

EXECUTIVE SUMMARY

This report provides a description, critical analysis, and recommendations for improvements to the environmental monitoring currently performed at the Rocky Flats Environmental Technology Site (hereafter referred to as Rocky Flats or Site). Sitewide monitoring programs for groundwater, surface water, soils and sediments, air quality, and ecology as well as project-specific monitoring were evaluated.

Each of the six monitoring programs were assessed for the effectiveness of the current monitoring activities and to determine if the program sufficiently addresses public environmental concerns.

GROUNDWATER MONITORING PROGRAM

The groundwater at the Site is monitored to protect the surface water, minimize impacts to the shallow groundwater, and to comply with the regulations. A shallow groundwater system consisting of two water-bearing layers, the upper and lower hydrostratigraphic units (UHSU and LHSU, respectively) and a deep aquifer underlie Rocky Flats. The majority of the groundwater monitoring is performed in the "uppermost aquifer" (UHSU).

The Site maintains a network of 262 monitoring wells across the Site to monitor the water quality and measure the hydrologic characteristics of the groundwater. Water levels are routinely measured in all 262 wells to provide hydrologic data for use in computer groundwater flow models and groundwater contour maps. This information is used to identify and assess potential groundwater migration pathways and to determine groundwater discharge patterns to the surface water.

The groundwater is sampled and analyzed from 89 of the 262 wells. Groundwater from each well is analyzed for a prescribed suite of contaminants. The 89 water quality wells are grouped into seven specified well categories based on similar monitoring objectives for the wells. Table I identifies the seven well categories and summarizes the monitoring objectives, general well locations, and the contaminants monitored.

Tier I and Tier II Action Levels are established for each groundwater analyte monitored. These Action Levels are based on regulatory standards and guidelines to protect the surface water from groundwater contamination. The groundwater is evaluated for an accelerated response action if a Tier I Action Level is exceeded. A Tier II Action Level exceedance triggers immediate groundwater management actions.

**TABLE I
MONITORING WELL CATEGORIES**

Well Category	Monitoring Objective	Location	Total Wells	Contaminants Monitored
Plume Definition Wells	Monitor groundwater contaminant concentrations for exceedance of Tier I Action Levels	Within 9 known groundwater contaminant plumes along suspect pathways to surface water	21	21 wells: VOCs, metals 19 wells: uranium, nitrate 14 wells: plutonium, americium 7 wells: strontium 11 wells: tritium, fluoride 12 wells: sulfate
Plume Extent Wells	Monitor movement of groundwater contaminant plumes	Along boundaries of 12 groundwater plumes along pathways to surface water	44	44 wells: VOCs, metals, 32 wells: uranium, nitrate 17 wells: plutonium, americium 16 wells: tritium, fluoride 10 wells: strontium
Drainage Wells	Monitor groundwater contaminant migration to surface water drainages	Within Walnut Creek and Woman Creek drainages downgradient from groundwater plumes	5	5 wells: VOCs, uranium 2 wells: plutonium, americium 1 well: strontium 4 wells: metals, nitrate 3 wells: sulfate
Boundary Wells	Monitor groundwater quality before it leaves the Site	Within drainages along eastern Site boundary	6	6 wells: VOCs, plutonium, americium, uranium, tritium, nitrate, fluoride, sulfate
D&D Monitoring	Monitor contaminant releases to groundwater during D&D activities in the Industrial Area	In Industrial Area near Bldg. 886	1	1 well: plutonium, americium, uranium, strontium, VOCs
Performance Monitoring	Monitor for contaminant impacts to groundwater from cleanup or source removal activities	Near project areas, currently at 881 Hillside, 903 Pad, East Trenches	12	12 wells: uranium, VOCs, metals, uranium, nitrate 6 wells: plutonium, americium, sulfate
RCRA Monitoring	Monitor releases from RCRA management units	Upgradient and downgradient from Landfill, PU&D Yard, Carbon Tetrachloride plume	14	14 wells: uranium, tritium VOCs, metals, sulfate, fluoride, nitrate 3 wells: plutonium, americium, strontium

A critical analysis was performed and opportunities to improve the Groundwater Monitoring Program at Rocky Flats were identified. The criticisms and recommended improvements are briefly summarized.

