS48	None
SW009	None

6.3.3 Data Analysis

Erosion and Actinide Transport Monitoring Locations: GS41 and GS42

Data collected at GS41 and GS42 will be used for Actinide Migration Evaluation (AME). Specifically, evaluation will include determination of sediment yield and associated actinide content on the suspended solids. These estimates will be calculated based on the analytical results obtained from TSS, Pu, Am, and U analyses.

Building 371 Footing Drain Monitoring Locations

Operation of B371BAS and B371SUBBAS provides real-time data confirming the proper operation of the B371 footing drain systems. B371 personnel are notified of a no flow condition alarm, which would initiate investigation of those systems. Telemetry has been made available to B371 personnel to allow for direct tracking of footing drain operation.

Site Water Balance Locations

Data collected at GS22, GS45, GS46, GS47, GS48, and SW009 will be applied to configuration and calibration of the Site-Wide Water Balance Model.

6.4 MONITORING FOR CORRELATION OF PLUTONIUM WITH TSS[6]

This monitoring objective is intended to establish the relationship of Pu concentrations with several indicator parameters, such as TSS, turbidity, or flow rate. The determination of relationships between Pu and indicator parameters will support future pond operations, investigations into actinide transport, and management decision making.

[6] This section on the relationship of Pu with suspended particulates is *not complete* in the current IMP. The material in this section of the IMP has been retained for future use; but several fundamental issues must be resolved, and a major rewrite will almost certainly be required before monitoring should begin. However, some of the monitoring required for this objective already occurs as part of other monitoring objectives. Consensus on this section may be difficult to achieve due to the concerns surrounding controlled detention. However, all members of the Surface Water IMP Team have agreed that decisions regarding controlled detention should be well-informed decisions based on monitoring data such as is identified in this section.

The Site intends to move toward controlled detention operation of the ponds in the future. The controlled detention design basis indicator for Pu may be at first TSS, which historical stormwater data have shown to be correlated with Pu activity at several locations. This correlation was a primary assumption in the design basis for the controlled detention *Pond Operations Plan*[7]. To test these hypotheses, it is desired that samples be analyzed for Pu and TSS at selected monitoring locations to be used operationally for controlled detention discharge of the ponds in the future. This evaluation may quantify the correlation between Pu and TSS.

The design basis for controlled detention is that Pu can be estimated as a function of TSS. Under controlled detention, the operational indicator might be turbidity, flow, or other related indicators that can be monitored in real-time. This section also addresses the correlation of Pu with other parameters that can be monitored in real-time for operational decision making. Although TSS may provide a satisfactory design basis, it requires time for a laboratory analysis, and thus cannot be used as an operational indicator in real-time.

This section specifies data needed to develop deterministic regression models for estimating Pu concentrations in Segment 4 (below the terminal ponds) on the basis of TSS or turbidity data from Segment 5 (above the terminal ponds) and from within the IA. This section will also provide data for models that could estimate the magnitude of Pu contaminant sources within the IA on the basis of data from Segments 4 and 5. With respect to surface water, research indicates a relationship may exist between the amount of Pu activity and the amount of TSS in the water. Radionuclides, including Pu, tend to associate with particulate materials. When particles are carried in surface-water runoff, radionuclides attached to the particles are transported as well. Therefore, measuring the amount of TSS in runoff from a specific drainage area may provide a characteristic ratio of Pu to TSS for that basin and insight into the amount of Pu activity being transported in the water.

If an initial significant correlation between Pu activity and TSS is determined for a drainage basin, this baseline correlation would prove useful for monitoring future cleanup and containment of Pu within that area. For example, removing a source of Pu-contaminated sediments from a watershed would result in reduced transport of Pu from the basin; and, barring the creation of new sources of Pu-contaminated sediments, the Pu activity associated with a similar TSS concentration would also have been lowered. Therefore, a decrease in the ratio of Pu activity to TSS would be indicative of the effectiveness of the source removal. In contrast, an increased ratio might indicate a new source of Pu-contaminated sediments.

Data from this monitoring would also support evaluations of the impact of D&D and watershed improvement activities.

6.4.1 Data Types, Frequency, and Collection Protocols

To evaluate the correlation between TSS, turbidity, and flow vs. Pu, monitoring at any three stations would suffice, but six stations should be monitored in case some do not correlate well. Since Pu is already monitored at terminal pond outfalls (POCs) and at the IA boundary (POE and NSD locations), flow, TSS, and turbidity (turbidity monitored real-time) will also be monitored at these eight stations.[8]

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[7] Pu is transported primarily on particulates in surface water.

[8] Turbidity measurement at SW022 and SW091 has proven difficult due to the ephemeral nature of the flow at these locations. The real-time, multi-parameter water quality probes require that certain sensors remain wet at all times. Since these locations are dry except during periods of direct runoff, the Site has historically employed 'sump' systems that use tap water to keep the sensors wet. These systems were designed to flush during direct runoff so that the tap water was replaced by runoff water. However, the relatively slow response time of the sensors, coupled with the relatively short duration of runoff events, often resulted in data that was poor or unusable. These sump systems were also susceptible the freezing during cold weather, which occasionally resulted in damage to the equipment. For these reasons, the Site has very limited turbidity data for SW022 and SW091.

To evaluate the predictive capability of the real-time flow and turbidity parameters, the Site must monitor these parameters at locations most likely to be predictive and far enough upstream to provide at least two hours of warning before an exceedance could occur in Segment 4 (at a POC). These stations include POEs GS10, SW093, and SW027 and NSDs SW022 and SW091. Each of these stations will be equipped with real-time water-quality probes to continuously monitor turbidity, where feasible.

Ideally, TSS would be analyzed for all samples collected at the above locations. However, sampling protocols for these stations (detailed in Sections 6.6, 6.7, and 6.8) often result in composite samples which are collected over periods exceeding the 7-day hold time for TSS analyses. Therefore, TSS can not be analyzed for all composite samples, but will be analyzed when possible. For reference, NSD locations collect composite samples during singular runoff events, while POCs and POEs collect composite samples continuously during all flows.

Data may be acquired as far upstream as Segment 5 or even within the IA to predict Pu as far downstream as the reservoirs.

6.4.2 FY00 Monitoring Scope

The following tables detail the planned Pu Correlation monitoring scope for FY00.

Table 6-13. Pu Correlation Monitoring Locations.

ID Code	Location	Primary Flow Measurement Device	Telemetry	Notes
SW093	N. Walnut Cr. upstream from the A-1 Bypass	36" Suppressed Rectangular Sharp-Crested Weir	Yes	Serves as an NSD and POE location
SW091	Gully NE of Solar Ponds outside inner fence	6" Cutthroat Flume	Yes	Serves as an NSD location
GS10	S. Walnut Cr. upstream from the B-1 Bypass	9" Parshall Flume	Yes	Serves as an NSD and POE location
SW022	Central Avenue Ditch at inner east fence	9.5" Parshall Flume	Yes	Serves as an NSD location
SW027	South Interceptor Ditch at Pond C-2	Dual Parallel 120° V-Notch Weirs	Yes	Serves as an NSD and POE location
GS11	Pond A-4 outlet works	24" Parshall Flume	Yes	Serves as a POC location
GS08	Pond B-5 outlet works	24" Parshall Flume	Yes	Serves as a POC location
GS31	Pond C-2 outlet works	24" Parshall Flume	Yes	Serves as a POC location

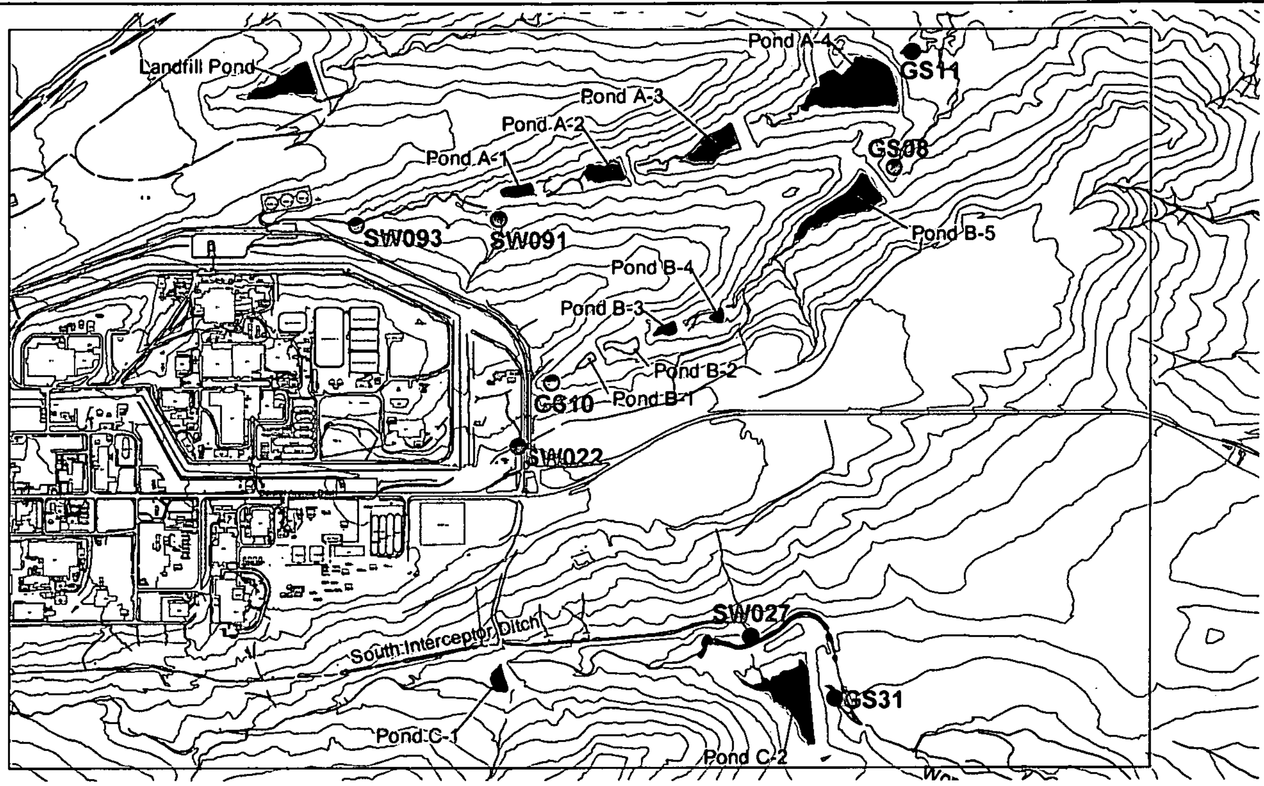

Figure 6-5. Map Showing Pu Correlation Monitoring Locations.

Table 6-14. Pu Correlation Field Data Collection: Parameters and Frequency.

ID Code	Parameter	
	Discharge	Turbidity[a]
SW093	15-min continuous	15-min continuous
SW091	15-min continuous	15-min continuous (see footnote 8)
GS10	15-min continuous	15-min continuous
SW022	15-min continuous	15-min continuous (see footnote 8)
SW027	15-min continuous	15-min continuous
GS11	15-min continuous	15-min continuous
GS08	15-min continuous	15-min continuous
GS31	15-min continuous	15-min continuous

Notes: [a] Turbidity is collected using real-time water-quality probes. These probes can not handle winter icing conditions without being damaged. Therefore, these probes collect data whenever possible, and data collection may not be possible for significant periods during the winter.

Table 6-15. Pu Correlation Sample Collection Protocols.

ID Code	Frequency[a]	Type[b]
SW093	see Section 6.7	Continuous flow-paced composites
SW091	see Section 6.6	Storm-event rising limb flow-paced composites
GS10	see Section 6.7	Continuous flow-paced composites
SW022	see Section 6.6	Continuous flow-paced composites
SW027	see Section 6.7	Continuous flow-paced composites
GS11	see Section 6.8	Continuous flow-paced composites
GS08	see Section 6.8	Continuous flow-paced composites
GS31	see Section 6.8	Continuous flow-paced composites

Notes: [a] Sample collection frequencies are determined by the primary monitoring objective for each location.
[b] Sample types are defined in Section 7.2.2.2.

Table 6-16. Pu Correlation Analytical Targets (Analyses per Year).

ID Code	TSS[a]	Pu[b]
SW093	10	see Section 6.7
SW091	12	see Section 6.6
GS10	10	see Section 6.7
SW022	12	see Section 6.6
SW027	10	see Section 6.7
GS11	10	see Section 6.8
GS08	10	see Section 6.8
GS31	3	see Section 6.8

Notes: [a] Ideally, TSS would be analyzed for all samples collected at the above locations. However, continuous flow-paced sampling protocols often result in composite samples which are collected over periods exceeding the 7-day hold time for TSS analyses. Therefore, TSS can not be analyzed for all continuous flow-paced composite samples, but will be analyzed when possible.
[b] Sample results are generated under the primary monitoring objective for each location.

6.4.3 Data Analysis

The correlation between total Pu activity and TSS will be periodically evaluated at three or more monitoring location pairs[9] for a period of six months or more, including peak spring runoff events and base flow. The Site may then attempt to establish the specific numerical values needed to design protective pond operations and structures. An identical evaluation may be made for a relationship between Pu activity and turbidity, or a combination of TSS and turbidity, or other indicators.

6.5 PERFORMANCE MONITORING

This section addresses monitoring the performance of specific actions[10] on Site for the release of contaminants to the environment. Project-specific Performance monitoring (PM) may be specified in the project plan through the review and approval process for those projects which pose a concern for a specific contaminant release, especially for a contaminant that may not be adequately monitored by other monitoring objectives downstream. Each PM location will target specific contaminants of greatest concern for the specific action being monitored. For example, PM for specific analytes may be needed for:

- Specific D&D Actions: The review and approval process for a D&D action may identify the need for PM specific to that action.
- Specific Remedial Actions: There are monitoring requirements associated with specific Operable Unit (OU) activities. For example, the existing consolidated treatment plant for OU1 and OU2 has a surface water discharge. PM specific to this discharge is specified in the work plans.
- Transition Actions: For example, proposed changes to water managment protocols may warrant PM. Specific PM may be needed in light of these types of changes if other monitoring in the IMP fails to provide adequate assurance of protecting the environment and public health.
- Best Management Practices (BMPs) for the Control of Plutonium Transport in Surface Water Runoff: For example, when a BMP (barrier, trap, filter, or other watershed improvement) is installed to control a potential source of Pu-contaminated runoff, the Site would like to determine the effectiveness of the BMP so that future resources may be allocated where they are most effective.

Monitoring of activities located within the IA is achieved, in general, through New Source Detection and POE monitoring (see Sections 6.6 and 6.7 for details) at the IA boundary (inner IA fence). Project-

[9] Monitoring location pairs: Theoretically, monitoring for TSS at GS10 (east edge of IA) may predict Pu activity monitored at GS08 (below Pond B-5). In this case, GS10 and GS08 would be a monitoring location pair.

[10] This is project-specific, versus the global monitoring (NSD and POE) of the IA discussed in Sections 6.6 and 6.7.

specific PM stations are portable and monitor specific high-risk Site activities, such as D&D of a particular building or building cluster. These mobile, temporary stations will be placed upstream from the routine monitoring stations (POE and NSD), closer to specific Site activities to monitor a specific sub-drainage for releases of contaminants specific to the activity in the sub-drainage.

6.5.1 Data Types, Frequency, and Collection Protocols

Data quality objectives must be specified in the project plan. Analyte suites (data types for collection) are generally determined by the contaminants of concern associated with a specific activity. Generally, automated samples are continuous flow-paced composites. However, protocols may be modified depending on the specific conditions for a monitoring location or drainage basin. Regardless, the sampling protocols are designed to accurately characterize existing flows, and confidently monitor for changes during the project activities.

Generally, monitoring is initiated with enough time prior to project activities such that 10 - 15 samples over varying flow rates can be collected (preferably 18 months prior to project initiation[11]). Results from these samples are used to establish a baseline for the sub-drainage. Monitoring continues during the activity, attempting to collect one sample per month. After project completion, monitoring continues long enough (approximately 3 months) to determine any impacts (both positive and negative) to surface-water quality.

PM can occur anywhere within the Site surface water drainage area (especially within the IA), downstream from a BMP, remediation, or high-risk activity.

6.5.2 FY00 Monitoring Scope

The following tables detail the planned Performance monitoring scope for FY00.

Table 6-17. Performance Monitoring Locations.

ID Code	Location	Primary Flow Measurement Device	Telemetry	Project
GS27	Small ditch NW of B884	2" Cutthroat Flume	Yes	D&D of B889; Watershed Improvements evaluation; also serves as Source Location monitoring station for GS10 Source Evaluation
GS32	Corrugated metal pipe (1.5') north of Solar Ponds in PA draining B779 area	NA[a]	Yes	D&D of B779; data also supports SW093 Source Evaluation
GS39	Corrugated metal pipe (1.0') north of 904 Pad draining 903/904 Pads and Contractor Yard areas	1' H-Flume	Yes	ER projects for 903 Pad; also serves as Source Location monitoring station for GS10 Source Evaluation
GS40	Outfall E of Tenth St. E of 750 Pad	1' Parshall Flume	Yes	700 Area D&D activities; also supports source eval. for GS10
GS43	Drainage ditch northeast of T886A	0.5' H-Flume	Yes	D&D of B886; also serves as Source Location monitoring station for GS10 Source Evaluation

[11] Due to the dynamic nature of Site Cleanup, initiation of Performance monitoring 18 months prior to an activity is rarely achieved. However, additional samples are often collected at an increased rate to establish baseline prior to initiation of project activities.

ID Code	Location	Primary Flow Measurement Device	Telemetry	Project
GS44	cmp between T771F and T771L	1' H-Flume	Yes	Performance monitoring location for B771/774 D&D activities; also supports source eval. for SW093
SW120	Drainage ditch north of Solar Ponds along PA perimeter road	4" Cutthroat Flume	Yes	Performance monitoring location for B771/774 D&D activities; also supports source eval. for SW093

Notes: [a] Due to the current configuration of in-place stormwater culverts, flow measurement at this location is not possible without significant construction modifications.

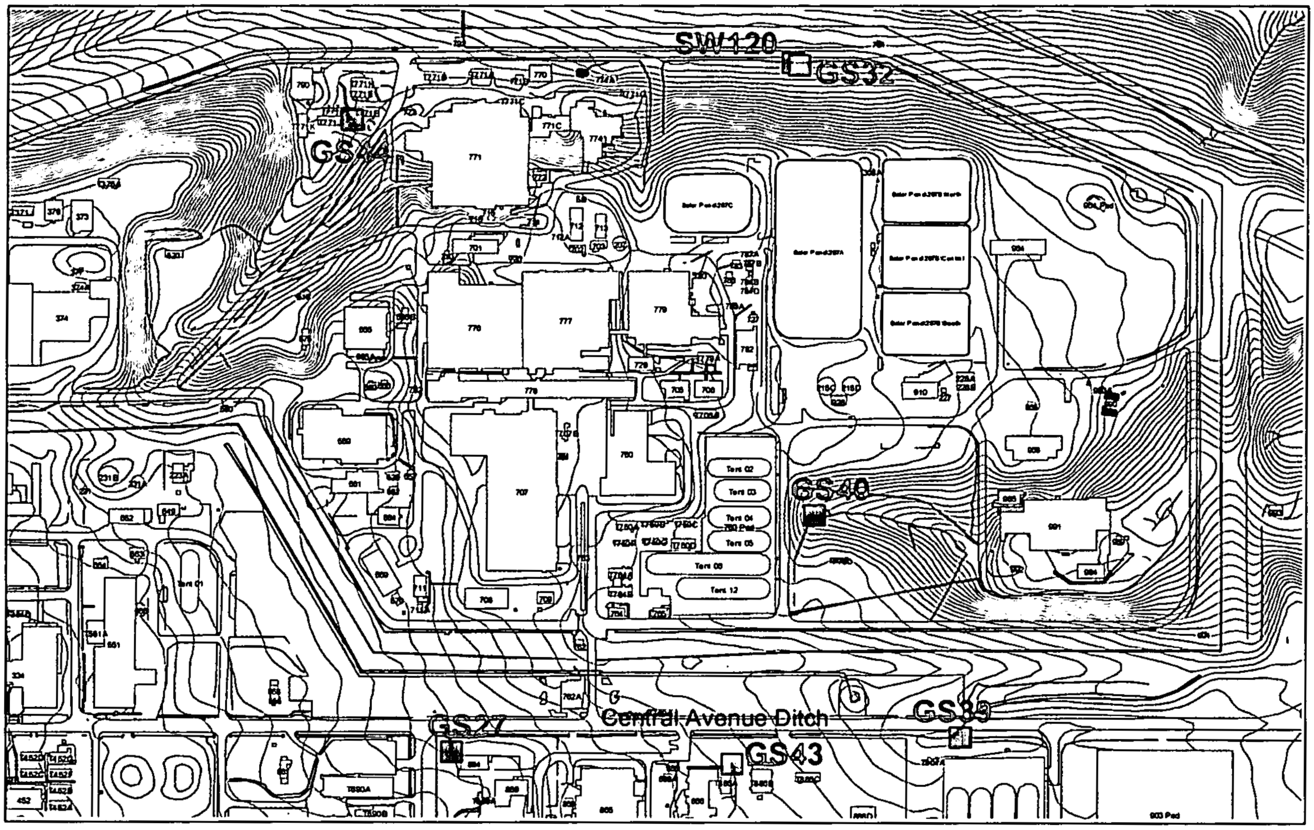

Figure 6-6. Map Showing Performance Monitoring Locations.