The number of contaminants monitored for groundwater samples from several wells is deficient. The analytical suite for some of the Plume Definition and Plume Extent Wells excludes several contaminants of concern identified for the groundwater plumes monitored by these wells. The analyte list for the Drainage and Boundary Wells should also be expanded to include all the analytes monitored in the upgradient wells and potential contaminants of concern in the Industrial Area. Further, the baseline monitoring for D&D Wells is inadequate and needs to include groundwater analyses for all known or suspected contaminants in the Industrial Area.

A Drainage Monitoring Well should be installed in North Walnut Creek immediately upgradient of the A-series ponds to monitor potential groundwater plume migration to the drainage area.

The semiannual sampling frequency is not sufficient for some well locations. Because the Boundary Wells are the last monitoring point before groundwater leaves the Site, an increased sampling frequency would be prudent. Because the potential for cross-media contaminant migration is greater during and after remediation projects, the sampling frequency for Performance Monitoring should be increased until monitoring shows the contaminant levels have stabilized. The semiannual sampling for the D&D Monitoring Well will not provide sufficient data to establish a baseline before D&D activities commence. The D&D Monitoring Well sampling should also be increased.

The groundwater in the lower hydrostratigraphic unit (LHSU) is monitored by only two wells. The justification for this limited monitoring should be explained and documented.

Because contaminated soils are potential contaminant sources to the groundwater, the interactions between contaminated soils and groundwater should be investigated.

Well purging and sampling procedures for low yield wells need to be established to ensure the groundwater samples are representative and not degraded by exposure to the atmosphere. Larger diameter wells should be considered to help mitigate sampling problems for low yield wells.

Alternative well construction materials should be considered for wells located in areas contaminated with organic compounds.

SURFACE WATER MONITORING PROGRAM

The surface water at Rocky Flats is monitored to ensure compliance with the regulatory requirements and to detect potential contaminant releases from the Industrial Area.

The Site is crossed by three major drainages: North Walnut Creek, South Walnut Creek, and Woman Creek. Three sets of detention ponds and one landfill pond hold water prior to release to offsite drainages. Four A-series ponds are located in the North Walnut Creek Channel, five B-series ponds in the South Walnut Creek drainage, and two C-series ponds are in the Woman Creek drainage. Numerous diversion canals and drainage ditches convey or divert water across the Site.

The Surface Water Monitoring Program incorporates 18 separate monitoring programs into a single Sitewide program. These programs are summarized in Table II.

**TABLE II
SURFACE WATER MONITORING PROGRAMS**

FOCUS AREA	MONITORING PROGRAM	PRIMARY PURPOSE	MONITORING POINTS
Industrial Area	New Source Detection	Monitor surface water in main drainages leaving the Industrial Area for impacts from remedial activities.	SW022, SW091, SW093, SW027, GS10
	Performance Monitoring	Project-specific monitoring to evaluate contaminant control during remedial or D&D activities in the Industrial Area.	GS27, GS28, GS32
	Incidental Waters	Evaluate accumulated water (> 50 gallons) in Industrial Area (utility pits, berms, footing drains, sumps, etc.) for discharge disposition.	Industrial Area, various sites
Water Quality	Non-Point of Compliance Monitoring at Indiana St.	Evaluate discharges leaving Rocky Flats at Walnut Creek and Woman Creek for nutrient land contaminant loading	GS01, GS03, Woman Creek (once each during pond discharge and nondischarge)
	Source Location	Global monitoring to locate and characterize new contaminant sources detected during environmental monitoring. Primary focus is Industrial Area, but applicable site-wide.	No monitoring station currently installed
	Ad Hoc Monitoring	Support special request monitoring.	As needed per request
	Internal Waste Stream Characterization for Permit Application	Regulatory compliance: NPDES Permit Modification. Characterize discharge from new waste stream.	Industrial Area: -Cooling Towers -Unidentified Waste Stream
Sewage Treatment Plant (STP)	Internal Waste Stream Authorization to Discharge to the STP	Predischarge evaluation for authorization to discharge to Sewage Treatment Plant.	Industrial Area
	Sewage Treatment Plant Collection System	Safety and regulatory compliance monitoring.	STP
	NPDES Permit Monitoring	Required monitoring of discharge to surface waters of the United States.	Outfall discharges at Buildings 995 and 374
Pond Influent, Operations and Discharge	Segment 5 Action Level Framework Monitoring	Evaluate discharges from Industrial Area for RFCA Action Level compliance (Segment 5 = terminal ponds, North and South Walnut Creeks, Pond C-2, South Interceptor Ditch).	SW093, GS10, SW027
	NPDES Discharges to and from Ponds	Regulatory Compliance to NPDES Permit. Base monitoring of point sources identified in the permit for discharge standard compliance.	Effluent from: Bldg. 995. Ponds A3, A4, B5, & Pond B5 Transfers
	Predischarge Monitoring	Regulatory compliance to NPDES Permit. Annual water quality monitoring.	Ponds A4, B5 Pond C-2
	Segment 4 Compliance Monitoring	Regulatory compliance monitoring of discharges from terminal ponds into Segment 4 (Ponds A-4, B-5, C-2, Walnut Creek and Woman Creek at Indiana St.).	GS11, GS08, GS31, GS01, GS03
	IDLH Monitoring (Dam Safety)	Monitor dam safety; evaluate safe pond capacity.	12 detention ponds: A-, B-, and C-series
Offsite Community Monitoring	Community Assurance Monitoring	Assess community water supplies and distribution systems.	Great Western Reservoir (raw and treated water); Distribution system for Broomfield and Denver Service Areas
	Uncharacterized Discharge Monitoring	Analyze uncharacterized discharge waters from Rocky Flats.	Walnut & Woman Creek at east Site Boundary, offsite reservoirs, municipalities
Extraneous Monitoring	Correlation of Plutonium with Total Suspended Solids	Evaluate the relationship of plutonium concentrations with indicator parameters.	Sitewide

Twelve monitoring stations, equipped with automated monitoring systems, are used to continuously sample surface water for analyses. Each station contains a flow meter linked to a portable automated sampler. The radio-based telemetry system allows flow meters and automatic samplers to operate remotely, and transmits and records real-time data at established time intervals.

A critical analysis of the Surface Water Monitoring Program identified some deficiencies and contradictions in the scope and implementation of the program. The criticisms and recommendations for improvements are summarized.

The New Source Detection and Segment 5 Action Level Framework (ALF) Monitoring Programs both monitor the surface water leaving the Industrial Area. These programs should be combined into a single, more rigorous program to effectively monitor the potential contaminant impacts to the surface water from Industrial Area activities.

The analyte lists for the New Source Detection and Segment 5 ALF Monitoring Programs should be expanded to include contaminants of concern identified for the Individual Hazardous Substance Sites (IHSSs) and associated groundwater contaminant plumes. The monitoring activities for these two programs should be closely integrated with the Site's groundwater monitoring program.

The analyte list for the target areas currently monitored under the Performance Monitoring Program is insufficient and does not provide adequate baseline information. All the contaminants of concern listed for the D&D target areas (currently Buildings 889 and 779) should be reviewed and included in the analyte list. Beryllium and hazardous constituents need to be analyzed for at the present Performance Monitoring locations.

The limited field screening protocol used to determine the discharge disposition for the Incidental Waters and Internal Waste Stream Authorization to Discharge to the Sewage Treatment Plant is not sufficient for proper disposal decisions. Waste streams considered for disposal to the environment or Sewage Treatment Plant should be analyzed in the laboratory for potential contaminants. The field screening protocol could be used to characterize like waste streams and minimize the laboratory analyses needed for disposal decisions.

Source Location Monitoring must be initiated soon after an Action Level exceedance is detected. The Site's 30-day response time should be eliminated and mitigation procedures and response actions should be evaluated concurrently with the Source Location Monitoring activities. A more rapid laboratory turnaround time for analytical results is needed. All appropriate parties, including the communities, should be

notified immediately when an exceedance is suspected. Rapid notification procedures need to be developed and implemented.