Table 6-18. Performance Field Data Collection: Parameters and Frequency.

ID Code	Parameter Discharge
GS27	15-min continuous
GS39	15-min continuous
GS43	15-min continuous
GS40	15-min continuous
GS44	15-min continuous
SW120	15-min continuous

Table 6-19. Performance Sample Collection Protocols.

ID Code	Frequency	Type[b]
GS27	1 per month	Storm-event rising-limb flow-paced composites[a]
GS32	1 per month	Storm-event rising-limb time-paced composites[a]
GS39	12 per year[c]	Continuous flow-paced composites
GS40	12 per year[c]	Continuous flow-paced composites
GS43	12 per year[c]	Continuous flow-paced composites
GS44	12 per year[c]	Continuous flow-paced composites
SW120	12 per year[c]	Continuous flow-paced composites

Notes: [a] Storm-event sampling at locations which are often dry and normally only receive stormwater runoff is opportunistic. Some locations may see flow only during wet months. Every attempt is made to achieve the target sample frequency; however, this is not always possible.
[b] Sample types are defined in Section 7.2.2.2.
[c]Annual total samples is 12 per year. Frequency of collection is based on expected flow volumes such that each sample collects water representing similar stream discharge volumes; for example, more samples are collected in wet spring months than dry winter months.

Table 6-20 Performance Analytical Targets (Analyses per Year).

ID Code	TSS[a]	Pu, Am	Pu, U, Am	CLP Metals
GS27	12		12	
GS32	12		12	12
GS39	12	12		
GS40	12	12		
GS43	12		12	12
GS44	12		12	12
SW120	12		12	12

Notes: [a] Ideally, TSS would be analyzed for all samples collected at the above locations. However, continuous flow-paced sampling protocols often result in composite samples which are collected over periods exceeding the 7-day hold time for TSS analyses. Therefore, TSS can not be analyzed for all continuous flow-paced composite samples, but will be analyzed when possible.

Table 6-21. Performance Telemetry Data Collection.

ID Code	Parameters
GS27	flow; sampler status (full or waiting)
GS32	flow; sampler status (full or waiting)
GS39	flow; current sample volume; expected sample volume based on flow[a]
GS40	flow; current sample volume; expected sample volume based on flow[a]
GS43	flow; current sample volume; expected sample volume based on flow[a]
GS44	flow; current sample volume; expected sample volume based on flow[a]
SW120	flow; current sample volume; expected sample volume based on flow[a]

Notes: [a] Provides an indication of equipment malfunction.

6.5.3 Data Analysis

Data evaluation will be specified for individual projects. A project-specific indicator might be a single monitoring result, a 30-day average for a specific analyte, or an indicator for the analyte of concern. Example decision rules are shown below. Generally, evaluation is performed as data becomes available, especially if an initial qualitative screening based on process knowledge indicates that an analytical result is higher than normal for a particular location.

IF The project-specific indicator is greater than the 95% upper tolerance limit (UTL) of baseline, THEN The Site will evaluate the specific activity to improve performance.

IF The project-specific indicator is less than the 95% lower tolerance level (LTL),

THEN The Site will conclude that the project has reduced environmental releases of the specific contaminant.

Table 6-22. Performance Monitoring Analytical Data Evaluation.

ID Code	Evaluation Types[a]
GS27	95% UTLs / LTLs; Loading Analysis
GS32	95% UTLs / LTLs; Loading Analysis
GS39	95% UTLs / LTLs; Loading Analysis
GS40	95% UTLs / LTLs; Loading Analysis
GS43	95% UTLs / LTLs; Loading Analysis
GS44	95% UTLs / LTLs; Loading Analysis
SW120	95% UTLs / LTLs; Loading Analysis

Notes: [a] Details on the evaluation of analytical results are given in Section 7.3.2.2.

6.6 NEW SOURCE DETECTION MONITORING

The New Source Detection (NSD) monitoring objective provides comprehensive coverage of the entire IA but is not specifically focused on individual actions within the IA. Performance monitoring of specific activities within the IA (or elsewhere) may be carried out under the Performance monitoring objective. This NSD objective monitors the performance of all remedial activities within the IA with respect to their impact on surface waters. However, it does not necessarily identify and locate a specific source within the IA[12]. This monitoring objective provides for monitoring of all main drainages from the IA into the three main channels of Stream Segment 5.

6.6.1 Data Types, Frequency, and Collection Protocols

This objective requires contaminant concentration data from surface-water samples taken at permanent monitoring locations located on five main surface-water pathways to the Site detention ponds. Analyses are performed for each of the contaminants and parameters listed below in order to establish a baseline. After a baseline has been established, evaluations will be performed as required by the decision rules. The basis for selecting these contaminants of concern and indicator parameters is described below.

- Plutonium (Pu), uranium (U), and americium (Am) are primary contaminants of concern to regulators and the public.
- Turbidity, pH, nitrate (NO_3^-), and conductivity are analyses performed continuously because they are inexpensive per measurement and can be used as real-time indicators to provide or negate reasonable cause to analyze for other specific contaminants.
- Turbidity may indicate increased contaminant loads in general and increased Pu specifically. (Pu in surface water is generally bound to particulates).
- pH can be used to detect an acid or caustic spill.
- Nitrate can be used in real-time to detect chemical spills that include plutonium nitrate.

[12] Location of a specific source would be performed under the Source Location monitoring objective described in Section 6.2.

- Conductivity can be used to corroborate a pH reading and to detect salt solution spills or significant concentrations of metals such as chromium, beryllium, silver, or cadmium.
- Precipitation data are used to determine whether a flow event results from rain/snow runoff, an operational discharge[13], or a spill. Precipitation data is collected at 10 locations across the Site. Effective precipitation for a given monitoring location drainage can be calculated.
- Water flow rate is needed to identify an event, trigger an automatic sampler, control the flow-paced sampling, and evaluate the magnitude of the spill or contaminant source (mass loading).
- Small changes to apparent base flow not attributable to rain or snow melt, or unusual runoff hydrograph shapes, may indicate a spill or operational discharge.

This monitoring objective is limited to information collected at the IA boundary, as represented by surface-water monitoring stations SW022, SW091, SW093, SW027, and GS10[14] (see Figure 3-1). This monitoring focuses on runoff into the three main drainage areas leaving the IA: North Walnut Creek, South Walnut Creek, and the South Interceptor Ditch / Pond C-2 drainage (see Figure 3-1). SW022 waters are normally monitored subsequently at GS10, so there is some redundancy in this pair of monitoring stations. SW022 has been included at the request of the EPA to provide increased sensitivity for the Central Avenue Ditch sub-drainage. Data from SW022 would also be used to aid the location of any new source detected at GS10.

For SW091, sampling is event-specific, focused on the time period during which the first-flush conditions prevail; specifically, the time period during the rising limb of a direct runoff[15] hydrograph after any storm event.[16] For SW022, sampling is continuous flow-paced during all flow periods.[17] For SW093, GS10, and SW027, the analytical data used for the NSD objective will be the same data as collected from the continuous flow-paced sampling used for monitoring Segment 5 Action Level compliance (see Section 6.7).

Only surface-water runoff from the IA is included, (i.e., baseflow, stormwater runoff flow, operational discharges, and spills to surface water). Spills are only included in this NSD monitoring as a secondary monitoring objective if an increase in flow rate is detected and cannot be attributed to precipitation runoff or other identified discharge. However, other management controls (e.g., SPCC/BMP) address monitoring of spills as a primary objective. These NSD locations also provide confirmation that containment measures for spills or accidental discharges have been effective through monitoring of the real-time indicator parameters.

Indicator monitoring will be performed for the parameters specified at the top of each column of Table 6-23.[18] The first three columns are Analytes of Interest (AoIs) monitored directly through sample

[13] An operational discharge can be defined as a footing drain or sump discharged to ground, an incidental water discharged to ground, spray water used for dust suppression during D&D, fire hydrant testing, a utility line break, etc.

[14] Subdrainage monitoring stations within the IA are used for Performance monitoring and source location but are excluded from the planned monitoring for this NSD decision rule.

[15] Direct runoff is defined as the runoff attributed to a precipitation event in excess of the current baseflow.

[16] Descriptions of sample collection protocols are given in Section 7.2.2.2.

[17] SW022 was converted from storm-event sampling to continuous flow-paced sampling on October 1, 1999 to facilitate more accurate load calculations in support of the GS10 Source Evaluation. Since the NSD decision rule uses 95% UTLs for data analysis, and the storm-event data can not be used in comparison with the flow-paced data, the UTL analysis will segregate sample types.

[18] Real-time indicator measurement at SW022 and SW091 has proven impractical due to the ephemeral nature of the flow at these locations. The real-time water quality probes require that their sensors remain wet at all times. Since these locations are dry except during periods of direct runoff, the Site has historically employed 'sump' systems that

analytical measurements. Although these three columns and rows have a different relationship than the others, they have been included so that all monitored parameters are shown on the same table. The remaining columns are indicator parameters that are monitored with inexpensive real-time probes in lieu of analyzing for the AoIs identified at the left of each row.

Table 6-23. Screening for New Source Detection: AoIs vs. Indicator Parameters.

	Routinely Monitored Parameters							
	Monitored AoIs			Indicator Parameters for AoIs				
AoIs	Pu	U	Am	Turbidity	pH	Conductivity	Nitrate	Flow Rate; Precipitation[a]
Plutonium	X			X			X	X
Uranium		X						X
Americium			X	X				X
Turbidity				X				X
pH					X		X	X
Conductivity						X		X
Nitrate						X	X	X
Chromium					X	X	X	X
Beryllium						X		X
Silver						X		X
Cadmium						X	X	X

Notes: [a] Precipitation data is collected at Sitewide locations. Precipitation data collection is not required at each NSD location, but Sitewide data is used for NSD evaluation.

6.6.2 FY00 Monitoring Scope

The following tables detail the planned New Source Detection monitoring scope for FY00.

Table 6-24. New Source Detection Monitoring Locations.

ID Code	Location	Primary Flow Measurement Device	Telemetry
SW093	N. Walnut Cr. 1000' upstream from the A-1 Bypass	36" Suppressed Rectangular Sharp-Crested Weir	Yes
SW091	Gully NE of Solar Ponds outside inner fence	6" Cutthroat Flume	Yes
GS10	S. Walnut Cr. upstream from the B-1 Bypass	9" Parshall Flume	Yes
SW022	Central Avenue Ditch at inner east fence	9.5" Parshall Flume	Yes
SW027	South Interceptor Ditch at Pond C-2	Dual Parallel 120° V-Notch Weirs	Yes

use tap water to keep the sensors wet. These systems were designed to flush during direct runoff so that the tap water was replaced by runoff water. However, the relatively slow response time of the sensors often resulted in data that was poor or unusable. These sump systems were also susceptible the freezing during cold weather, which occasionally resulted in damage to the equipment. For these reasons, the Site has very limited real-time indicator data for SW022 and SW091, and water-quality probes are not routinely deployed at these locations.

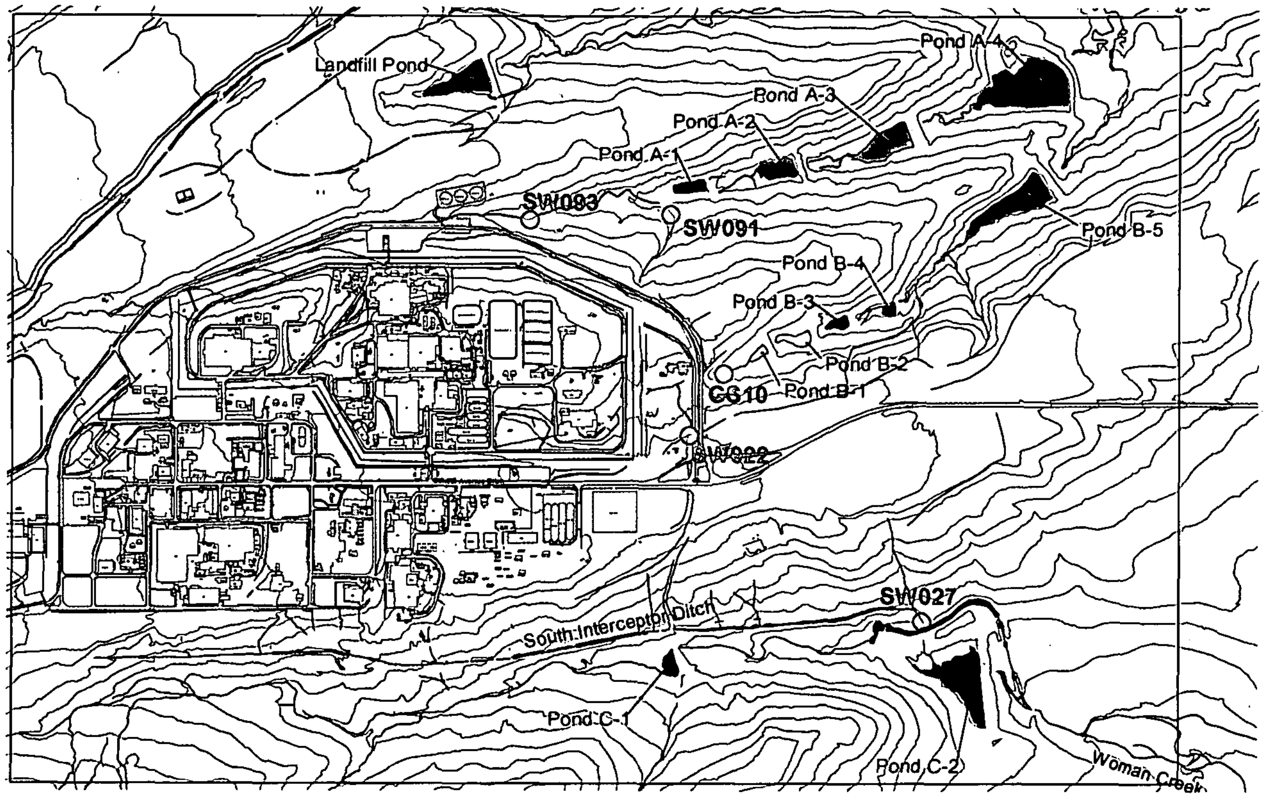

Figure 6-7. Map Showing New Source Detection Monitoring Locations.

Table 6-25. New Source Detection Field Data Collection: Parameters and Frequency.

	Parameter		
ID Code	**Discharge**	**Real-Time pH, Conductivity, Turbidity, Nitrate**	**Precipitation**
SW093	15-min continuous	15-min continuous	
SW091	15-min continuous	See footnote 18	
GS10	15-min continuous	15-min continuous	
SW022	15-min continuous	See footnote 18	15-min continuous
SW027	15-min continuous	15-min continuous	

Table 6-26. New Source Detection Sample Collection Protocols.

ID Code	Frequency[a]	Type[b]
SW093	12 per year[c]	Continuous flow-paced composites
SW091	1 per month[d]	Storm-event rising-limb flow-paced composites
GS10	12 per year[c]	Continuous flow-paced composites
SW022	12 per year	Continuous flow-paced composites
SW027	12 per year[c]	Continuous flow-paced composites

Notes: [a] Only SW091 will be sampled on the rising limb of the hydrograph, as originally specified for this decision rule. Stations SW093, SW027, and GS10 are the Segment 5 Action Level (POE) monitoring stations (see Section 6.7). At these Segment 5 stations, NSD will be performed by statistically testing the continuous flow-paced sample results required for the POE objective. The same test criterion will be used, except that continuous flow-paced samples will be tested against flow-paced variability. These locations will collect more than the target 12 samples for the NSD objective. All results collected at these locations under the POE objective will be used in the NSD objective.

[b] Sample types are defined in Section 7.2.2.2.

[c] Sample frequency distribution during the year for SW093, GS10, and SW027 (POEs) is given in Section 6.7 (POE decision rule).

[d] Storm-event sampling at locations which are often dry and normally only receive direct runoff is opportunistic. These locations may see flow only during wet months. Every attempt is made to achieve the target sample frequency; however, this is not always possible.

Table 6-27. New Source Detection Analytical Targets (Analyses per Year).

ID Code	TSS[a]	Pu, U, Am
SW093[b]	12	12
SW091	12	12
GS10[b]	12	12
SW022	12	12
SW027[b]	12	12

Notes: [a] Ideally, TSS would be analyzed for all samples collected at the above locations. However, continuous flow-paced sampling protocols often result in composite samples which are collected over periods exceeding the 7-day hold time for TSS analyses. Therefore, TSS can not be analyzed for all continuous flow-paced composite samples, but will be analyzed when possible.
[b] Stations SW093, SW027, and GS10 are the Segment 5 Action Level (POE) monitoring stations (see Section 6.7). At these Segment 5 stations, NSD will be performed by statistically testing the continuous flow-paced sample results required for the POE objective. The same test criterion will be used, except that continuous flow-paced samples will be tested against flow-paced variability. These locations will collect more than the target 12 samples for the NSD objective. All results collected at these locations under the POE objective will be used in the NSD objective.

Table 6-28. New Source Detection Telemetry Data Collection.

ID Code	Parameters		
	Hydrologic	Sampling	Real-Time Water Quality
SW093	flow	current sample volume; expected sample volume based on flow[a]	summary statistics, instantaneous measurements (on demand), high/low alarms for pH, specific conductivity, nitrate, and turbidity
SW091	flow	sampler status (full or waiting)	
GS10	flow	current sample volume; expected sample volume based on flow[a]	summary statistics, instantaneous measurements (on demand), high/low alarms for pH, specific conductivity, nitrate, and turbidity
SW022	flow; precipitation	current sample volume; expected sample volume based on flow[a]	
SW027	flow	current sample volume; expected sample volume based on flow[a]	summary statistics, instantaneous measurements (on demand), high/low alarms for pH, specific conductivity, nitrate, and turbidity

Notes: [a] Provides an indication of equipment malfunction.

6.6.3 Data Analysis

Indicator monitoring will be performed for the parameters specified at the top of each column of Table 6-23. The first three columns are Analytes of Interest (AoIs) monitored directly through sample analytical measurements. The remaining columns are indicator parameters that are monitored with low-cost real-time probes in lieu of analyzing for the AoIs identified at the left of each row. If a significant increase is detected in any one of these indicator parameters, then there is reasonable cause to suspect the presence of the AoI identified at the left end of the row in which an "X" appears. For example, if the pH probe detects a very low pH, then the Site would have reasonable cause to suspect the presence of chromic acid, elevated conductivity, and possibly, high nitrate, all of which are AoIs for Segment 5. If there were reasonable cause to suspect the presence of these analytes of interest, then the Site would perform additional analytical procedures specific for the analytes of interest.

Data collected by water quality probes at New Source Detection locations are considered and evaluated, at a minimum, in the following ways:

- Daily average values are checked (daily on work days) using the radio telemetry equipment;
- A general qualitative evaluation of data is performed (generally monthly);
- A detailed work-up of 15-minute data is generated and archived; and

- A detailed work-up and evaluation of daily averages (including tolerance limits) is completed and archived.

Each of these data evaluation activities is completed for all water quality parameters measured by the probes. Additional evaluation may be performed for a variety of reasons including spill investigations, special requests, and studies of probe performance. The above listed data evaluation activities are described individually, in greater detail in Section 7.3.2.3.

Generally, analytical data evaluation is performed as data becomes available, especially if an initial qualitative screening based on process knowledge indicates that an analytical result is higher than normal for a particular location. The desired evaluation frequency is semi-monthly, within one week of the 15th and last day of any given month.

Screening for reasonable cause to suspect a new source:

IF The mean concentration of any of the screening indicator variables in Table 6-23 exceeds the 95% UTL/LTL of baseline for that variable,

THEN The Site will evaluate the need for further action under RFCA ALF, such as source evaluation and control. Evaluations will address persistence, trends, and risk of Action Level exceedances at POEs.

Table 6-29. New Source Detection Monitoring Analytical Data Evaluation.

ID Code	Evaluation Type[a]
SW093	95% UTLs / LTLs; Loading Analysis
SW091	95% UTLs / LTLs; Loading Analysis
GS10	95% UTLs / LTLs; Loading Analysis
SW022	95% UTLs / LTLs; Loading Analysis
SW027	95% UTLs / LTLs; Loading Analysis

Notes: [a] Details on the evaluation of analytical results are given in Section 7.3.2.2.

6.7 STREAM SEGMENT 5 POINT OF EVALUATION MONITORING

This monitoring objective deals with POE monitoring of Segment 5 for adherence with the RFCA Action Level Framework (ALF). Response to exceedances of Action Levels at POEs are different than the responses associated with contaminated runoff before it reaches Segment 5 or after it enters Segment 4. IA monitoring upgradient of Segment 5 is designed to detect new contaminant sources within the IA. Downstream, Segment 4 is monitored at POCs to protect designated uses, the ecology, and the public health.

Historical data collected prior to RFCA monitoring indicate that several regulated contaminants may exceed their RFCA action level criteria at the designated POEs. Such exceedances will require source evaluation and the development of a mitigation plan. The initial response to these exceedances might be to invoke the Source Location decision rule, perform special monitoring tailored to the specific source evaluation, and take action upstream of Segment 5 to protect Segment 5 from contaminant sources that caused such exceedances.

6.7.1 Data Types, Frequency, and Collection Protocols

The analytical decision inputs are those analytes specified as the Segment 5 AoIs per Table 6-30, as sampled at the POEs for Stream Segment 5. RFCA provides specific criteria for virtually every possible contaminant for the main stream channels of Segment 5. In developing the IMP, the DQO team identified a subset of those contaminants that are of sufficient interest to warrant monitoring under ALF.

Table 6-30. RFCA Segment 5 AoIs.

Radionuclides:	Total Pu-239,240	High level of public concern. Known carcinogen. Known past releases (within the past 10 years) have exceeded RFCA stream standards and action levels. This provides reasonable cause to expect future releases in excess of RFCA Action Levels.
	Total U-233,234, U-235, U-238	Known renal toxicity. Present on Site. Past exceedances provide reasonable cause to expect future releases in excess of RFCA stream standards and action levels.
	Total Am-241	Known carcinogen. Present on Site. Known past exceedances provide reasonable cause to expect future releases in excess of RFCA stream standards and action levels.
Metals:	Total Be	Known to cause berylliosis in susceptible individuals when exposed by inhalation. May also cause contact dermatitis. Present on Site. Will be monitored as an indicator of releases from process and waste storage areas.
	Total Cr	Physiological and dermal toxicity. High level of regulatory concern due, in part, to the chromic acid incident of 1989. Low levels can cause significant ecological damage.
	Dissolved Ag	Highly toxic to fish at low levels if chronic. State of Colorado temporarily removed its stream standard for silver, while under study. The study has been completed, and the standard will be reinstated at the next triennial review of South Platte stream standards, if not before. Used on Site only for photographic development. Routinely accepted by POTWs as municipal waste, but discharge is regulated. May be removed from this list later, if data do not support concern.
	Dissolved Cd	Highly toxic to fish at low levels if chronic. Known human carcinogen (prostate cancer) and depletes physiologic calcium. Used on Site in plating processes. Monitoring data for the Interceptor Trench System (ITS) and the proposed discharge of untreated ITS waters into Walnut Creek provide reasonable cause to expect future releases in excess of RFCA Action Levels.
	Hardness	Required to evaluate metals analyses, due to its effect on solubility and subsequent toxicity of these metals.
Real Time Monitoring of Physical and Indicator Parameters:	pH	Extremes are toxic to humans and ecology. Regulatory concern due to chromic acid incident. Real-time monitoring is inexpensive and effective method of detecting acid spills such as (chromic acid or plutonium nitrate) or failure of treatment systems.
These parameters provide real-time alarms for a wide variety of regulated contaminants, and are also a required component of monitoring for AoIs.	Conductivity	Conductivity is an indicator of total dissolved ions, metals, anions, and pH. Real-time monitoring of conductivity is an inexpensive indicator of overall water quality.
They require no laboratory analyses, and are the Site's most cost-effective defensive monitoring.	Turbidity	Turbidity is a general indicator of elevated contaminant levels, and may be correlated with Pu.
	Nitrate	Past releases near RFCA stream standards and action levels upstream of ponds provide reasonable cause to expect future releases in excess of RFCA stream standards and action levels. Certain discharges often include nitrate, and may challenge RFCA action levels.
	Flow	Required to detect flow events, pace automated samplers, evaluate contaminant loads, and plan pond operations and discharges. Affects nearly every decision rule, and is the most commonly discussed attribute of Site surface waters.

Notes: VOAs, Fe, and Mn are specifically excluded from this list. The parties recognize that VOAs will not be effectively monitored at these monitoring stations, and defer to the decision rules that drive monitoring closer to the sources of VOA contamination.
POTW = Publicly owned treatment works
VOA = Volatile organic analysis

Segment 5 includes the terminal ponds, and the main stream channels of North and South Walnut Creek, Pond C-2, and the SID. Monitoring will be performed for Stream Segment 5 only as represented by POEs SW093, SW027, and GS10 (see Figure 3-1).

Sampling for AoIs at POEs is performed by collecting continuous flow-paced composite samples. The recommended monitoring design detailed in the IMP is to take samples for FY00 as specified in Table 6-34. The intent is to take no less than one sample per quarter, and no more than four composite samples per month from each of the three monitoring points. The ideal sampling rate is one composite sample for each 500,000 gallons of stream flow, and each composite sample should comprise a target of 50 flow-paced grab samples.

Table 6-34 presents the location-specific number of samples per month recommended by statisticians at Pacific Northwest National Laboratory (PNNL) that worked with the DQO working group. There are both practical and statistical advantages to this sample allocation design. Averaging a larger number of samples is more expensive, but it protects the Site from regulatory action in response to a spurious, non-representative monitoring result.

There are secondary advantages to this monitoring plan. A larger number of samples allows for estimates of variability that can be used to refine the monitoring plan over time. The monitoring program specified here is a technically defensible approach that represents a compromise between a statistical design, a design based on professional judgement, and a design based on budgetary constraints. This design will generate data that are representative of actual contaminant levels and loads.

This design is consistent with the intent of the 30-day moving average specified in RFCA but allows some flexibility. Where there is no significant flow, there may be no samples completed within a 30-day period, and where the flows, loads, and variability are expected to be higher, sample numbers are also higher. Note that flow-paced monitoring will continue during dry periods, although, as stated, flows may be so low that it takes more than 30 days to fill the composite sample container.

Indicator parameters are measured using real-time water-quality probes as discussed in Section 6.6 for the NSD monitoring objective. These data may be used in this decision rule for correlations and trending.

6.7.2 FY00 Monitoring Scope

The following tables detail the planned POE monitoring scope for FY00.

Table 6-31. POE Monitoring Locations.

ID Code	Location	Primary Flow Measurement Device	Telemetry
SW093	N. Walnut Cr. 1000' upstream from the A-1 Bypass	36" Suppressed Rectangular Sharp-Crested Weir	Yes
GS10	S. Walnut Cr. upstream from the B-1 Bypass	9" Parshall Flume	Yes
SW027	South Interceptor Ditch at Pond C-2	Dual Parallel 120° V-Notch Weirs	Yes

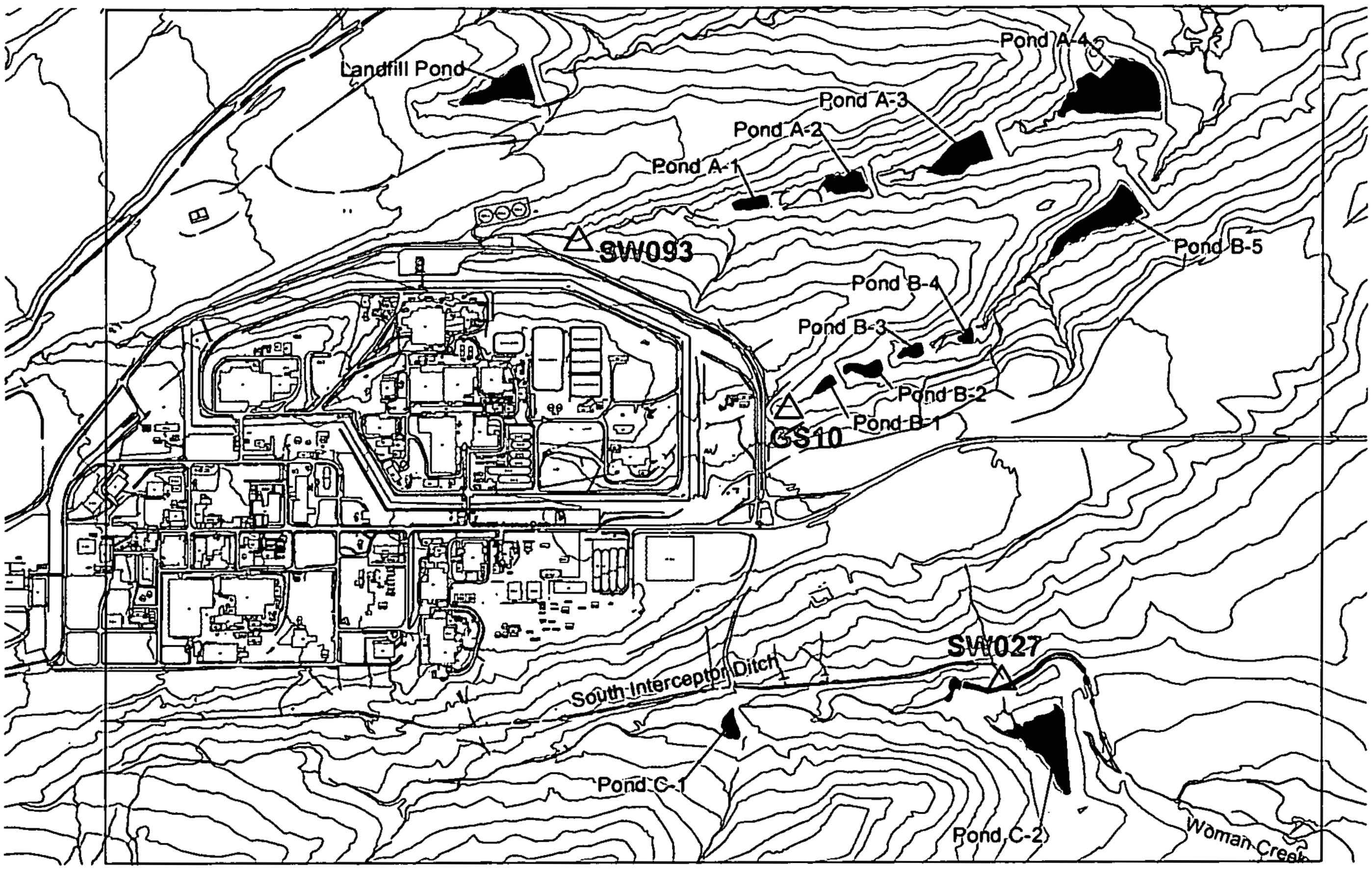

Figure 6-8. Map Showing Point of Evaluation Monitoring Locations.

Table 6-32. POE Field Data Collection: Parameters and Frequency.

ID Code	Parameter	
	Discharge	Real-Time pH, Conductivity, Turbidity, Nitrate
SW093	15-min continuous	15-min continuous
GS10	15-min continuous	15-min continuous
SW027	15-min continuous	15-min continuous

Table 6-33. POE Sample Collection Protocols.

ID Code	Frequency[a]	Type[b]
SW093	36 per year	Continuous flow-paced composites
GS10	34 per year	Continuous flow-paced composites
SW027	16 per year	Continuous flow-paced composites

Notes: [a] Sample frequency distribution during the year for SW093, GS10, and SW027 (POEs) is given in Table 6-34.
[b] Sample types are defined in Section 7.2.2.2.

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Table 6-34. POE Target Sample Distribution.

Month	SW093	GS10	SW027	Totals
Oct 99	3	3	0	6
Nov 99	4	3	0	7
Dec 99	2	1	1	4
Jan 00	2	1	0	3
Feb 00	2	2	0	4
Mar 00	4	4	1	9
Apr 00	4	4	4	12
May 00	4	4	4	12
Jun 00	4	4	4	12
Jul 00	2	3	0	5
Aug 00	2	2	1	5
Sep 00	3	3	1	7
Totals	**36**	**34**	**16**	**86**

Table 6-35. POE Analytical Targets (Analyses per Year).

ID Code	TSS[a]	Dissolved Ag, Be, Dissolved Cd, Cr	Hardness	Pu, U, Am
SW093	36	36	36	36
GS10	34	34	34	34
SW027	16	16	16	16

Notes: [a] Ideally, TSS would be analyzed for all samples collected at the above locations. However, continuous flow-paced sampling protocols often result in composite samples which are collected over periods exceeding the 7-day hold time for TSS analyses. Therefore, TSS can not be analyzed for all continuous flow-paced composite samples, but will be analyzed when possible.

Table 6-36. POE Telemetry Data Collection.

ID Code	Parameters		
	Hydrologic	Sampling	Real-Time Water Quality
SW093	flow	current sample volume; expected sample volume based on flow[a]	summary statistics; instantaneous measurements (on demand); high/low alarms for pH; high alarms for specific conductivity, nitrate, and turbidity
GS10	flow	current sample volume; expected sample volume based on flow[a]	summary statistics; instantaneous measurements (on demand); high/low alarms for pH; high alarms for specific conductivity, nitrate, and turbidity
SW027	flow	current sample volume; expected sample volume based on flow[a]	summary statistics; instantaneous measurements (on demand); high/low alarms for pH; high alarms for specific conductivity, nitrate, and turbidity

Notes: [a] Provides an indication of equipment malfunction.

6.7.3 Data Analysis

Sampling for AoIs at POEs is performed by collecting continuous flow-paced composite samples. Indicator parameters are measured using real-time water-quality probes. These AoIs and indicator parameters are evaluated using 30-day or 1-day moving averages, as specified in RFCA and implemented by the ALF or DQO working groups involving consensus of all parties to RFCA. Pu, Am, U, Be, Cr, dissolved Ag, and dissolved Cd are evaluated using volume-weighted 30-day moving averages at POEs[19]. Indicator parameters pH and nitrate are evaluated as 1-day arithmetic averages with mathematical consideration given to the log nature of pH measurements.

The parties to RFCA agree that continuous monitoring probes will be used as indicators that may suggest a need for additional monitoring, mitigating action, or management decision. The parties agree that compliance and enforcement issues will be resolved on the basis of standard analytical procedures required by the applicable agreement or regulations, e.g., RFCA, or CERCLA. The parties agree that continuous monitoring field probes should NOT be used to determine compliance or serve as a basis for enforcement action, unless the applicable regulation specifies such a probe as the enforceable analytical method for a particular measurement.

Moving averages for AoIs are to be calculated for the preceding period, verified by additional analyses at the discretion of the monitoring organization, and formally reported to the DOE, RFFO within 30 days of gaining knowledge that an exceedance may have occurred (i.e., within 30 days of receiving a high analytical result). This 30-day period allows time for verification analyses after the monitoring organization gains knowledge that an exceedance may have occurred before formal notification to DOE, RFFO of an actual exceedance is required. RFCA requires that DOE, RFFO inform regulators within 15 days of DOE, RFFO gaining knowledge (not just a suspicion) that an exceedance (verified) has (actually) occurred. In addition, DOE will, within 30 days of gaining knowledge of the exceedance, submit a plan and schedule for source evaluation. During this 45-day period between first suspicion and formal notification to regulators, the DOE, RFFO may initiate discretionary mitigating action. The delay interval will prevent undue public alarm when the initial high result is not confirmed by subsequent monitoring. Informal communications between the parties are intended during the delay interval.

Generally, analytical data evaluation is performed as preliminary data become available. If an initial qualitative screening indicates that an analytical result is higher than the action level for a particular AoI, then the 30-day average is calculated immediately upon receipt of the preliminary result. The desired evaluation frequency is semi-monthly, within one week of the 15th and last day of any given month.

IF	The appropriate summary statistic[20] for any AoI in the main stream channels of Stream Segment 5, as monitored at the designated POEs, exceeds the appropriate RFCA action level
THEN	The Site must notify EPA and CDPHE, evaluate for source location, and implement mitigating action[21] if appropriate[22].

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[19] The 30-day average for a particular day is calculated as a volume-weighted average of a 'window' of time containing the previous 30-days which had flow. Each day has its own discharge volume (measured at the location with a flow meter) and activity (analytical result from the sample in place at the end of that day). Therefore, there are 365 30-day moving average values for a location which flows all year (366 values in a leap year). At locations which monitor pond discharges or have intermittent flows, 30-day averages are reported as averages of the previous 30 days of greater than zero flow. For days where no activity is available, either due to failed lab analysis or non-sufficient quantity (NSQ) for analysis, no 30-day average is reported. The calculation of 30-day averages is discussed in detail in Section 7.3.2.2.

[20] Appropriate action levels and standards for volume-weighted 30-day moving averages or 1 calendar day arithmetic averages, are specified for individual contaminants in RFCA.

[21] Mitigating action may include, but not be limited to, the following examples: 1) Immediate action to halt a discharge or contain a spill; or 2) Use of the Source Location decision rule to seek out and mitigate upstream contaminant sources.

[22] EPA determines the consequences for an exceedance of any action level (not just those for AoIs) at any location within the segment (not just at the consensus monitoring points). This decision rule presents the consensus decision rule that drives our monitoring activities. It is an implementation, rather than a reiteration, of RFCA.

Table 6-37. POE Monitoring Analytical Data Evaluation.

ID Code	Evaluation Type[a]
SW093	30-Day Volume-Weighted Moving Averages; Loading Analysis
GS10	30-Day Volume-Weighted Moving Averages; Loading Analysis
SW027	30-Day Volume-Weighted Moving Averages; Loading Analysis

Notes: [a] Details on the evaluation of analytical results are given in Section 7.3.2.2.

6.8 STREAM SEGMENT 4 POINT OF COMPLIANCE MONITORING

RFCA provides specific standards for Walnut and Woman Creeks below the terminal ponds (Segment 4). These criteria and the responses to them are different than the criteria and actions associated with Segment 5. This section deals only with monitoring discharges from the terminal ponds into Segment 4 and the additional POCs for Segment 4 at Indiana Street. Terminal pond discharges will be monitored by POCs GS11, GS08, and GS31. Walnut Creek will be monitored at Indiana Street by POC GS03. Woman Creek will be monitored at Indiana Street by POC GS01. These locations are shown on Figure 3-1.

With the completion of the Woman Creek Reservoir, located just east of Indiana Street and operated by the city of Westminster, all Woman Creek flows will be detained in cells of the new reservoir until the water quality has been assured by monitoring of Woman Creek at Indiana Street. There is concern that meeting standards for radiologic parameters in Pond C-2 discharge does not adequately demonstrate that all water leaving the Site via Woman Creek and entering the Woman Creek Reservoir is meeting the radiologic standards. Woman Creek water (combined with Pond C-2 or flowing in the absence of any Pond C-2 water) will enter the Woman Creek Reservoir. This is the basis for setting an additional RFCA POC for Woman Creek at Indiana Street (GS01) for those radiologic contaminants that could be directly attributable to the Site (i.e., not naturally occurring).

For Walnut Creek, a similar POC, GS03, has been established at Walnut Creek and Indiana Street. Although the Walnut Creek drainage is not undergoing operational changes similar to Woman Creek, it is possible that contaminated overland runoff or landfill drainage may enter Walnut Creek below the terminal pond monitoring points (GS11 and GS08), yet upstream of Indiana Street.

6.8.1 Data Types, Frequency, and Collection Protocols

The analytical decision inputs are those analytes specified as the Segment 4 AoIs (Table 6-38), as sampled at the POCs for Stream Segment 4.

Monitoring performed for Stream Segment 4 is limited to POCs GS11, GS08, GS31, GS03, and GS01 (see Figure 3-1).