The monitoring currently performed for the Sewage Treatment Collection systems is minimal and requires improvement. A monitoring plan should be developed and implemented to analyze the influent and wastewater at intermediate unit operations to determine treatment efficiencies and locations where untreated pollutants may be accumulating. A response plan to mitigate a contaminant exceedance should be developed and incorporated as soon as possible. Lastly, the effluent from the Sewage Treatment Plant should be monitored for an expanded suite of potential contaminants prior to discharge to ensure the surface water quality is not degraded.

Additional Segment 5 ALF Monitoring stations should be installed at the influent to the detention ponds. Water samples from these locations should be analyzed for radionuclides, metals, volatile and semi-volatile organic compounds, and inorganic compounds.

The Site needs to develop and implement pond management options and alternative procedures to avoid offsite discharge of contaminated detention pond water. Contingent temporary storage or pond re-routing alternatives should be in place. Pond water treatment options also should be available. Additional automated water samplers installed at pond influent locations should be considered. The decision to discharge contaminated pond water should not be at the sole discretion of the Site.

Segment 4 Compliance Monitoring is the last monitoring that is performed before the surface water leaves the Site. The analyte list and monitoring locations for the Segment 4 Compliance Monitoring should be expanded. At least three additional surface water monitoring stations should be installed in the drainages near the groundwater Boundary Well locations in the subdrainages near the East Access Gate and near the southeastern and northeastern corners of the Site. Redundant surface water monitoring at points upstream from the Site boundary in Woman and Walnut Creeks should also be considered. The analyte list for the Segment 4 Compliance Monitoring locations should be expanded to at least match the analyses performed on the Boundary Well groundwater samples.

Additional offsite water sampling is recommended in the canals and waterways that carry waters destined for community water supply sources. The Site should consider extending the McKay Bypass Canal to bypass Walnut Creek.

Implementation and notification procedures for the Uncharacterized Discharge Monitoring Program need to be developed and described. The procedures should include a reporting strategy for timely

notification to the downstream communities of an uncharacterized release, identify potential mitigation procedures, and ensure that a contingency budget is allocated for this program.

The Site should review the procedures for monitoring low flow surface water. The automated samplers should be programmed to trigger sampling for both high and low flow events.

SOIL AND SEDIMENT MONITORING

Currently there is no soil or sediment monitoring program in place at Rocky Flats. The Site discontinued the soil monitoring program in 1994. Presently, soils and sediments are evaluated only during remedial investigations or special focus studies.

A soil and sediment monitoring program is recommended for the Site. Statistically valid random sampling grids should be developed along selected transects to collect representative surface and subsurface soil samples. Routine sediment sampling should be incorporated into the Surface Water Monitoring Program or implemented as a stand-alone program.

A data collection program and modeling investigation should be instituted to determine the magnitude of contaminated sediment transport during flooding periods. Strategies should be developed to control offsite transport of contaminated sediments.

The scope of the Actinide Migration Study currently in progress should be expedited and finalized. The study should include assessments of the mobility of plutonium and other actinides under both anoxic and oxygenated conditions. The Actinide Migration Study findings should be used to plan and strategize remedial activities that minimize contaminant migration and are protective of the environment.

AIR MONITORING PROGRAM

The Air Monitoring Program is diverse and is used to monitor a wide variety of pollutant concentrations. It includes monitoring for radiological, non-radiological, and meteorological parameters at selected locations to provide information about the air quality conditions existing at and near the Site.

The Air Monitoring Program is intended to support both compliance demonstrations and emergency response requirements at Rocky Flats. Air monitoring is performed by the Site contractor, CDPHE, and the communities. Air sampling stations are located onsite, at the Site perimeter, and offsite in the nearby communities. The monitoring systems currently in operation at the Site and the party responsible for the monitoring system are presented in Table III.

TABLE III
AIR MONITORING SYSTEMS

Monitoring System	Responsible Agency/Party
Meteorological Station (2 towers)	Site Contractor
Rocky Flats Monitoring Network (5 stations)	CDPHE—Air Pollution Control Division
Radioactive Ambient Air Monitoring (35 locations)	Site Contractor
Onsite Radiation Monitoring (16 locations)	CDPHE—Radiation Control Group
Community Radiation Monitoring (5 stations)	Communities
Building Effluent Monitoring (22 significant locations, 31 others)	Site Contractor

Findings from the critical analysis of the Air Monitoring Program and recommendations for improvements are briefly summarized as follows.