Sampling for AoIs at POCs is performed by collecting continuous flow-paced composite samples. The recommended monitoring design detailed in the IMP is to take samples for FY00 as specified in Table 6-42. Flow-paced monitoring is maintained at all times for all five POCs in Segment 4, even though no samples are anticipated from terminal pond stations except during planned pond discharges.

Historically, terminal pond discharges occurred on average once per year for Pond C-2 and 9 times per year for A-4 and B-5 combined. Since the DQO process targeted 3 samples per discharge (for FY97), terminal pond POCs targeted 30 composite samples to be collected annually.

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Table 6-38. RFCA Segment 4 AoIs.

Terminal Pond POCs		
Radionuclides:	Total Pu-239,240	High level of public concern. Known carcinogen. Known past releases (within the past 8 years) have exceeded RFCA stream standards and action levels. This provides reasonable cause to expect future releases in excess of RFCA stream standards and action levels.
	Total U-233,234, U-235, U-238	Known renal toxicity. Present on Site. Past exceedances provide reasonable cause to expect future releases in excess of RFCA stream standards and action levels.
	Total Am-241	Known carcinogen. Present on Site. Known past exceedances provide reasonable cause to expect future releases in excess of RFCA stream standards and action levels.
Real Time Monitoring of Physical and Indicator Parameters:	pH	Extremes are toxic to humans and ecology. Regulatory concern due to chromic acid incident. Real-time monitoring is inexpensive and effective method of detecting acid spills such as (chromic acid or plutonium nitrate) or failure of treatment systems.
These parameters provide real-time alarms for a wide variety of regulated contaminants, and are also a required component of monitoring for AoIs.	Conductivity	Conductivity is an indicator of total dissolved ions, metals, anions, and pH. Real-time monitoring of conductivity is an inexpensive indicator of overall water quality.
They require no laboratory analyses, and are the Site's most cost effective defensive monitoring.	Turbidity	Turbidity is a general indicator of elevated contaminant levels, and may be correlated with Pu.
	Nitrate	Past releases near RFCA stream standards and action levels upstream of ponds provide reasonable cause to expect future releases in excess of RFCA stream standards and action levels. Certain discharges often include nitrate, and may challenge RFCA action levels.
	Flow	Required to detect flow events, pace automatic samplers, evaluate contaminant loads, and plan pond operations and discharges. Affects nearly every decision rule, and is the most commonly discussed attribute of Site surface waters.
Indiana Street POCs		
Radionuclides:	Total Pu-239,240	High level of public concern. Known carcinogen. Known past releases (within the past 8 years) have exceeded RFCA stream standards and action levels. This provides reasonable cause to expect future releases in excess of RFCA stream standards and action levels.
	Total Am-241	Known carcinogen. Present on Site. Known past exceedances provide reasonable cause to expect future releases in excess of RFCA stream standards and action levels.
	Tritium	Tritium is an AoI for the cities, due to the past release of tritium (1973).
Real Time Monitoring of Physical and Indicator Parameters:	Water-Quality Parameters	Indiana Street is not a point of compliance for the real-time monitoring parameters.
	Flow	Required to detect flow events, pace automatic samplers, and evaluate contaminant loads. Affects nearly every decision rule, and is the most commonly discussed attribute of Site surface waters.

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During FY97, all routine North and South Walnut Creek water was discharged from A-4 (B-5 was pump transferred to A-4, except during periods of high stormwater runoff). Starting in FY98, Pond B-5 began periodic direct discharge to Walnut Creek, effectively dividing discharges to Walnut Creek between Ponds A-4 and B-5. Therefore, sampling protocols starting in FY98 were modified such that the total number of continuous flow-paced composite samples to be collected annually for discharges from both A-4 and B-5 would be comparable to the FY97 targets. For Fiscal Years 1993 through 1997, the total combined discharge volume for A-4 and B-5 was 687 Mgals in 43 discharge batches, or 16 Mgals per discharge batch on average. Targeting three composite samples per discharge gives one composite sample per 5.3 Mgals of discharge volume. This composite sample frequency (1 per 5.3 Mgals) will preserve the targeted sampling frequencies (based on discharge volume) while maintaining effective cost controls (based on total sample costs). For FY00 planning purposes, 9 samples will be collected from A-4, and 18 from B-5, resulting in the collection of the targeted 27 composite samples (see Table 6-42)[23]. However, this sample planning is also dependent on the routing for the WWTP effluent. Any future changes in the management of Walnut Creek water could result in sampling protocol modifications to preserve the initial intent of the DQO process.

The source(s) of the water sampled at the Indiana Street POCs (GS01 and GS03) must be determined prior to sample planning at these locations. Monitoring at GS01 and GS03 calls for samples to be segregated based on water origin (natural creek flows or terminal pond discharges commingled with natural flows).

POC GS01 will collect 3 samples during each C-2 discharge; storm runoff and baseflow samples will be based on average annual volumes. During storm runoff and baseflow, the target at GS01 is one sample per 500,000 gallons, with a maximum of 3 samples during any one month (see Table 6-42). GS03 will collect the targeted 27 samples during A-4 and B-5 discharges (GS03 will collect the same number of composite samples as the terminal pond POCs for each discharge). During storm runoff and baseflow periods between pond discharges, GS03 will target 2 composite samples every 15 days. The goal is to have at least 2 analytical results for any 30-day period for averaging purposes. The Site may combine samples of the same flow pacing to reduce analytical costs and avoid samples of non-sufficient quantity for analysis.

6.8.2 FY00 Monitoring Scope

The following tables detail the planned POC monitoring scope for FY00.

Table 6-39. POC Monitoring Locations.

ID Code	Location	Primary Flow Measurement Device	Telemetry
GS11	Pond A-4 outlet works	24" Parshall Flume	Yes
GS08	Pond B-5 outlet works	24" Parshall Flume	Yes
GS31	Pond C-2 outlet works	24" Parshall Flume	Yes
GS03	Walnut Creek and Indiana St.	6" and 36" Parallel Parshall Flumes	Yes
GS01	Woman Creek and Indiana St.	18" Parshall Flume	Yes

[23] The number of samples collected at each pond depends on the amount of water discharged from each pond. Of the combined North and South Walnut Creek inflows, 66% flows to B-5 and 34% flows to A-4, on average. It is entirely possible that no water will be direct discharged from Pond B-5, and no samples would be collected at GS08. All B-5 water would be pumped to A-4, and all POC samples for both A-4 and B-5 would then be collected at GS11. Regardless, the targeted 27 samples is specified for budget planning purposes.

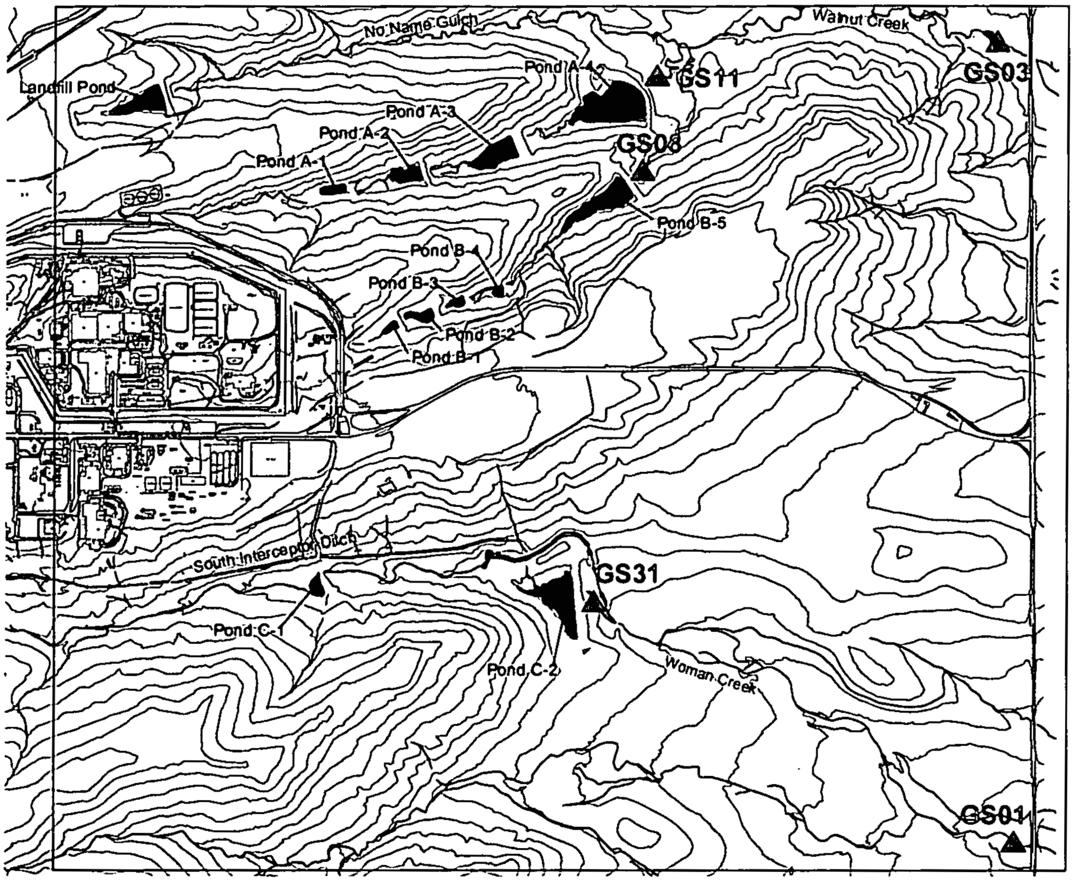

Figure 6-9. Map Showing Point of Compliance Monitoring Locations.

Table 6-40. POC Field Data Collection: Parameters and Frequency.

ID Code	Parameter		
	Discharge	**Real-Time pH, Conductivity, Turbidity, Nitrate**	**Precipitation**
GS11	15-min continuous	15-min continuous	
GS08	15-min continuous	15-min continuous	
GS31	15-min continuous	15-min continuous	
GS03	15-min continuous		15-min continuous
GS01	15-min continuous		15-min continuous

Table 6-41. POC Sample Collection Protocols.

ID Code	Frequency	Type[b]
GS11	9 per year[a]	Continuous flow-paced composites
GS08	18 per year[a]	Continuous flow-paced composites
GS31	3 per year[c]	Continuous flow-paced composites
GS03	58 per year[a]	Continuous flow-paced composites
GS01	28 per year[c]	Continuous flow-paced composites

Notes: [a] Assuming one composite sample per 5.3 Mgals of terminal pond discharge volume. Number may vary due to pond water management activities.
[b] Sample types are defined in Section 7.2.2.2.
[c] Assumes 1 C-2 discharge per year; 3 composite samples per discharge.

Table 6-42. POC Target Sample Distribution.

Time Period	Pond			Walnut Creek at Indiana Street [GS03]	Woman Creek at Indiana Street [GS01]	Total Number of Samples
	A-4 [GS11]	B-5 [GS08]	C-2 [GS31]			
During Discharge	9[a]	18[a]	3[b]	27[a]	3[b]	60
Storm and Base Flow[c]						
October 99	NA	NA	NA	3	1	4
November 99	NA	NA	NA	3	2	5
December 99	NA	NA	NA	3	2	5
January 00	NA	NA	NA	3	2	5
February 00	NA	NA	NA	2	2	4
March 00	NA	NA	NA	3	3	6
April 00	NA	NA	NA	2	3	5
May 00	NA	NA	NA	1	3	4
June 00	NA	NA	NA	2	3	5
July 00	NA	NA	NA	4	2	6
August 00	NA	NA	NA	2	2	4
September 00	NA	NA	NA	3	0	3
FY00 Totals	9	18	3	58	28	116

Notes: [a] Assuming one composite sample per 5.3 Mgals of terminal pond discharge volume. Number may vary due to pond water management activities.
[b] Assumes 1 C-2 discharge per year; 3 composite samples per discharge.
[c] GS01 and GS31 distribution based on PNNL recommendations; GS03 distribution based on average monthly number of day without a terminal pond discharge using WY98-WY00 data (period when neither A-4 or B-5 direct discharged) assuming approximately one composite every 8 days.

Table 6-43. POC Analytical Targets (Analyses per Year).

ID Code	TSS[a]	Pu, U, Am	Pu, Am, Tritium
GS11	9	9	NA
GS08	18	18	NA
GS31	3	3	NA
GS03	58	NA	58
GS01	28	NA	28

Notes: [a] Ideally, TSS would be analyzed for all samples collected at the above locations. However, continuous flow-paced sampling protocols often result in composite samples which are collected over periods exceeding the 7-day hold time for TSS analyses. Therefore, TSS can not be analyzed for all continuous flow-paced composite samples, but will be analyzed when possible.

Table 6-44. POC Telemetry Data Collection.

ID Code	Parameters		
	Hydrologic	Sampling	Real-Time Water Quality
GS11	flow	current sample volume; expected sample volume based on flow[a]	summary statistics, instantaneous measurements (on demand), high/low alarms for pH, specific conductivity, nitrate, and turbidity
GS08	flow	current sample volume; expected sample volume based on flow[a]	summary statistics, instantaneous measurements (on demand), high/low alarms for pH, specific conductivity, nitrate, and turbidity

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ID Code	Parameters		
	Hydrologic	**Sampling**	**Real-Time Water Quality**
GS31	flow	current sample volume; expected sample volume based on flow[a]	summary statistics, instantaneous measurements (on demand), high/low alarms for pH, specific conductivity, nitrate, and turbidity
GS03	flow; precipitation	current sample volume; expected sample volume based on flow[a]	
GS01	flow; precipitation	current sample volume; expected sample volume based on flow[a]	

Notes: [a] Provides an indication of equipment malfunction.

6.8.3 Data Analysis

Sampling for AoIs at POCs is performed by collecting continuous flow-paced composite samples. Indicator parameters are measured using real-time water-quality probes. These AoIs and indicator parameters are evaluated using 30-day or 1-day moving averages, as specified in RFCA and implemented by the ALF or DQO working groups involving consensus of all parties to RFCA. Pu, Am, U, and Tritium are evaluated using volume-weighted 30-day moving averages at POCs[24]. Indicator parameters pH and nitrate are evaluated as 1-day arithmetic averages with mathematical consideration given to the log nature of pH. Indicators are not evaluated under this monitoring objective for the Indiana Street POCs.

The parties to RFCA agree that continuous monitoring probes will be used as indicators that may suggest a need for additional monitoring, mitigating action, or management decision. The parties agree that compliance and enforcement issues will be resolved on the basis of standard analytical procedures specified by the applicable regulation or agreement, e.g., NPDES, RFCA, or CERCLA. The parties agree that continuous monitoring field probes should NOT be used to determine compliance or serve as a basis for enforcement action, unless the applicable regulation specifies such a probe as the enforceable analytical method for a particular measurement.

Generally, analytical data evaluation is performed as preliminary data become available. If an initial qualitative screening indicates that an analytical result is higher than the standard for a particular AoI, then the 30-day average is calculated immediately upon receipt of the preliminary result. The desired evaluation frequency is semi-monthly, within one week of the 15th and last day of any given month. RFCA requires that DOE, RFFO inform regulators within 15 days of DOE, RFFO gaining knowledge (not just a suspicion) that an exceedance (verified) has (actually) occurred.

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[24] The 30-day average for a particular day is calculated as a volume-weighted average of a 'window' of time containing the previous 30-days which had flow. Each day has its own discharge volume (measured at the location with a flow meter) and activity (analytical result from the sample in place at the end of that day). Therefore, there are 365 30-day moving averages for a location which flows all year (366 in a leap year). At locations which monitor pond discharges or have intermittent flows, 30-day averages are reported as averages of the previous 30 days of greater than zero flow. For days where no activity is available, either due to failed lab analysis or NSQ for analysis, no 30-day average is reported. The calculation of 30-day averages is discussed in detail in Section 0.

IF — The volume-weighted 30-day moving average for any AoI in Stream Segment 4, as represented by samples from the specified RFCA POCs (i.e., terminal pond discharges and Indiana Street) exceeds the appropriate RFCA standard

THEN — The Site must:

- Notify EPA, CDPHE, and either Broomfield or Westminster, whichever is affected;
- Submit a plan and schedule to evaluate for source location, and implement mitigating action if appropriate; and
- The Site may receive a notice of violation.

Table 6-45. POE Monitoring Analytical Data Evaluation.

ID Code	Evaluation Type[a]
GS11	30-Day Volume-Weighted Moving Averages; Loading Analysis
GS08	30-Day Volume-Weighted Moving Averages; Loading Analysis
GS31	30-Day Volume-Weighted Moving Averages; Loading Analysis
GS03	30-Day Volume-Weighted Moving Averages; Loading Analysis
GS01	30-Day Volume-Weighted Moving Averages; Loading Analysis

Notes: [a] Details on the evaluation of analytical results are given in Section 7.3.2.2.

6.9 NON-POINT OF COMPLIANCE MONITORING AT INDIANA STREET

The State has proposed to conduct this Non-POC monitoring as a prudent management action, and it is the intent of the RFCA parties that no enforcement action will be taken based on this monitoring. There are several reasons to monitor for certain contaminants and nutrients in the water leaving the Site in both drainages. The actions to be taken based on this monitoring are variable and may not be known until the monitoring results are available.

The CWQCC is moving toward waste load allocations for all segments of the Big Dry Creek drainage. Nutrient loadings generated by the Site are carried off Site via Walnut Creek, which can either bypass Great Western Reservoir or be directed into the reservoir. Water bypassing the reservoir enters Segment 1 of Big Dry Creek, which then flows into the South Platte River. The Broomfield water replacement project will result in changes to the quantity and quality of water that could enter Great Western Reservoir. For these reasons, it will be necessary to monitor nutrient loads leaving the Site under all three of these conditions:

- Water leaving the Site via Walnut Creek is 100% Site discharge (used and potentially contaminated by the Site before discharge from terminal ponds).
- Water leaving the Site via Walnut Creek is 100% natural stream flow (no pond discharge included).
- Water leaving the Site via Walnut Creek is a mixture of Site pond discharge and natural stream flow.

With the changes in flow configuration in the Woman Creek drainage, there is a need to monitor to determine new ambient levels for various analytes at monitoring station GS01. The results of these analyses will be used to determine what changes in water quality, if any, have occurred as a result of the new flow configuration.

6.9.1 Data Types, Frequency, and Collection Protocols

The complete list of parameters and analytes (analytes collected by CDPHE) is given in Table 6-46. Only the continuously-measured water-quality parameters will be collected by the Site.

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Table 6-46. Non-POC Monitoring Analytes and Parameters.

Total ammonia
Nitrite
Nitrate
Total phosphate as P
Orthophosphate
Be, Cd, Ag, Cr
Isotopic uranium
pH
Temperature
Conductivity
Flow

Non-POC monitoring is limited to Stream Segment 4, as represented by samples taken from Walnut Creek at Indiana Street and Woman Creek at Indiana Street (GS03 and GS01 respectively, see Figure 6-9).

6.9.2 FY00 Monitoring Scope

The following tables detail the planned Non-POC monitoring scope for FY00.

Table 6-47. Non POC Monitoring Locations.

ID Code	Location	Primary Flow Measurement Device	Telemetry
GS01	Woman Creek and Indiana St.	9" Parshall Flume	Yes
GS03	Walnut Creek and Indiana St.	6" and 36" Parallel Parshall Flumes	Yes

Table 6-48. Non POC Field Data Collection: Parameters and Frequency.

ID Code	Parameters		
	Discharge	Real-Time pH and Conductivity	Precipitation
GS01	15-min continuous	15-min continuous	15-min continuous
GS03	15-min continuous	15-min continuous	15-min continuous

Notes: Parameters are measured opportunistically when continuous flow is present and freezing conditions will not damage the probes.

6.9.3 Data Analysis

No specific data evaluations are required of the Site for this monitoring objective.

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6.10 BUFFER ZONE HYDROLOGIC MONITORING

Some monitoring is performed to characterize interactions between the various environmental media. Possible interactions are presented in Table 6-49, which represents a conceptual model of integrated monitoring at the Site. Some significant interactions that require decision making and data are presented below.

As indicated in Table 6-49, there are interactions between surface water, air, groundwater, and the flora and fauna of the Site.[25] Concerns have been expressed that changes in flow into and out of the Site could impact habitat and species of concern both onsite and downstream (e.g., the Prebles meadow jumping mouse onsite, and whooping cranes in Nebraska). For example, aggregate mining activities west of the Site may alter surface water flowing onto the Site and could impact species of concern on Site and downstream. DOE, RFFO could be held responsible for these impacts. Also, Site closure activities (e.g., closure of the Building 995 wastewater treatment plant and modification of the Interceptor Trench System) could significantly alter drainage and flow patterns. In fact, water is one of the key abiotic components structuring some of the significant habitats. Should the availability or quality of water be affected by upgradient off-Site activities or upgradient on-Site activities, significant habitats could be adversely affected.

In consideration of these potential impacts, watershed-level information is collected regarding water availability in the BZ. Current flow monitoring in the BZ, in addition to that performed under RFCA, is shown in Table 6-50. The flow data are collected at 15-minute intervals, downloaded, and compiled monthly. However, DQOs for this monitoring have not yet been developed, and data evaluation to assess ecological impacts has not yet been initiated. Site-specific relationships between water availability and ecological health are not yet known. Therefore, additional data, currently uncollected, could be required (e.g., accurate information on purchased water, data on exfiltration and infiltration of underground pipes, additional water-quality parameters, and data on alluvial flow through the BZ habitats of concern).

Table 6-49. Interactions Between Media, Significance at RFETS, and Monitoring to Evaluate Interactions.

Interactions Between Media	Significance at RFETS	Monitoring to Evaluate Interactions
Surface Water to Ecology	Potentially significant; surface water flow and contamination could impact local ecology. However, the local ecology has remained healthy during a variety of climatic and flow conditions.	Data from existing Site-wide surface water monitoring may be used to assess potential ecological impacts. The ecological monitoring program is also designed to detect ecological changes and assess general ecological health. In addition, project-specific evaluations are conducted to assess potential impacts.
Surface Water to Groundwater	Not significant; groundwater recharge from surface water is not significant.	No monitoring is necessary to characterize or assess groundwater impacts.
Surface Water to Air	Not significant; surface water quality will not significantly impact air quality (i.e., cause exceedances of air quality standards).	Any significant impacts on air or water quality will be detected by existing DOE, CDPHE, and project-specific monitoring.
Surface Water to Soil	Potentially significant; water in drainages and ponds will not significantly increase contaminant concentrations in soil; however, runoff could spread contaminants on surface soils and increase sediment concentrations.	Soil monitoring is conducted to determine the impacts of surface water runoff and the extent of required soil removal before, during, and after individual remediation projects. Results of the actinide migration studies will be used to determine whether existing soil monitoring needs to be modified or expanded.

[25] This table taken directly from the Site IMP.

Interactions Between Media	Significance at RFETS	Monitoring to Evaluate Interactions
Groundwater to Surface Water	Significant; most of the Site groundwater flows into Site surface water drainages.	Existing surface water monitoring will detect any impacts from groundwater. Data from Site-wide groundwater monitoring (Site-wide and project-specific) is also used to assess and predict potential surface water impacts.
Air to Surface Water	Potentially significant; point source and fugitive emission sources could degrade surface water quality.	Surface water monitoring (Site-wide and project-specific) will detect increases in contaminant concentrations. Also, any significant impacts on air quality will be detected by existing DOE, CDPHE, and project-specific air monitoring.
Soil to Surface Water	Significant; contaminants in soils are transported to surface water via runoff and surface water quality is degraded.	Site-wide and project-specific surface water monitoring will detect increases in contaminant concentrations. Soil monitoring is also conducted to determine the impacts of runoff and the extent of required soil removal before, during, and after individual remediation projects. Results of the actinide migration studies will be used to determine whether existing soil monitoring needs to be modified or expanded.

6.10.1 Data Types, Frequency, and Collection Protocols

BZ hydrologic monitoring will be performed only as represented by GS01, GS02, GS03, GS04, GS05, GS06, GS16, SW118, and SW134 (see Figure 3-1).

Sampling at BZ stations is performed by collecting storm-event, rising-limb, flow-paced composites. The recommended monitoring design detailed in the IMP is to take samples for FY00 as specified in Table 6-52.

6.10.2 FY00 Monitoring Scope

The following tables detail the planned BZ Hydrologic monitoring scope for FY00.

Table 6-50. BZ Hydrologic Monitoring Locations.

ID Code	Location	Primary Flow Measurement Device	Telemetry
GS01	Woman Creek and Indiana St.	18" Parshall Flume	Yes
GS02	Mower Ditch and Indiana St.	9" Parshall Flume	No
GS03	Walnut Creek and Indiana St.	6" and 36" Parallel Parshall Flumes	Yes
GS04	Rock Creek at Rte. 128	9" Parshall Flume	Yes
GS05	North Woman Creek at West Site Boundary	9" Parshall Flume	No
GS06	South Woman Creek at West Site Boundary	6" Parshall Flume	No
GS16	Antelope Springs	6" Parshall Flume	No
SW118	N. Walnut Creek W of Portal 3	169.5° V-Notch Weir	Yes
SW134	Gravel Pits on Rock Creek Near West Site Boundary	6" Parshall Flume	Yes

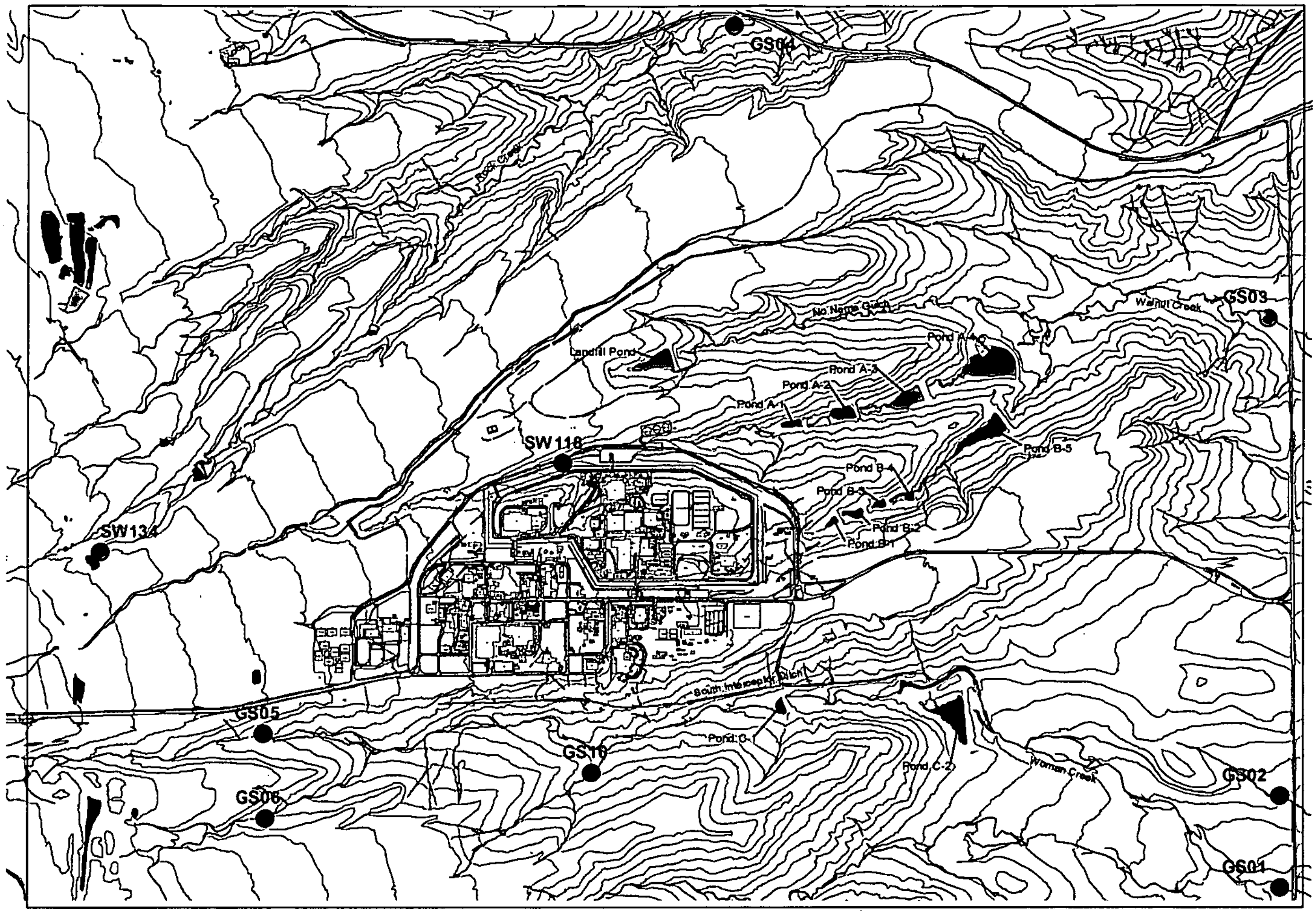

Figure 6-10. Map Showing Buffer Zone Hydrologic Monitoring Locations.

Table 6-51. BZ Hydrologic Field Data Collection: Parameters and Frequency.

ID Code	Parameter	
	Discharge	**Precipitation**
GS01	15-min continuous	15-min continuous
GS02	15-min continuous	NA
GS03	15-min continuous	15-min continuous
GS04	15-min continuous	15-min continuous
GS05	15-min continuous	15-min continuous
GS06	15-min continuous	NA
GS16	15-min continuous	NA
SW118	15-min continuous	15-min continuous
SW134	15-min continuous	NA

Table 6-52 BZ Hydrologic Sample Collection Protocols.

ID Code	Frequency	Type[a]
GS01	Quarterly with an additional TSS in spring	Storm-event, flow-paced composites
GS02	NA	NA
GS03	Quarterly with an additional TSS in spring	Storm-event, flow-paced composites
GS04	Quarterly with an additional TSS in spring	Storm-event, flow-paced composites
GS05	Quarterly with an additional TSS in spring	Storm-event, flow-paced composites
GS06	Quarterly with an additional TSS in spring	Storm-event, flow-paced composites
GS16	NA	NA
SW118	NA	NA
SW134	Quarterly	Storm-event, flow-paced composites

Notes: [a] Sample types are defined in Section 7.2.2.2.

Table 6-53. BZ Hydrologic Analytical Targets (Analyses per Year).

ID Code	TSS	Sed/Sand	Ca,Mg,Na,K,Cl,F,SO_4,HCO_3
GS01	5	4	4
GS03	5	4	4
GS04	5	4	4
GS05	5	4	4
GS06	5	4	4
SW134	4	4	4

Table 6-54. BZ Hydrologic Telemetry Data Collection.

ID Code	Parameter	
	Hydrologic	Sampling
GS01	flow; precipitation	sampler status (full or waiting)
GS03	flow; precipitation	sampler status (full or waiting)
GS04	flow; precipitation	sampler status (full or waiting)
SW118	flow; precipitation	NA
SW134	flow	sampler status (full or waiting)

6.10.3 Data Analysis

Although no routine data evaluations are required, the following preliminary decision rules have been proposed by the IMP:

IF The seasonal average or yearly average water availability or quality entering Rock Creek, Walnut Creek, or Woman Creek drainages diminishes below baseline due to off-Site activities,

THEN The Site will notify Jefferson County and the U.S. Fish and Wildlife Service (USFWS) to determine what actions, if any, should be taken to restore availability and/or quality to historical levels.

IF Activities occurring within Site boundaries result in a depletion of the seasonal or yearly average natural flow greater than the historic baseline, or at rates that are determined to have a negative impact on downstream habitats or individual species,

THEN The Site will determine what management actions should be taken to ameliorate this problem.

IF Significant changes to alluvial groundwater availability in a wetlands habitat are determined,

THEN Notify parties of potential impacts to the wetlands habitat and continue groundwater and ecological monitoring.

IF A proposed action could adversely affect a listed species or its critical habitat,

THEN The Site will consult with the USFWS.

Secondary Data Uses Could Include:

- Determining the impact of mining on Rock Creek water quality and availability;
- Interpreting potential causes of declines in any of the valued habitats on Site;
- Supporting water management planning;
- Evaluating cumulative impacts of all actions (on and off Site);
- Validating any predicted impacts of the selected alternative to downstream resources; and
- Supporting the Site's biological assessment and USFWS's biological opinion.

7. GENERAL MONITORING TASKS

All tasks completed for this activity shall comply with the requirements of RFCA, the IA IM/IRA, and the Site IMP. These documents specify monitoring locations, data requirements for each location, and the administrative framework for using the data to make management decisions related to surface water at the Site. Generally, there are three fundamental tasks associated with the implementation of the Site automated surface-water monitoring program. These are: 1) monitoring station design and installation (instrumentation selection, deployment, and testing); 2) field data and sample collection (monitoring station operation and maintenance); and 3) data evaluation, analysis, and reporting.

7.1 MONITORING STATION INSTALLATION

7.1.1 Task Descriptions

Site personnel shall install and/or upgrade instrumentation at the monitoring locations shown in Figure 3-1.[26] Typical equipment for each station will include an ISCO® flow meter controlling an ISCO® portable automated sampler. Sampler intakes must be positioned such that representative samples are collected at each station.[27] A Geomation® remote radio telemetry system will be used to transmit data in real-time from certain stations to Site personnel and other potential users of the transmitted data. Certain locations will also be equipped with dedicated multi-parameter water quality probes capable of transmitting and/or logging data. Water-quality probes must be positioned to ensure that they collect representative data and remain wet at all times.[28] Certain locations will also be equipped with dedicated precipitation gages. Precipitation gages must be installed such that nearby structures do not interfere with precipitation collection. Power for the instrumentation will be provided by AC line power, where available, with battery backup. Where AC power is unavailable, solar/DC power systems will be used. Each station will have a primary flow-control structure. The flow-control structures may be existing culverts or concrete stormwater conveyance structures. However, in most cases, flumes or weirs will be

[26] New locations not shown in Figure 3-1 will also be installed and maintained by Site personnel.

[27] Intakes are positioned to collect only water that flowed through the flow-control structure. The intakes must be secured high enough off the streambed so as not to collect non-representative sediment quantities, but low enough to be submerged during near zero flow rates. Consideration is also given such that intake position minimizes the effects of winter freezing conditions.

[28] Probes must be positioned in the flow path, but in a location such that they will not be damaged by high flows. At locations which are dry during some periods, special flow-through sump systems may be constructed such that the probes remain wet between direct runoff periods.

purchased and/or fabricated for installation in natural stream channels and ditches, or fastened to existing concrete or metal stormwater conveyance structures.

The installation task may require minor hand excavation of channel banks and beds for installation of the flow-control structure in ditches or natural channels. All construction and soil disturbance permit requirements will be fulfilled and permits obtained prior to installation. For fastening of flow-control structures to existing structures, a rotary hammer or carbide-tip steel drill may be used to drill holes in the structures for attachment of the flow-control structure by either lag screws or expansion bolts. Alternatively, temporary flow-control structures may be installed by simply using tarps and sandbags to secure a flume in a channel and ensure that all runoff enters the flume. Each location will require a unique application of flow-control structure and means for securing the structure in place. For excavation applications, an areal impact of no more than 15 square feet is expected per site.

After the flow-control structure is installed, it is instrumented with the monitoring equipment. The equipment is then programmed and performance checked to complete the installation.

7.1.2 Types of Data Collected

Detailed specifications for each monitoring station shall be recorded in a field log book. Instrument programming information, field observations, repair/modification records, and calibration records shall also be recorded in a field logbook. Discharge ratings will be generated for each flow-control structure. Locations will be surveyed using a global positioning system (GPS) or screen digitized using GIS. Existing flow-control structures will have relative elevations surveyed annually to ensure proper operation.

7.1.3 Records Produced

Quality Assurance records produced as part of this activity are:

1. Field log books
2. Photographs of station installations
3. Discharge ratings

7.1.4 Applicable Instructions and Methods

All flow-control structures, ISCO® instrumentation, water quality probes, telemetry nodes and power equipment shall be installed, programmed, and performance checked per the manufacturer's instructions. Programming and calibration of the ISCO® equipment shall be done in accordance with the manufacturer's instructions which also are referenced in Surface Water SOPs: PRO.092 *Event-Related Surface Water Sampling* and PRO.084 *Operation and Maintenance of Stream-Gaging and Sampling Stations.*

Additional resources are as follows:

Grant, D.M., 1992, *ISCO Open Channel Flow Measurement Handbook*, Third Edition, ISCO Environmental Division, Lincoln, Nebraska.

Kennedy, E.J., 1984, *Techniques of Water Resource Investigations of the United States Geological Survey, Chapter A10 Discharge Ratings at Gaging Stations*, Book 3 Applications of Hydraulics, U.S. Department of the Interior, U.S. Geological Survey, U.S. Government Printing Office, Alexandria, Virginia.

Rantz, S.E., 1982, *Measurement and Computation of Streamflow: Volume 1. Measurement of Stage and Discharge,* U.S. Geological Survey Water-Supply Paper 2175, U.S. Department of the Interior, U.S. Government Printing Office, Washington, D.C.

Rantz, S.E., 1982. *Measurement and Computation of Streamflow: Volume 2. Computation of Discharge,* U.S. Geological Survey Water-Supply Paper 2175, U.S. Department of the Interior, U.S. Government Printing Office, Washington, D.C.

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7.1.5 Required Resources

One to two qualified people (Section 5.2) will be required to install each monitoring station. Common hand tools, power tools, and supplies will be required to install the flow-control structures. Examples of these include but are not limited to:

- rubber tarp material
- 1/2" neoprene rubber gasket material
- 50 lb. - 70 lb. sand bags
- 1/4" to 1/2" nuts, bolts, and washers
- plywood and dimensional lumber
- hose clamps
- plastic wire ties
- plumber's putty
- cordless drill / hammer drill
- miscellaneous hand tools
- shovels / pick axe

Installation of the ISCO equipment usually is accomplished using hand and battery-powered tools with little need for other equipment.

7.1.6 Data Quality

Monitoring station installation must be adequately documented to ensure flow control structures meet specifications and provide quality flow records. Written notes documenting the specifications for each flow-control structure, including dimensions, relative elevations, and photographs showing the completed monitoring station are required to document that the monitoring station record is scientifically defensible.

7.1.7 Work Product Objectives

The product of this project is a network of fully functional automated surface-water monitoring stations. Fifty-three locations[29] currently are scheduled for operation in Fiscal Year 2000. The supported decision rule(s) for each location are given in Table 7-1.

7.1.8 Acceptable Criteria

The monitoring stations must be properly installed and fully functional as timely as practical to meet desired monitoring goals. Flow control structures must be as level, plumb, and leak free as practical. Instrumentation must be powered, performance checked, and recording representative data. The equipment must be secured and sealed to prevent weather and animal damage to the equipment and to minimize the potential for tampering.

7.1.9 Applicable Software

The ISCO® monitoring equipment operates on proprietary Flowlink software. Geomation® telemetry operates with proprietary Geonet Suite software. YSI® water quality probes operate with proprietary EcoWatch software. This software operates on a lap-top computer which shall be used to program the instrumentation and download data from the field.

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[29] This includes 45 gaging stations and 8 telemetry nodes collecting pond information and precipitation data. Five of these telemetry nodes are included in the IDLH section (6.1); the other 3 are repeater nodes (ID codes RPTR, RPTR2, RPTR3) which collect precipitation data.

Table 7-1. Matrix of Monitoring Locations and Supported IMP Decision Rules.

	Supported Decision Rule										
ID Code	**IDLH**	**Source Location**	**Ad Hoc**	**Pu vs. TSS**	**Performance**	**New Source Detection**	**POE**	**POC**	**Non-POC**	**BZ Hydro**	**Precipitation**
GS01								✓	✓	✓	✓
GS02										✓	
GS03								✓	✓	✓	✓
GS04										✓	✓
GS05										✓	✓
GS06										✓	
GS08	✓			✓				✓			
GS09	✓										
GS10				✓		✓	✓				
GS11	✓			✓				✓			
GS12	✓										
GS16										✓	
GS22			✓								
GS27		✓			✓						
GS31	✓			✓				✓			
GS32		✓			✓						
GS33		✓									
GS34		✓									
GS35		✓									
GS38		✓									
GS39		✓			✓						
GS40		✓			✓						
GS41			✓								
GS42			✓								
GS43		✓			✓						
GS44		✓			✓						
GS45			✓								
GS46			✓								
GS47			✓								
GS48			✓								
SW009			✓								
SW021		✓									
SW022		✓		✓		✓					✓
SW023		✓									
SW027	✓			✓		✓	✓				
SW060		✓									
SW091				✓		✓					
SW093	✓			✓		✓	✓				
SW118		✓								✓	✓
SW120		✓			✓						
SW132		✓									
SW134										✓	
SW100100		✓									
B371BAS			✓								
B371SUBBAS			✓								
Pond A-3	✓										
Pond A-4	✓										
Pond B-5	✓										
Pond C-2	✓										
Landfill Pond	✓										
RPTR											✓
RPTR2											✓
RPTR3											✓

7.2 DATA COLLECTION

7.2.1 Types of Data

The types of data that the stations shall collect may include the following depending on the location-specific monitoring objective:

1. Continuous record of stream stage (later converted to discharge) on 15-minute intervals[30].
2. Surface-water sample record, indicating date and time of the collection of individual grab samples that are composited in the sample bottles. Data also includes the sample flow pacing, enable levels for storm-event samples, grab volumes, and missed grab samples (including likely cause, i.e. frozen intakes).
3. Routine instrument inspection and performance check notes recorded in field log books.[31]
4. Continuous record at 15-minute intervals of water quality parameters.
5. Continuous record at 5- or 15-minute intervals of precipitation.[32]
6. Crest stage indicator data to allow for flow estimates when the capacity of the primary structure is exceeded.