Meteorological data collection is an important component of the Air Monitoring Program. Although the appropriate meteorological parameters are monitored, several periods of unexplained data gaps were observed in the Quarterly Environmental Monitoring Reports. These data gaps are not acceptable and must be justified and explained when reported.

The air sampling for volatile organic compounds under the Rocky Flats Monitoring Network is of limited use. Because this sampling is performed at the fenceline rather than near the potential contaminant source, the downwind concentrations of these compounds is low due to the natural dispersion by the wind. The fenceline location of the monitoring stations is too distant from a potential volatile organic compound source to detect a release. Monitoring should be performed at the project site close to the potential source during active project work to better detect any release.

The meteorological monitoring at the Rocky Flats Monitoring Network monitoring stations may be unnecessary and redundant. Although the capability of correlating measured pollutants with wind direction is important, one meteorological tower for the entire Site should be adequate to provide the required data. The Site should re-evaluate the value of meteorological monitoring at these locations.

Data collected by the Radioactive Ambient Air Monitoring Program are both required and useful. It provides a means to assess the impacts of Site operations and activities on the surrounding environment.

However, potential impacts cannot be assessed unless the samples that are collected are analyzed. At present, only a percentage of the samples are analyzed. Unanalyzed samples are archived and analyzed only when deemed necessary by Site staff. The data quality objectives and decision rules for this sampling need to be clearly identified, explained, and presented.

The Onsite Radiation Control Monitoring provides an independent assessment of public exposure to radiological contaminant releases at the Site. The air samples collect particulate samples close to the emission source and are analyzed for a full range of radioactive elements. This sampling program is actually an ongoing particulate sizing study to determine if a definitive size range can be identified for radioactive airborne materials. Although this study has been ongoing for several years, study results have not been published. The significant findings to date from this valuable study should be assembled, interpreted, and published as soon as possible.

The Community Radiation Monitoring Program (COMRAD) is valuable and the continuation of this team effort should be encouraged and supported. A Coefficient of Haze (tape sampler) or BETA Attenuation Particulate Monitor should be considered for use at the COMRAD monitoring sites to provide near real-time information to detect a significant release from the Site. These samplers should also be considered for installation at the X-2 and X-3 monitoring sites for the Radioactive Ambient Air Monitoring Program.

The presentation of air monitoring data in the Quarterly Environmental Monitoring Reports needs considerable improvement. Recommended improvements include adding narrative to explain the significance or interpretation of the data presented, using pollutant roses for visual depiction of the data, and the use of graphs and figures to compare measured values to standards or normal background levels.

ECOLOGICAL MONITORING PROGRAM

The primary focus of the Ecological Monitoring Program is to conserve the viable ecosystems, detect problems or undesirable impacts to the buffer zone ecosystems, and protect unique natural resources and special-concern species present at the Site. The program is designed to provide data for management and conservation decisions to support the future cleanup and remediation activities planned for the Site.

The Ecological Monitoring Program currently consists of qualitative estimates of key parameters in five important or sensitive vegetation communities. These parameters include species richness estimates of plants, birds and mammals in the five vegetation communities, identification of noxious and intrusive weed invasions, and monitoring changes in the Preble's Meadow Jumping Mouse populations and habitats. The Site monitors the five vegetation communities, wildlife communities, and protected species.

The critical analysis identified several deficiencies in the Ecological Monitoring Program. A summary of the criticisms and recommendations for improvements is presented below.

The ecology of the entire Site and related adjacent areas should be viewed in a holistic sense, with more studies and data acquisition focused on overlooked areas in order to define the true ecosystem.

The extent of the present data collection efforts are performed in limited areas, and should be expanded to include additional areas upgradient and downgradient from Industrial Area activities.

Ecological monitoring is not well integrated with the monitoring efforts of other environmental media. Because the ecology is potentially impacted by all environmental media, integration with the other monitoring programs is important to ensure that the ecology is sufficiently protected.

An independent conservator should be appointed to oversee and help manage the ecological conservation efforts at the Site.