Sample analytical results are returned from the laboratories both in hardcopy and electronically. Data retrievals from hardcopy or the Rocky Flats Soil and Water Database (SWD) are obtained for subsequent evaluation and reporting.[33] The analytical methods that shall be used for the RFETS automated surface-water monitoring program are shown in Table 7-2.

7.2.2 Task Descriptions

7.2.2.1 Flow and Precipitation Data Collection

The monitoring locations begin collecting flow data immediately upon installation. The flow meters log stream stage continuously, storing data points on 15-minute intervals. Five-minute stage data are also collected where flow meter memory capabilities permit. This higher resolution data can be used for more detailed data evaluations; all routine evaluations use the 15-minute data. Particular care is needed during winter freezing conditions to prevent damage to the flow meters. This may involve temporary suspension of data collection until more favorable weather conditions resume.

Crest stage indicator data is collected at selected locations to allow for flow estimates when the capacity of the primary structure is exceeded.

Continuous record at 5- or 15-minute intervals of precipitation is collected at selected locations. Precipitation gages are positioned across the Site to collect representative sitewide variations and allow for areal precipitation calculations. Precipitation gages are performance checked quarterly to manufacturer's recommendations. Precipitation equipment may be performance checked, repaired, or replaced as needed based on data trends and professional judgment.

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[30] Five-minute stage data is also collected where flow meter memory capabilities permit. This higher resolution data can be used for more detailed data evaluations; all routine evaluations use the 15-minute data.

[31] Flow meters are adjusted to match staff gages on an as needed basis. Precipitation gages are performance checked quarterly. Water-quality probes are removed from the field monthly for a performance check and adjustment in the laboratory to at least manufacturers recommendations. Equipment may be performance checked and adjusted, repaired, or replaced as needed based on data trends and professional judgment.

[32] Precipitation gages are positioned across the Site to collect representative sitewide variations and allow for areal precipitation calculations.

[33] Analytical data is typically received in preliminary hard-copy format and hand entered for evaluation.

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Table 7-2. RFETS Automated Surface Water Monitoring Network Analyte List, Preservation and Containerization Requirements.

Class of Analytes	Volume Required for Analysis	Preservative	Container
Total Radionuclides (Pu, U, Am) or (Pu, Am) Alpha Spectrometry	4 Liters	Nitric Acid to pH<2	Polyethylene
Tritium Alpha Scintillation	250 ml	None, 4°C	Clear Glass
Total Metals (Be, Cr) ICP	1 Liter	Nitric Acid to pH<2	Polyethylene
Dissolved Metals (Cd, Ag) AA	1 Liter	Nitric Acid to pH<2	Polyethylene
Hardness as $CaCO_3$	1 Liter	Nitric Acid to pH<2	Polyethylene
Total Suspended Solids (TSS)	1 Liter	None, 4°C	Polyethylene
Nitrate/Nitrite as N	250 ml	Sulfuric Acid to pH<2	Polyethylene
CLP Metals, Total ICP	1 Liter	Nitric Acid to pH<2	Polyethylene
Cl^-, F^-, SO_4, HCO_3/CO_3, TSS, TDS	1 Liter	None, 4°C	Polyethylene
Total Organic Carbon (TOC)	250 ml	Sulfuric Acid to pH<2	Amber glass
Sand/Sediment split	1 Liter	None, 4°C	Polyethylene
Rad screen	120 ml	None, 4°C	Polyethylene

Routine weekly inspection and maintenance of the monitoring stations is required to detect leaks or damage to the flow-control structures, troubleshoot problems with the instrumentation, and provide calibration notes for subsequent computation of the discharge records for each station.[34] Flow meters are adjusted to match staff gages on an as needed basis. Flow measurement equipment may be performance checked, repaired, or replaced as needed based on data trends and professional judgment.

At least once a month, the flow and precipitation data shall be downloaded from the flow meters to a lap-top PC. These data shall then be transferred to Site servers for compilation and evaluation. All data is backed-up to multiple electronic media to avoid accidental data loss. Many of the collected data are also logged via telemetry as a secondary (redundant) data collection platform.

7.2.2.2 Sample Collection

Location-specific sample collection protocols are detailed in the Site IMP and given above in Section 6. The telemetry system will centrally monitor the status of field samplers. For sites without telemetry, professional judgment and precipitation data will be used to determine if a composite sample is likely to have been collected. Stations determined to have completed composites will be visited for collection, at which time the data from the flow meter will be recorded and downloaded electronically to a lap-top PC to obtain the sampling interval information. Information regarding missed grabs[35], grab sample flow-

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[34] The telemetry system is also used to detect equipment malfunctions prior to an actual field visit. Receipt of anomalous data initiates a field visit.

[35] Missed grab samples may be caused by equipment malfunction or the freezing of sample intake lines. Some locations employ self-regulating heat tape systems where AC power is available. Freeze-protection systems are currently in place at all POC locations.

pacing, and grab sample volume is recorded directly from the sampler to field logbooks. Information regarding enable levels is recorded directly from the flow meter to field logbooks.

The sample shall be removed from the sampler, sealed, and taken to Commodore Advanced Sciences Inc. (CASI) for sample preparation, shipment, and tracking.[36] A clean sample bottle will then be placed in the sampler for the next targeted sample.[37] Since some composite samples will remain in the field during filling for as long as a month, samples will be acidified in the container to a pH<2 following collection from the field. The acidified samples will stand for 24 hours to remove any constituents which may have sorbed to the inside-surface of the container.[38]

Sample Types

Continuous Flow-Paced Composite Samples

Continuous flow-paced composite samples are collected during all flow conditions. Automated samplers collect grab samples year-round at all times. When a composite sample is removed from the sampler for analysis, the next composite sample starts filling immediately. The composite sample consists of multiple grab samples[39] which are flow-paced. In other words, one grab sample is collected in the sample bottle each time a specified volume of stream discharge is measured by the flow meter. Figure 7-1 is an example of flow-pacing of grab samples every 4,390 cubic feet of stream discharge for a continuous flow-pacing sampling event. The chosen flow pace depends on expected stream discharge, the composite volume desired, and the desired composite sampling time period.[40] Details on the method used to determine the desired flow pace are given in the following section.

Ideally, by flow-pacing composite samples and effectively collecting more frequent grabs during higher flow rates, an analytical result (concentration [e.g. mg/L] or activity [e.g. pCi/L]) that is representative of the entire sampling period is obtained. This result can then be used with the corresponding discharge volume to calculate a constituent load.

This sampling protocol is currently utilized at POCs, POEs, Source Location, and selected Performance monitoring locations.

Storm-Event Rising-Limb Flow- or Time- Paced Composite Samples

Storm-event, rising-limb, flow- and time- paced samples are composite samples collected during the initial 'first flush' conditions during a direct runoff event.[41] The automated samplers are programmed to wait for direct runoff conditions at all times year-round. When the flow meter measures a predetermined

[36] ASI prepares, ships, and track all samples according to the applicable Site QA/QC documents.

[37] ASI is responsible for the cleaning of sample bottles according to Site QA/QC requirements. All locations have dedicated sample bottles to reduce the risk of cross-contamination. Sample bottle cleaning tools are also dedicated for POCs. Clean sample bottles waiting for deployment are stored in the Surface Water field trailer.

[38] For analyses which can not be acidified prior to analysis (i.e. TSS), the required volume is removed from the sample bottle prior to acidification.

[39] Current grab sample volume for continuous flow-paced composite samples is 200ml. This volume was chosen to maximize the number of grabs while achieving adequate repeatability. ISCO® samplers have a sample volume repeatability of ±10ml. Therefore, a volume error of ±5% can be expected.

[40] The Site IMP specifies the targeted composite sample collection frequency for each monitoring location.

[41] For locations that have flow measurement capabilities, flow-paced composite samples are collected. Locations without flow measurement collect time-paced composite samples.

increase in stream stage (manually set as the sampler 'enable level')[42], the sampler begins collecting grab samples. Although the samplers are programmed to collect composite samples for all runoff events, only selected composite samples are retained for analysis. Professional judgment is used to select representative samples for analysis.[43] When a composite sample is removed from the sampler to be submitted for analysis (or to be discarded), a clean sample container is installed and the sampler is reset to wait for the next runoff event.

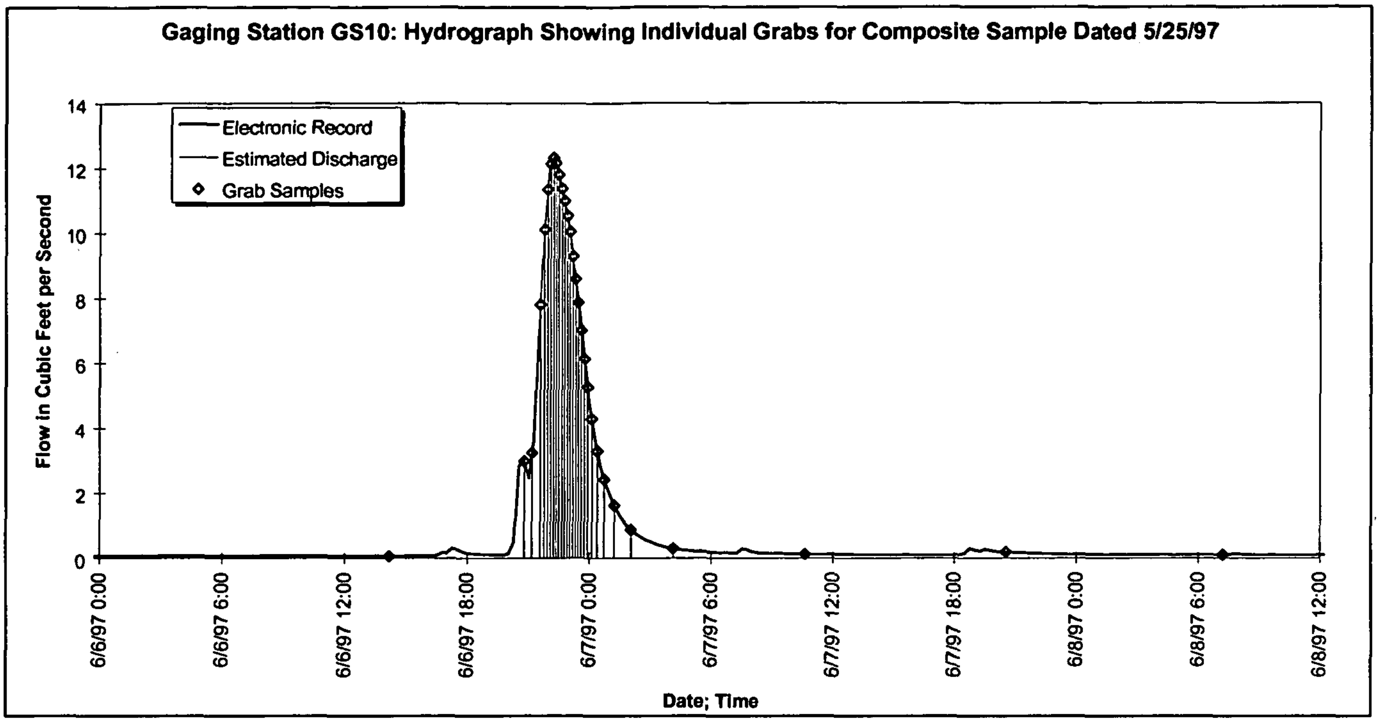

Figure 7-1. Example of Hydrograph Showing Continuous Flow-Paced Composite Sampling.

A composite sample generally consist of 15 grab samples[44] which are flow- or time- paced. In other words, one grab sample is collected in the sample bottle each time a specified volume of stream discharge is measured by the flow meter or at uniform time intervals. Figure 7-2 shows a hydrograph during a rising-limb storm-event sample which received a grab sample every 200 cubic feet of stream discharge. The chosen flow- or time- pace depends on expected stream discharge during the rising limb, such that all the 15 grab samples are collected during the rising limb. Details on the method used to determine the desired flow pace are given in the following section.

[42] The enable level is chosen based on professional judgment, considering the seasonal runoff conditions expected for a particular location. The intent is to begin sampling at the first indication of direct runoff. This can either be some level above normal baseflow, or when an ephemeral location first measures runoff.

[43] The intent is to collect samples according to the sampling frequencies targeted by the IMP and given in Section 6. For many of the current locations, this frequency is one per month. Samples are also selected for analysis with the intent to sample a range of rising-limb runoff rates, extreme events (i.e. very large precipitation events), and events where samplers at multiple locations enabled for the same runoff event.

[44] Current grab sample volume for storm-event rising limb flow-paced composite samples is 500-1000ml. This location-specific volume is chosen to obtain the required volume of sample based on the location-specific analyte suites.

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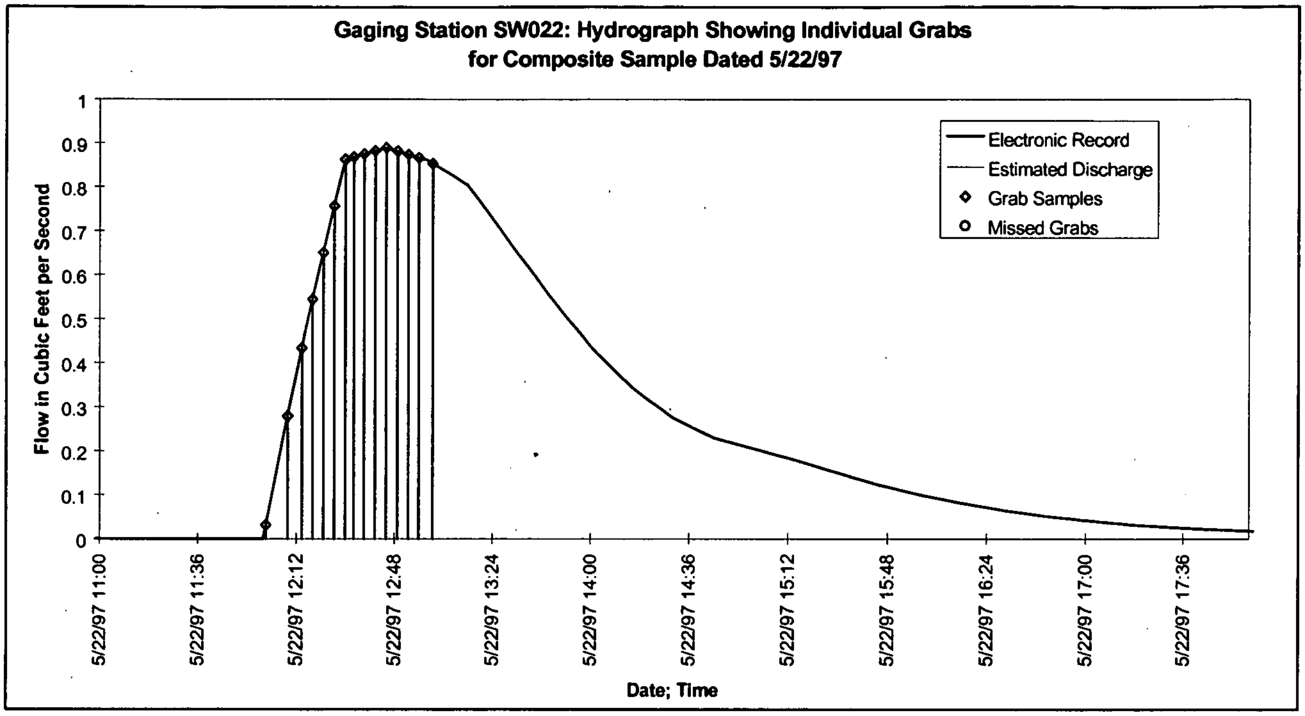

Figure 7-2. Example of Hydrograph Showing Rising-Limb Flow-Paced Composite Sampling.

Storm-Event Flow- and Time- Paced Composite Samples

Storm-event flow- and time- paced samples are composite samples collected during the entire direct-runoff event. The automated samplers are programmed to wait for direct runoff conditions year-round at anytime. When the flow meter measures a predetermined increase in stream stage (manually set as the sampler 'enable level')[45], the sampler begins collecting grab samples. Although the samplers are programmed to collect composite samples for all runoff events, only selected composite samples are retained for analysis. Professional judgment is used to select representative samples for analysis.[46] When a composite sample is removed from the sampler to be submitted for analysis (or to be discarded), a clean sample container is installed and the sampler is reset to wait for the next runoff event.

A composite sample generally consists of 15 grab samples[47] which are either flow- or time- paced. In other words, one grab sample is collected in the sample bottle each time a specified volume of stream discharge is measured by the flow meter or at uniform time intervals. The chosen flow- or time- pace depends on expected stream discharge during the direct-runoff period, such that the 15 grab samples are collected during the direct runoff period. Details on the method used to determine the desired flow pace are given in the following section.

[45] The enable level is chosen in the field using professional judgment such that sampling begins at the first indication of direct runoff (e.g. when an ephemeral location first measures runoff).

[46] The intent is to collect samples based on the objective of the monitoring location. Samples are also selected for analysis with the intent to sample a range of runoff rates, extreme events (i.e. very large precipitation events), and events where samplers at multiple locations enabled for the same runoff event.

[47] Current grab sample volume for storm-event flow-paced composite samples is 500-1000ml. This location-specific volume is chosen to obtain the required volume of sample, based on the location-specific analyte suites.

Flow Pacing of Automated Samplers

Continuous Flow-Paced Composite Samples

The chosen flow pacing for a composite sample must satisfy the following criteria:

- The composite sample should fill during the specified time period as determined by the sample collection frequencies targeted by the Site IMP.[48]
- The collected sample volume must be adequate such that the location-specific analyses can be completed by the laboratory.[49] The location-specific minimum volumes are given in Table 7-3.

The following steps are used to determine the appropriate flow pace for a continuously collected composite sample.

1. The location-specific targeted time period for the composite sample must be known. These targets are outlined in Section 6.

   For example, the IMP targets 4 composite samples for the month of May at GS10 (Table 6-34).

2. The expected discharge volume for the targeted time period must then be calculated using historic flow record.[50] For locations without any historic flow record, professional judgment, estimations related to basin size, and/or record at upstream/downstream locations are used to determine expected discharge volumes.

   For example, at GS10 the expected discharge volume for May is 5.52 Mgals. In order to collect 4 samples for the month, 1 sample is collected for every 1.38 Mgals.

3. The targeted number of 200ml grab samples for the composite sample is then determined. The targeted number of grabs is set using professional judgement to collect a volume between the minimum required sample volume[49], and the maximum volume which can be contained in the sample bottle.[51] This allows for variation in total measured discharge (from the expected discharge based on historic record), while still collecting the composite sample in the targeted time period.

   For example, at GS10 the composite sample bottles can contain a maximum of 22 liters, and the minimum required sample volume for analysis is 7.0 liters. Consequently, the sampler at GS10 is programmed to collect sixty 200ml grab samples for a targeted composite sample volume of 12 liters.

4. The expected discharge volume is then divided by the targeted number of grab samples to obtain a discharge volume per grab sample. This is the flow pace for the composite sample.

   Continuing the GS10 example, collecting 60 grab samples for a stream discharge of 1.38 Mgals gives a flow pace of 23,000 gallons per grab sample.

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[48] Samples are flow-paced based on average expected discharge rates calculated from historic discharge records. Consequently, samples may fill in periods shorter than the targeted period when flow rates are significantly higher than normal. Similarly, samplers may not fill during the targeted period if flow rates are significantly lower than predicted by historical flow record.

[49] Specific analyses each require some minimum volume of sample for analysis. Therefore, the minimum required sample volume depends on the location-specific analyte suite.

[50] The expected discharge volume is the historic average volume. All available flow record after 10/1/92 is used (data prior to 10/1/92 is considered less reliable). The period of record depends on monitoring location.

[51] The Site currently employs 15 and 22 liter carboys.

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Storm-Event and Storm-Event Rising-Limb Flow- and Time- Paced Composite Samples

The chosen flow- or time- pacing for a composite sample must satisfy the following criteria:

- The composite sample should fill during the specified time period (i.e. during the rising limb or the entire runoff hydrograph as appropriate).

Professional judgment is used in the field to select the flow pace needed to collect a sample during the targeted period. Seasonal adjustments are applied to define the conditions that represent first flush and direct runoff.

Table 7-3. Minimum Composite Sample Volumes Required for Complete Laboratory Analysis.

Monitoring Location	Volume Required for Complete Analyses	Required # of Grabs
GS01 RFCA	4.25 +1 (for TSS*) = 5.25 L	22 - 27* (200mL grabs)
GS01 BZ	2.0 L	2 (1L grabs)
GS02	2.0 L	2 (1L grabs)
GS03 RFCA	4.25 +1 (for TSS*) = 5.25 L	22 - 27* (200mL grabs)
GS03 BZ	2.0 L	3 (0.85L grabs)
GS04	2.0 L	4 (0.5L grabs)
GS05	2.0 L	2 (1L grabs)
GS06	2.0 L	3 (0.75L grabs)
GS08	4.0 +1 (for TSS*) = 5.0 L	20 - 25* (200mL grabs)
GS10 (increased FY00 analyte suite)	7.0 + 1 (for TSS*) = 8.0 L	35 - 40* (200mL grabs)
GS11	4.0 +1 (for TSS*) = 5.0 L	20 - 25* (200mL grabs)
GS27	5.0 L	6 (0.9 L grabs)
GS31	4.0 +1 (for TSS*) = 5.0 L	20 - 25* (200mL grabs)
GS32	6.0 L	8 (0.75 L grabs)
GS33	4.0 +1 (for TSS*) = 5.0 L	20 - 25* (200mL grabs)
GS34	4.0 +1 (for TSS*) = 5.0 L	20 - 25* (200mL grabs)
GS35	4.0 +1 (for TSS*) = 5.0 L	20 - 25* (200mL grabs)
GS38	4.0 +1 (for TSS*) = 5.0 L	20 - 25* (200mL grabs)
GS39	4.0 +1 (for TSS*) = 5.0 L	20 - 25* (200mL grabs)
GS40	4.0 +1 (for TSS*) = 5.0 L	20 - 25* (200mL grabs)
GS41	5.0 L	5 (1 L grabs)
GS42	5.0 L	5 (1 L grabs)
GS43	5.0 + 1 (for TSS*) = 6.0 L	25 - 30* (200mL grabs)
GS44	5.0 + 1 (for TSS*) = 6.0 L	25 - 30* (200mL grabs)
SW021	10.0 L	10 (1L grabs)
SW022	4.0 +1 (for TSS*) = 5.0 L	20 - 25* (200mL grabs)
SW022 (synoptic sampler)	10.0 L	10 (1L grabs)
SW023	10.0 L	10 (1L grabs)
SW027	7.0 + 1 (for TSS*) = 8.0 L	35 - 40* (200mL grabs)
SW060	10.0 L	10 (1L grabs)
SW091	5.12 L	6 (1 L grabs)
SW093	7.0 + 1 (for TSS*) = 8.0 L	35 - 40* (200mL grabs)
SW118	4.0 +1 (for TSS*) = 5.0 L	20 - 25* (200mL grabs)
SW120	5.0 + 1 (for TSS*) = 6.0 L	25 - 30* (200mL grabs)
SW132	10.0 L	10 (1L grabs)
SW134	2.0 L	2 (1L grabs)
SW100100	10.0 L	10 (1L grabs)

* TSS to be run if sample is collected within 7-day hold time.

7.2.2.3 Real-Time Water Quality Data Collection

At the NSD and terminal-pond POC locations, collection of continuous record at 15-minute intervals of pH, conductivity, nitrate, and turbidity are targeted by the IMP. The telemetry system will be used to provide real-time alarms, and 15-minute interval data will be downloaded from the water-quality probes on a monthly basis.

At the Indiana Street POC locations, collection of continuous record at 15-minute intervals of pH and conductivity are targeted by the IMP. Real-time data acquisition is not required, and 15-minute interval data will be downloaded from the water-quality probes on a monthly basis.

These water-quality probes must remain wet at all times. This is problematic for locations that are intermittently dry, and use of clean-water reservoirs during dry periods does not allow for adequate parameter stabilization upon flushing with stormwater. Consequently, data are not representative of runoff conditions. For this reason, data collected at these types of locations is opportunistic, and does not cover all periods.

Water quality probes begin collecting location-specific parameter data on 15-minute intervals upon installation. Particular care is needed during winter freezing conditions to prevent damage to the probes. This may involve temporary suspension of data collection until more favorable weather conditions resume.

Water-quality probes are removed from the field every 30-40 days for a performance check and adjustment in the laboratory to at least manufacturer's recommendations. Equipment may be performance checked, repaired, or replaced as needed based on data trends and professional judgment.

7.2.2.4 Telemetry Data Collection

The telemetry system will centrally monitor the status of the majority of monitoring locations. Telemetry is a valuable tool for the efficient operation of extensive automated monitoring networks, significantly reducing the amount of time-consuming field visitation. The system is fully flexible to allow for changing management needs. The data transmission needs are determined by the Site personnel responsible for the operation and maintenance of the monitoring network. The telemetry system also serves as a secondary data-collection platform for management decision support.[52]

Telemetry provides real-time information routinely used to manage systems such as the Site detention ponds. Data streams for pond operations include pond water elevation, inflow/outflow rates, and piezometer levels. Flow and precipitation data are also transmitted for network operation decision-making support and to confirm proper operation of flow meters. Real-time water-quality alarms are transmitted to notify personnel of anomalous conditions which may be indicative of acute or chronic degradation of Site surface waters.

Similarly, telemetry provides the status of automated sampling equipment. Since the rate of sample collection is determined by the weather (i.e. runoff volumes from precipitation events control sampling rate), real-time sampler status transmission greatly reduces the need for field visitation. Data streams include storm-event sampler status (enabled or waiting) and current composite sampler volume (i.e. the number of grab samples and the corresponding bottle volume).

7.2.3 Records Produced

Working records produced from the data-collection task shall be kept by SW in building T130C. These records include the following items.

1. Field log books

[52] Primary data collection of most data is performed by field downloading the data directly from the instrumentation. The telemetry also serves as a redundant data collection system should field instrumentation memory malfunction.

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2. Paper strip charts from flow meters
3. Electronic data from the flow meters, water quality probes, precipitation gages, and telemetry system on magnetic media
4. Chain of Custody forms for sample shipment/disposition
5. Sample Collection forms (SWD)

7.2.4 Applicable Instructions and Methods

Data collection procedures are further outlined in Site SOPs and instrumentation manufacturer instruction manuals. The applicable Site SOPs are as follows.

- 5-21000-OPS-SW.02 - *Field Parameter Measurement*
- RMRS/OPS-PRO.081 - *Surface Water Sampling*
- RMRS/OPS-PRO.093 - *Discharge Measurement*
- RMRS/OPS-PRO.092 - *Event-Related Surface-Water Sampling*
- RMRS/OPS-PRO.084 - *Operation and Maintenance of Stream-Gaging and Sampling Stations*
- 5-21000-OPS-FO.03 - *General Equipment Decontamination*
- 5-21000-OPS-FO.05 - *Base Laboratory Work*
- 5-21000-OPS-FO.06 - *Handling of Personal Protective Equipment*
- 5-21000-OPS-FO.07 - *Handling of Decontamination Water and Wash Water*
- 5-21000-OPS-FO.11 - *Field Communications*
- 5-21000-OPS-FO.13 - *Containerization, Preserving, Handling, and Shipping of Soil and Water Samples*
- 5-21000-OPS-FO.14 - *Field Data Management*
- 5-21000-OPS-FO.19 - *Base Laboratory Work*

The applicable manufacturer manuals are as follows.

- ISCO, Inc., 1989, *Instruction Manual Model 3210 Ultrasonic Open Channel Flow Meter*, Rev. E, ISCO, Inc., Nebraska, June.
- ISCO, Inc., 1989, *Instruction Manual Model 3220 Flow Meter*, Rev. F, ISCO, Inc., Nebraska, December.
- ISCO, Inc., 1990, *Instruction Manual Model 3230 Flow Meter*, Rev. C, ISCO, Inc., Nebraska, May.
- ISCO, Inc., 1994, *Instruction Manual Model 4230 Flow Meter*, Rev. C, ISCO, Inc., Nebraska, June.
- ISCO, Inc., 1994, *FLOWLINK3 Tutorial*, Rev. C, ISCO, Inc., Nebraska, July.
- ISCO, Inc., 1994, *Instruction Manual Model 4220 Flow Meter*, Rev. C, ISCO, Inc., Nebraska, June.
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- ISCO, Inc., 1990, *Model 3700R/ 3740 Refrigerated Sampler Instruction Manual*, ISCO, Inc., Nebraska, June.
- ISCO, Inc., 1990, *Model 3700 Portable Sampler Instruction Manual*, Rev. C, ISCO, Inc., Nebraska, October.
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- ISCO, Inc., 1994, *3710 Portable Sampler Instruction Manual*, Rev. K, ISCO, Inc., Nebraska, April.
- Hydrolab Corporation, 1994, *Recorder Water Quality Multiprobe Logger Operating Manual*, Hydrolab Corporation, Texas, May.
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- YSI, Inc., 1996, *6000UPG Multi-Parameter Water Quality Monitor Instruction Manual*, Yellow Springs Instruments Inc., Ohio.
- Geomation Measurement and Control Systems, Inc., 1992, *Geonet Operation Reference*, Geomation, Inc., Colorado, November.

Other applicable resources are as follows.

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Grant, D.M., 1992, *ISCO Open Channel Flow Measurement Handbook*, Third Edition, ISCO Environmental Division, Lincoln, Nebraska.

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Rantz, S.E., 1982, *Measurement and Computation of Streamflow: Volume 1. Measurement of Stage and Discharge,* U.S. Geological Survey Water-Supply Paper 2175, U.S. Department of the Interior, U.S. Government Printing Office, Washington, D.C.

Rantz, S.E., 1982. *Measurement and Computation of Streamflow: Volume 2. Computation of Discharge,* U.S. Geological Survey Water-Supply Paper 2175, U.S. Department of the Interior, U.S. Government Printing Office, Washington, D.C.

Water Measurement Manual, Revised Reprint, 1984, U.S. Department of the Interior, Bureau of Reclamation, U.S. Government Printing Office, Denver, Colorado.

7.2.5 Required Resources

Three qualified field personnel shall be available within SW to operate and maintain the monitoring locations. Two people are needed to perform routine inspection of the locations. One additional person is needed to be an alternate location inspector and to provide support for sampling events which require a significant amount of work to collect samples and refill the samplers with clean containers. Site sampling subcontractor personnel will be used to containerize and ship samples obtained from the composite sample containers and upload sample tracking data to the SWD database.

The use of government vehicles and two-way radios will be required for routine station inspection and maintenance. Vehicles and two-way communication equipment shall be provided by the Site.

Examples of equipment requirements for the data-collection task are as follows.

1. ISCO equipment supplies: desiccant cartridges, strip chart paper, fuses, spare parts, etc.
2. Lap-top PC with programming software and interrogator cables
3. Field log books, pens, markers
4. 15- or 22-Liter composite bottles (with lids)

5. Personal protective equipment (steel-toe boots, coveralls, safety glasses, insect repellent, sunscreen, rain gear, sunglasses, and hard hats where applicable)
6. Multimeter
7. Sample collection forms
8. Labels / labeling tape
9. Tape measure
10. Hand level
11. PC with Excel software and a laser printer
12. Pressurizing water sprayer
13. Deionized water
14. Buffers and standards for probe calibration
15. Field pH, nitrate, and conductivity meters
16. Office and base laboratory space

Consumable field equipment and supplies will need to be procured for each FY. Equipment may also need to be procured to support increased scope (i.e. new location) and replace broken (unfixable) or obsolete units.

7.2.6 Data Quality

Field data must be of sufficient quality to make management decisions concerning Site surface water. Field and analytical data must be scientifically defensible and consistent with sound scientific principles and standards for data collection and evaluation. Quality assurance requirements contained in the *RMRS Quality Assurance Program Plan (QAPD)*, (RMRS, 1998) are applicable to the work activities described herein. The RMRS QAPD stipulates project-specific QA requirements to be addressed in project implementation documents. The specific QA document for this project is the *Quality Assurance Program Plan for the Automated Surface-Water Monitoring Program (QAPP)* (RMRS, 2000).

7.2.7 Work Product Objectives

The work products resulting from this task are the data required to satisfy the requirements of the monitoring decision rules outlined in the IMP and the other project plans and SAPs which call for surface-water monitoring. The collected data must also comply with the needs of the appropriate regulatory requirements such as RFCA.

7.2.8 Acceptable Criteria

SW personnel will evaluate the data to determine its reliability. Criteria applicable to acceptable data collected under this task are as follows.

1. Flow, precipitation, and water-quality parameter data is collected using industry standard criteria, manufacturers recommendations, and according to the resources given in Section 7.2.4.
2. Analytical data should be "non-rejected" as determined by the data validator or SW personnel, and hold-times for sample analysis should not be exceeded.
3. Recorded field notes should be clear and concise.

7.2.9 Applicable Software

The ISCO monitoring equipment operates on proprietary Flowlink software. Geomation telemetry operates with proprietary Geonet software. YSI water quality probes operate with proprietary EcoWatch software. This software will operate on a laptop computer which will be used to program the instrumentation and download data from the field. Microsoft Excel is needed to perform data-reduction

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tasks for the stream stage / discharge data and is required to work with the chemical analysis data obtained from SWD.

7.3 DATA ANALYSIS AND REPORTING

7.3.1 Types of Data and Reports

A description of the data collected for this task can be found in Section 7.2 of this work plan. These data will be the subject of interpretive evaluations detailed in this Section that will be performed by Site personnel on a routine basis. Additional project or investigation-specific analyses are not covered in this work plan.[53] Many of these routine evaluations are delivered to parties as specified in the IMP, RFCA, and the IA IM/IRA. These report(s) may contain some or all of the following items:

- Daily mean discharge for each monitoring location,
- Daily means for real-time water quality parameters,
- Data tables presenting analytical results,
- Summary statistics for each analyte of interest, including computation of required statistics including UTL/LTLs and 30-day averages,
- Summary of significant findings and conclusions drawn from evaluation of the data, and
- Highlights of the program management and operation.

7.3.1.1 Semi-Monthly Evaluation and Reporting

For each monitoring objective (NSD, ALF, etc.), applicable summary statistics (95% UTL, 30-day volume-weighted moving average, 1-day average) for each AOI will be calculated semi-monthly as specified by the IMP. The notification and reporting process, depending on the AOI and the monitoring location, will be followed as specified by RFCA and the IMP.

7.3.1.2 Quarterly Reports

Information for each quarter will be presented in Quarterly Reports which will be made available at the Quarterly Information Exchange Meetings in Broomfield.

These data include:

- Daily mean discharge for each POC, POE, and Performance monitoring location,
- Data tables presenting analytical results, and
- Highlights of the program management and operation.

7.3.1.3 Annual Reports

Information for each fiscal year will be presented in an Automated Surface-Water Monitoring Annual Report that will be made available during the subsequent fiscal year.

Annual Reports shall include:

- Daily mean discharge and summary statistics for each monitoring location,
- Daily means and summary statistics for real-time water quality parameters,
- Daily precipitation totals,
- Data tables presenting analytical results,

[53] These types of analyses will be performed by skilled professionals to industry standards and subject to peer review. Details are contained in the applicable SAPs or Work Plans.

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- Summary statistics for each analyte of interest, including computation of required statistics including UTL/LTLs and 30-day averages,
- An evaluation of water-quality correlations,
- A loading analysis for Pu and Am for all locations,
- Summary of significant findings and conclusions drawn from evaluation of the data, and
- Highlights of the program management and operation.

7.3.2 Task Descriptions

The data evaluation and reporting task involves routine data compilation, evaluation, and reporting of the data collected in the data collection task.

7.3.2.1 Hydrologic Data Evaluation

Flow and precipitation data is compiled and evaluated using industry standard criteria, manufacturer recommendations, and the resources given in Section 7.3.4. Data are routinely considered and evaluated in the following ways:

- Values are checked using the radio telemetry equipment for project management decision support;
- A detailed work-up of 15-minute interval data is generated and archived; and
- A detailed work-up and evaluation of daily averages is completed and archived.

Additional evaluation may be performed for a variety of reasons including spill investigations, special requests, project-specific Performance monitoring evaluations, and hydrologic studies.

7.3.2.2 Analytical Data Evaluation

Analytical data is compiled and evaluated using industry standard criteria, manufacturers recommendations, and according to the resources given in Section 7.3.4. Data are routinely considered and evaluated in the following ways:

- Evaluation of data using UTLs/LTLs is currently performed for the Performance and NSD monitoring objectives,
- Evaluation of data using 30-day volume-weighted moving averages is currently performed for the POE and POC monitoring objectives, and
- Actinide loading analysis is performed monthly to quarterly, on an as needed basis.

Additional evaluation may be performed for a variety of reasons including source evaluations, spill investigations, special requests, and water-quality studies.

<u>95% UTLs / LTLs</u>

Evaluation of analytical and real-time water-quality data using UTLs/LTLs is currently performed for the Performance and NSD monitoring objectives. The method is as follows:

- Tolerance limits are calculated semi-monthly for each monitoring location.
- Data sets are selected to cover a moving 3-year window of time.[54] The intent is to evaluate for statistically significant changes in water-quality while attempting to minimize seasonal and hydrologic fluctuations.[55]

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[54] A 3-year moving window is chosen where possible. For many Performance locations, monitoring only lasts a year or two. Under those circumstances, all data is used, and particular qualitative/quantitative attention is given to the effects of hydrology and seasonality on the results.

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- The distribution of the data is established (normal or lognormal) using probability plotting (histogram), skewness, and the W test.
- Based on the distribution, 95% tolerance limits with 95% confidence are calculated.
- Individual data are then compared to these tolerance limits, and decision are made based on that comparison tempered by professional judgment.

30-Day Volume-Weighted Moving Averages

Evaluation of analytical data using 30-day volume-weighted moving averages is currently performed for the POE and POC monitoring objectives. The method is as follows:

- 30-day averages are calculated semi-monthly for each POC and POE (within one week of the 15th and last day of each month).
- Calculations are performed using daily time steps. The 30-day average for a particular day is calculated using a 'window' of time which includes the previous 30 days which had both flow and measurements of radionuclide activity. Therefore, for a location with continuous flow and complete analytical results, 365 (366 in a leap year) 30-day average values are calculated annually.
- When no radionuclide result is available for a particular day, then no 30-day average is calculated for that day (per IMP guidelines). No analytical result may be available either due to a non-sufficient quantity for analysis (referred to as an NSQ condition in the IMP) or a failed lab analysis.
- Each calendar day is assigned the activity (analytical result in pCi/l) of the composite sample that was filling at the end of that day (specifically, at 23:59:59). When a negative analytical result (e.g. -0.002 pCi/l) is returned from the lab due to blank correction, then a value of 0.0 pCi/l is used for calculation purposes.
- Each calendar day has an associated surface-water volume (liters) that was measured by the flow meter. Flow record may contain estimated values for certain conditions.[56]
- The daily surface-water volume is then multiplied by the corresponding activity to calculate a load in pCi for each day.
- The sum of the daily loads (pCi) for the preceding 30-days is divided by the sum of the daily surface-water volumes (liters) for the preceding 30-days to calculate the volume-weighted 30-day average activity (pCi/L).
- These 30-day averages are then compared to the appropriate Action Levels and Standards and reported according to the requirements of the IMP and RFCA.

Loading Analysis

Storm-Event Sampling Analytical Results

Load estimation for storm-event sampling is generally used to evaluate the relative radionuclide loads at monitoring locations which are tributary to POEs and POCs. The method is as follows:

- The time period for loading comparison is selected (e.g., monthly, seasonal, annual, etc.).

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[55] Closure activities are expected to result in modifications to contaminant source areas, drainage pathways, and runoff distribution. Such changes in water quality would not necessarily be indicative of a release. Consequently, tolerance limits are being used here to help identify acute releases of contaminants as opposed to long-term changes in water quality. The shortcoming of this approach is that chronic releases may not be indicated by comparison with tolerance limits; however, significant chronic trends should be measured through the POE and POC monitoring objectives.