Additional analyses should be performed to quantify contaminant concentrations in ponds and soils, and determine the contaminant Action Levels for specific pollutants to protect sensitive ecosystems. Also, additional sampling of vegetation and lower forms of animals, both terrestrial and aquatic, should be performed to determine the contaminant concentrations in the organisms and evaluate the potential for contaminant bioaccumulation that may result from increased D&D activities.

The Ecological Monitoring Program is limited to qualitative measurements of species richness and diversity. The lack of statistically-based quantitative data precludes making proper management decisions. The program should be revised to increase the number of monitoring locations to allow sufficient quantification of the ecological data. Ecological monitoring should quantify species viability (offsite compared to onsite) for selected representative species and habitats.

The ecological data should be correlated with data from the other monitored environmental media to predict trends and improve the overall ecological monitoring efforts.

PROJECT-SPECIFIC MONITORING

Project-Specific Monitoring is a subset of the various Sitewide multi-media programs. This monitoring is initiated for all major Site activities that could pose a potential threat to public health and the environment. Project-Specific Monitoring is typically performed during environmental restoration, D&D, remediation, and construction projects. The need for, scope, and type of environmental monitoring to be performed is determined on a case-by-case basis, depending on the nature of the project activity and knowledge of the project site.

Project-Specific Monitoring is not presented as a distinct environmental monitoring program at Rocky Flats, and was not included in the Integrated Monitoring Plan for fiscal year 1997. Instead, various guidance documents and checklists are used to develop the data quality objectives and monitoring specifications for Project-Specific Monitoring.

The various guidance documents are used to assist project managers in the identification, preparation, review, and approval process for developing projects that comply with prevailing regulatory requirements. This process for determining the Project-Specific Monitoring requirements is cumbersome and inefficient. Moreover, some of the guidance documents were developed several years ago and may be out-of-date.

The Site's arbitrary guidance document/checklist approach to decision-making for Project-Specific Monitoring requirements is not acceptable. The inefficiency of this process provides significant opportunity for omissions and errors to occur during the project planning process. These exclusions might be overlooked and may result in unanticipated problems during project activities.

The Site is currently developing a single, all-encompassing guidance document called *The Rocky Flats Cleanup Agreement Implementation Guidance Document*, which will reportedly provide a comprehensive guidance for planning all project activities. This guidance document should be completed as soon as possible, and distributed for peer review and finalization. The guidance document should present a clearly defined process for determining the need for and type of environmental monitoring required for all categories of projects (i.e., remediation, demolition, etc.) performed at the Site. It should also include reporting procedures that are distributed to the public. This report should notify the public when a specific project will be initiated, identify the project objectives, and specify the anticipated project outcome.

The Site should develop a flexible project planning process that includes provisions for monitoring the uncertainties inherent in cleanup and remediation projects. One methodology commonly used is the so-called "observational approach." This methodology incorporates the uncertainties of project site conditions into the project planning process and provides for procedural modifications of the project scope to respond to deviant project site conditions.

The Site should also consider forming a Project-Specific Advisory Board to peer review various stages of the project planning process. The Advisory Board should include environmental media-specialists as well as representatives from the regulatory agencies and the public.

CONCLUSIONS

All of the environmental monitoring programs currently in place at Rocky Flats could use some improvement. The monitoring programs for each discrete media are designed primarily to comply with the regulations. Although the monitoring mostly meets the regulatory requirements, minimal monitoring is performed. This limited focus does not satisfy the public concerns.

The lack of integration across and between the separate monitoring programs for each environmental media is a major deficiency in the overall monitoring program at Rocky Flats. A more comprehensive and inclusive multi-media approach to environmental monitoring is necessary for an effective monitoring program. Improved communication with the public stakeholders is also important. The public is entitled to full disclosure of the monitoring results and Site activities that potentially impact the communities.

Most of the deficiencies identified for the various monitoring programs are easily resolved and should be addressed. An effective, comprehensive environmental monitoring program is vital for detecting and tracking contamination before it becomes widespread, and in the long-term is much less costly than remediation. With a renewed focus beyond regulatory compliance and a commitment to working with the public, a cost-effective environmental management strategy is attainable.