[56] Estimation is required when flow rates exceed the capacity of the flow-control structure (e.g., a flume), winter ice conditions result in an inaccurate measurement, or when there is an equipment failure.

- The arithmetic average[57] of the analytical results (pCi/L) for the selected time period is calculated.[58]
- The average activity is multiplied by the associated flow volume (liters) to obtain a load in pCi.

Continuous Flow-Paced Sampling Analytical Results

Load estimation for continuous flow-paced sampling is generally used to evaluate the relative radionuclide loads of tributary monitoring locations and as a closer estimation of actual loads at specific monitoring locations. The nature of the continuous sampling during all flow conditions allows for more accurate load calculations compared to storm-event sampling. The method is as follows:

- The time period for loading comparison is selected (e.g., monthly, seasonal, annual, etc.).
- The analytical result (pCi/L) for a particular composite sample period is multiplied by the associated flow volume (streamflow in liters) to obtain a load for each composite sample period (pCi).[59]
- The sum of the individual composite-sampling period loads (for the selected time period) is calculated in pCi.

7.3.2.3 Real-Time Water Quality Data Evaluation

Data collected by real-time water quality probes at NSDs, POEs, and POCs are compiled and evaluated using industry standard criteria and manufacturer's recommendations, in accordance with the resources listed in Section 7.2.4. Data are routinely considered and evaluated in the following ways:

- *Telemetry Check*: Daily average values are checked using the radio telemetry equipment for project management decision support;
- *Compilation of 15-minute Data*: A detailed compilation of 15-minute data is generated and archived; and
- *Calculation and Evaluation of Daily Averages*: A detailed calculation and evaluation of daily averages is completed and archived.

Each of these data evaluation activities is completed for all water quality parameters measured by the probes. Additional evaluation may be performed for a variety of reasons including spill investigations, special requests, and studies of probe performance. These three routine data evaluation activities are described in greater detail below.

Telemetry Check

- Daily average values for the previous day are checked using the radio telemetry equipment on all normal working days, or roughly 4 to 5 times per week. This check is made for all parameters measured at the given location.

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[57] In addition to arithmetic average activity, median total, monthly and or seasonal average activity, and/or other location-specific activity estimation method may be used. The intent is to establish a range of activity estimations (and corresponding load) in order to estimate a range of possible relative load contributions.

[58] It is unknown if the activity of storm-event runoff is representative of the overall activity of the surface-water discharge for a particular location. If it is assumed that actinide transport increases during high runoff periods (as TSS transport increases), then the average storm-event activity may be an overestimation of the overall activity. For example, at a location with a significant relative proportion of baseflow (assuming baseflow to be of lower activity), a higher load may be estimated than was actually transported. On the other hand, for a location with no flow other than direct runoff, the estimation may be more accurate. Regardless, for most loading estimations the intent is to examine relative loads for multiple tributary monitoring locations. When a relationship between flow rate and activity can be determined (or other relationship), this relationship may be used to estimate load.

[59] When a composite sample period overlaps the selected time period for loading, then a proportion of the load for the entire sampling period is calculated based on relative streamflow volume.

- The intended purpose of this daily check is to help identify otherwise undetected releases as well as possible water quality probe malfunctions. In the event of an unusual reading, or an apparent suspicious trend in readings, hourly average and even instantaneous 15-minute records may be retrieved from telemetry for more information.

Compilation of 15-Minute Data

- Water-quality record at 15-minute intervals, collected monthly from the water quality probes, is compiled into spreadsheets including 15-minute flow record. This is the most detailed record maintained, and consequently may be useful in the investigation of the duration and impact of acute releases.
- Water quality measurements are also plotted with the flow record as a function of time for visual inspection.

Calculation and Evaluation of Daily Averages

- From the 15-minute data, summary tables are created containing daily averages for each parameter.
- Daily average values for each parameter are transferred to a spreadsheet file summarizing all mean daily probe results for that location for that water year. This file is also updated with mean daily flow rates.
- Updated results are used to calculate 95% Upper Tolerance Limit (UTL) values for pH, specific conductivity, nitrate, and turbidity (95% Lower Tolerance Limit (LTL) value is also calculated for pH).
- Data sets for tolerance limits are selected to cover a moving 1-year window of time. Tolerance limits are recalculated with each additional data entry in recognition of the expectation that Site surface water quality will change as the Site approaches closure.[60] The intent is to evaluate for significant changes in water-quality while attempting to minimize the effects of seasonal fluctuations.
- Mean daily water quality results are plotted with updated UTL and LTL values for a visual check.
- Summary statistics, consisting of monthly averages for each parameter, are prepared from daily average values.

7.3.3 Records Produced

The records produced for this task include reports containing the items listed in Sections 7.3.1 and 7.3.2 of this document, including letters of transmittal of the reports. Electronic copies of the data evaluations are also produced.

7.3.4 Applicable Instructions and Methods

The applicable resources are as follows.

Bedient, P.B. and W.C. Huber, 1992, *Hydrology and Floodplain Analysis*, Second Edition, Addison-Wesley Publishing Company, Reading, Massachusetts.

Chow, V.T., Maidment, D.R., and L.W. Mays, 1988, *Applied Hydrology*, McGraw-Hill, Inc., New York, New York.

[60] Closure activities are expected to result in modifications to drainage pathways and runoff distribution. Such changes in water quality would not be indicative of a release. Consequently, tolerance limits are being used here to help identify acute releases of contaminants as opposed to long-term changes in water quality. The shortcoming of this approach is that chronic releases may not be indicated by comparison with tolerance limits; however, significant chronic trends should be obvious in summary statistics.

Evett, J.B. and L. Cheng, 1987, *Fundamentals of Fluid Mechanics*, McGraw-Hill, Inc., New York, New York.

Gilbert, R.O., 1987, *Statistical Methods for Environmental Pollution Monitoring*, Van Nostrand Reinhold, New York, New York.

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Water Measurement Manual, Revised Reprint, 1984, U.S. Department of the Interior, Bureau of Reclamation, U.S. Government Printing Office, Denver, Colorado.

7.3.5 Required Resources

Two Environmental Engineers are currently required to produce the required reports and evaluations for this activity. Two PCs equipped with the applicable software are needed for this task.

7.3.6 Field Quality Control Samples

Quality assurance requirements contained in the *RMRS Quality Assurance Program Plan (QAPD)*, (RMRS, 1998) are applicable to the work activities described herein. The RMRS QAPD stipulates project-specific QA requirements to be addressed in project implementation documents. The specific QA document for this project is the *Quality Assurance Program Plan for the Automated Surface-Water Monitoring Program (QAPP)* (RMRS, 2000). The types and quantities of QC samples that will be collected in the field and shipped to the subcontractor laboratory are outlined in the *QAPP*.

7.3.7 Data Archival

Data will be archived to the SW NT fileserver, dedicated Iomega Jaz cartridges (removable media), and/or Site databases (e.g. SWD, ISEDS/EDDIE) for backup and storage.

7.3.8 Work Product Objectives

The work products for this task are reports that summarize the data and provide management criteria. The report(s) shall at least contain the following material.

- Daily mean discharge for each monitoring location;

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- Daily means for real-time water quality parameters;
- Data tables presenting analytical results;
- Summary statistics for each analyte of interest, including computation of required statistics including UTL/LTLs and 30-day averages;
- Summary of significant findings and conclusions drawn from evaluation of the data;
- Highlights of the program management and operation.

7.3.9 Acceptable Criteria

The reports shall be scientifically defensible, understandable to a non-technical audience, and have a professional appearance. The reports shall contain all available, applicable, and acceptable data. The reports shall be prepared in a timely fashion so as to meet Site schedules.

7.3.10 Applicable Software

Software programs Microsoft Excel, Microsoft Word, Microsoft Access, ISCO Flowlink, YSI PC6000, YSI Ecowatch, PCAnywhere, GeoNet, and an applicable statistical package (for functions not supported by other programs) are needed for this task.

7.4 DATA QUALITY INDICATORS

The assessment of data quality indicators is significant to determine data usability. The principal data quality indicators are precision, bias, accuracy, representativeness, comparability, and completeness (PARCC). Of the six principal data quality indicators, precision and bias are quantitative measures, representativeness and comparability are qualitative, completeness is a combination of both qualitative and quantitative measures, and accuracy is a combination of precision and bias.

The specific QA document for this project is the *Quality Assurance Program Plan for the Automated Surface-Water Monitoring Program (QAPP)* (RMRS, 2000). A detailed description of the PARCC requirements for this project is contained in the *QAPP.*

7.5 DATA QUALITY ASSESSMENT

Data Quality Assessment (DQA) is the scientific and statistical evaluation of data to determine if the data are of the right type, quality, and quantity to support the intended use.

The specific QA document for this project is the *Quality Assurance Program Plan for the Automated Surface-Water Monitoring Program (QAPP)* (RMRS, 2000). A detailed description of the DQA requirements for this project is contained in the *QAPP.*

8. ENVIRONMENTAL SAFETY AND HEALTH COMPLIANCE

Compliance with an existing Health and Safety Plan will be required to perform the work in the field. This project complies with a plan titled *Health and Safety Plan for Automated Surface-Water Monitoring in Support of the Rocky Flats Clean-up Agreement and the Industrial Area IM/IRA* (Doc# RF/RMRS-97SWHSP.01; Revision 0; 8-15-97).

9. SCHEDULE

The schedule of tasks/activities for this program is given in the associated Sections above. Implementation of the current Site surface-water monitoring requirements began on October 1, 1996. As requirements change, complete implementation is achieved as timely as practicable pending receipt and deployment of procured equipment. The implementation is completed to facilitate collection of complete and quality data sets subject to work schedule, weather, and funding constraints.

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10. FUNDING

Budget for surface water monitoring program is included under four separate K-H Environmental Media Management (WBS #1HAD) activities. These activities include Surface Water Monitoring (Activity # 1HAD5120P2); SW Analysis, Modeling, & Reporting (Activity # 1HAD5220P2), RFCA/IMP Water Compliance (Activity #1HAD5310P2), and Clean Water Act Compliance (Activity # 1HAD5320P2). Each activity spans a period of 72 months (from May 22, 2000 through closure).

The first activity, Surface Water Monitoring, is further divided into three separate line items. These line items are SW Monitoring Station Maintenance (i.e., automated monitoring system installation, operation, and maintenance); SW Compliance Monitoring (i.e., sample and field data collection and sample shipping); and SW analytical (i.e., laboratory analysis, analytical data package verification and validation, and sample tracking). The FY01 budgeted cost of work scheduled (BCWS or budget) for these line items are $217K, $359K, and $196K respectively for an activity total of $772 K.

The second activity, SW Analysis Modeling & Reporting is also divided into three separate line items. Line items include Data Assessment/Reporting (i.e., analytical data package reviews, analytical and field data compilation, analysis and interpretation, and report preparation); RFCA SW Evaluations (i.e., separate investigations into the probable causes or sources of RFCA reportable values for RFCA Point of Evaluation and Point of Compliance monitoring locations); and Surface Water D&D Monitoring (i.e., planning and implementation of performance monitoring for D&D and ER projects). The FY01 budget for these line items are $213K, $24K, and $45K, respectively, for an activity total of $282K.

The third activity, RFCA/IMP Water Compliance consists of a single line item, RFCA/IMP Compliance Support. Integrated Monitoring Plan revisions, strategic planning, and integration of surface water and ground water monitoring programs under RFCA are included in the scope of this line item. The FY01 budget for this activity (which includes a significant amount groundwater monitoring program budget for this activity) is $120K.

The fourth and final activity, Clean Water Act Compliance also consists of a single line item, Clean Water Act Compliance Support. Regulatory support, line management guidance, and monitoring program upgrades required for the compliance with the Clean Water act are included in the scope of this line item. The FY01 budget for this activity is $107K.

11. REFERENCES

Many references are listed previously in the associated Sections.

Bedient, P.B. and W.C. Huber, 1992, *Hydrology and Floodplain Analysis*, Second Edition, Addison-Wesley Publishing Company, Reading, Massachusetts.

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EG&G, 1992. *Rocky Flats Plant Drainage and Flood Control Master Plan, Woman Creek, Walnut Creek, Upper Big Dry Creek, and Rock Creek*, EG&G Rocky Flats, Inc., Rocky Flats Plant, Golden, Colorado, Section VII.

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EG&G, 1991. *Quality Assurance Program Planning*, EG&G manual number 1-50000-ADM-02.01, EG&G Rocky Flats, Inc., Rocky Flats Plant, Golden, Colorado.

Gilbert, R.O., 1987, *Statistical Methods for Environmental Pollution Monitoring*, Van Nostrand Reinhold, New York, New York.

Grant, D.M., 1992, *ISCO Open Channel Flow Measurement Handbook*, Third Edition, ISCO Environmental Division, Lincoln, Nebraska.

Kaiser-Hill Company L.L.C., DOE RFFO, 1999a. *Rocky Flats Environmental Technology Site Integrated Monitoring Plan FY2000*, Golden, Colorado, September.

Kaiser-Hill Company L.L.C., 1999b *Rocky Flats Environmental Technology Site Integrated Monitoring Plan Background Documents FY2000*, a working group including: City of Broomfield, City of Arvada, City of Westminster, City of Northglenn, City of Thorton, Colorado Department of Public Health and Environment, Department of Energy - Rocky Flats Filed Office, U.S. Environmental Protection Agency - Region VIII, and the Kaiser-Hill Team.

Kennedy, E.J., 1984, *Techniques of Water Resource Investigations of the United States Geological Survey, Chapter A10 Discharge Ratings at Gaging Stations*, Book 3 Applications of Hydraulics, U.S. Department of the Interior, U.S. Geological Survey, U.S. Government Printing Office, Alexandria, Virginia.

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RFCA, 1996a. *Final Rocky Flats Cleanup Agreement,* Colorado Department of Public Health and Environment, U. S. Environmental Protection Agency.

RMRS, 1996b. *Pond Operations Plan*: Revision 2 (RF/ER-96-0014.UN; PADC-96-00358), Kaiser-Hill Company, Golden, Colorado.

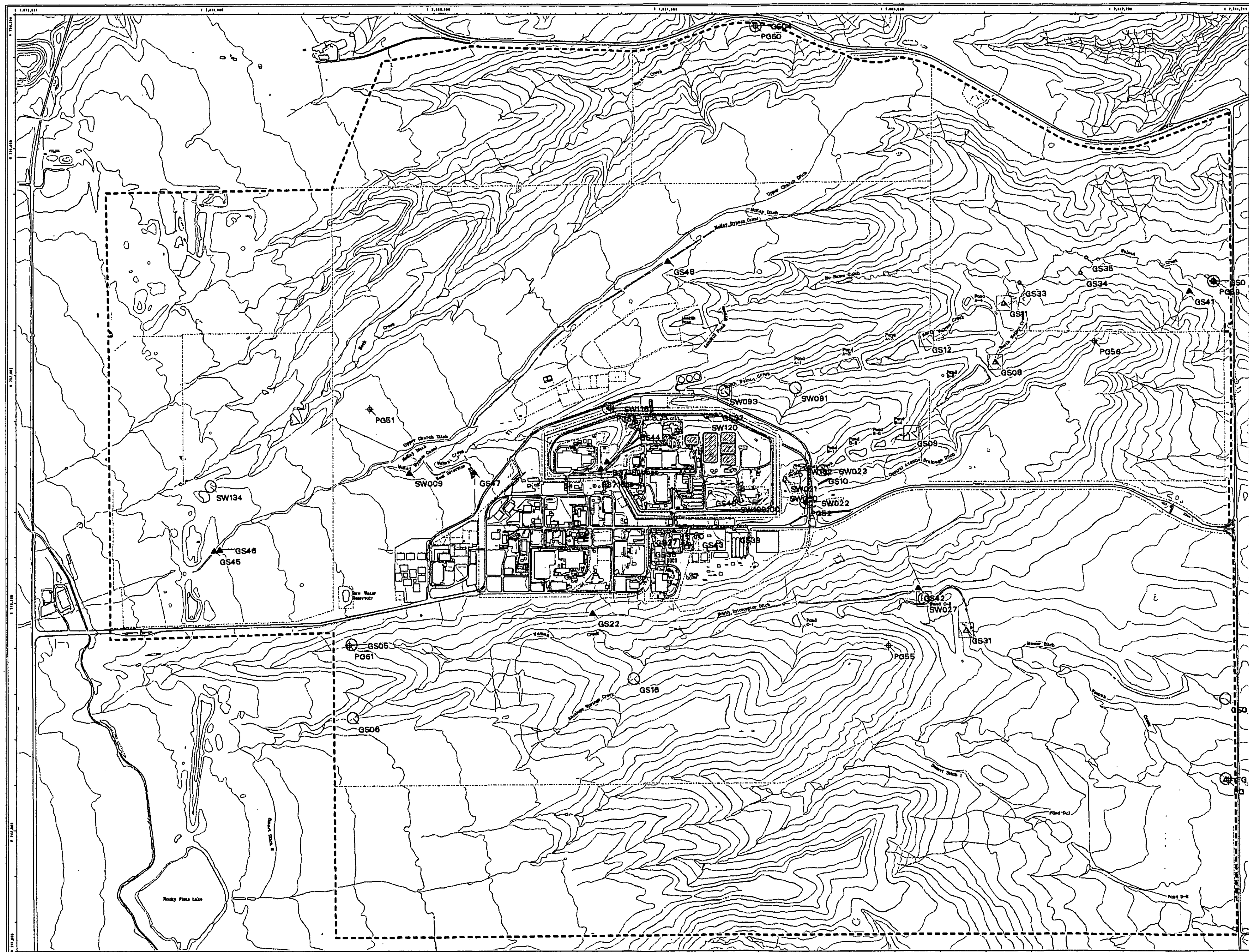
RMRS, 1998a. *Emergency Response Plan for Failure of Dams A-4, B-5, or C-2,* RMRS/OPS-PRO.063, Kaiser-Hill Company, Golden, Colorado, March.

RMRS, 1998b. *RMRS Quality Assurance Program Plan (QAPD)*, RMRS L.L.C., Rocky Flats Environmental Technology Site, Golden, Colorado.

RMRS, 2000a. *Quality Assurance Program Plan for the Automated Surface-Water Monitoring Program,* RF/RMRS-2000-013, Rev. 0, Golden, Colorado, March.

RMRS, 2000b *Sampling and Analysis Plan for Automated Synoptic Surface-Water and Sediment Sampling for the GS10 Source Investigation*, Rev. 0, Golden, Colorado, March.

Automated Surface Water Monitoring Locations and Precipitation Gages



EXPLANATION

- Precipitation Gage

Monitoring Location Objective*

- Buffer Zone Hydrologic
- New Source Detection
- Point of Compliance
- Point of Evaluation
- Source Location
- Ad Hoc
- Performance
- IDLH**

Standard Map Features

- Buildings and other structures
- Solar Evaporation Ponds (SEP)
- Lakes and ponds
- Streams, ditches, or other drainage features
- Fences and other barriers
- Contour (20-Foot)
- Rocky Flats boundary
- Paved roads

DATA SOURCE BASE FEATURES:
Buildings, fences, hydrography, roads and other structures from 1994 aerial fly-over data captured by EG&G RSL, Las Vegas. Digitized from the orthophotographs. 1/95
Topology (contours) were derived from digital elevation model (DEM) data by Morrison Knudson (MK) using ESRI Arc TIN and LATTICE to process the DEM data to create 5-foot contours. The DEM data was captured by the Remote Sensing Lab, Las Vegas, NV, 1994 Aerial Flyover at ~ 10 meter resolution. DEM post-processing performed by MK, Winter 1997.

NOTE:
* The monitoring objective(s) performed at each location are detailed in the Surface Water Section of the Site Integrated Monitoring Plan.

** IDLH (Immediate Danger to Life & Health) refers to the monitoring objective for safe operation of the Site detention ponds.

Scale = 1 : 21250
1 inch represents approximately 1771 feet

250 0 500 1000ft

State Plane Coordinate Projection
Colorado Central Zone
Datum: NAD27

U.S. Department of Energy
Rocky Flats Environmental Technology Site

GIS Dept. 303-966-7707

Prepared by: DynCorp — THE ART OF TECHNOLOGY

Prepared for: KAISER•HILL COMPANY

MAP ID: 2k-0227

September 22, 2000

Original map contents are preserved. Logo and date have changed.

NT_Svr w:/projects/fy2k/2k-0227/auto-sw-loc-2k-b.aml

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