

EVOLUTION OF THE ROCKY FLATS PLANT DETENTION POND MONITORING PROGRAM

Nicholas S. Demos and Edward C. Mast
EG&G Rocky Flats

R. Keith Owenby
Ogden

Michelle R. Rehmann
Woodward-Clyde Consultants

ABSTRACT

The Rocky Flats Plant (RFP) conducts an extensive surface water monitoring program to meet the requirements of a complex series of laws, agreements, orders, and technical objectives. The program has evolved over the past two years in response to regulatory requirements and agreements between the Department of Energy (DOE), the State of Colorado, and the U.S. Environmental Protection Agency (EPA). Monitoring and control programs that have involved all affected parties in the decision-making process have been undertaken. This paper provides a brief history of the evolution of the surface water control and monitoring program, and presents considerations for future changes and improvements.

INTRODUCTION

When constructed on the high plains northwest of Denver in 1952, the Rocky Flats Plant (RFP) was considered advanced in every aspect, including water management. Water systems for the RFP were entirely self-contained and comprehensive, including treatment plants to provide potable water and handle sanitary waste. Despite the lack of federal, state, or local water regulations in the 1950's, waste water released to downstream bodies of water, Standley Lake and Great Western Reservoir, was monitored and controlled by the plant through a series of detention ponds (Fig. 1). The practice of discharging treated process waste water was discontinued in 1973.

Because of public perception about risks from effluents, strict water quality standards have been applied to the water in the ponds to protect the water supply reservoirs.

RFP surface water is supplied by base flow from streams and ditches, treated sanitary sewage treatment plant (STP) effluents, stormwater runoff, and seeps. Surface water at the RFP is managed primarily through the A, B, and C series detention ponds. EG&G RFP has designed a sampling program to meet state, EPA and DOE concerns and to provide a background of information on water quality.

Seven point source discharge locations are permitted for RFP surface water release under the current National Pollutant Discharge Elimination System (NPDES) permit for the plant. Three of the locations allow for discharge of water off site; however, only two locations are currently being utilized for off-site discharge. Other sampling and analysis requirements are imposed by a Federal Facilities Compliance Agreement (FFCA) which modified the NPDES permit, the Agreement in Principle (AIP) between DOE and the State of Colorado, and DOE Orders. The site wide surface water and sediment sampling program promulgated by DOE Order 5400.1 has evolved continuously and significantly since its inception. The sampling and analysis program requires constant revisions to meet changing regulatory requirements, treatment and water management activities, and characterization needs.

Activities scheduled for 1992 include continued monitoring and streamlining of the program based on analytical results and implementing innovative monitoring and

characterization methodologies associated with remedial investigations.

HISTORICAL BACKGROUND

Despite the absence of applicable water regulations in the 1950's, releases of Rocky Flats Plant (RFP) treated process waste water were monitored and controlled. Three series of detention ponds were constructed along primary drainages to capture and control runoff and plant generated waste water prior to release. In December, 1973 a decision was made to halt the off-site discharge of treated, low-level process waste water. At that time treated process water and laundry waste water were impounded in the A- and B-series detention ponds and controlled by spray evaporation. Since 1974, water discharged off site has consisted of treated sanitary waste water and runoff. Further upgrades have been made in surface water management, including enhancement of plant water reuse programs to include recycling of treated process waste water (1).

In more recent years, Standley Lake and Great Western Reservoir have become sources of drinking water for area residents, and strict water quality standards have been applied to the waters discharged from RFP. The A- and B-series of detention ponds along North and South Walnut Creeks respectively, and the C-series along Woman Creek (Fig. 2), were constructed on the RFP property to capture and control runoff and plant generated waste. Today, the ponds serve as NPDES discharge points and provide storm-water runoff collection. When ponds are maintained in a near-full condition, minimal spill containment and runoff capacities are available; therefore, timely release of water is required to comply with the NPDES discharge permit and to ensure dam safety (2).

REGULATORY REQUIREMENTS

The RFP surface water monitoring program is required for regulatory compliance and fulfillment of DOE orders. These requirements include the Clean Water Act (CWA), National Pollutant Discharge Elimination System (NPDES), DOE Order 5400.1 "General Environmental Protection Program," and DOE Order 5400.5 "Radiation Protection of the Public and the Environment." The primary regulations and

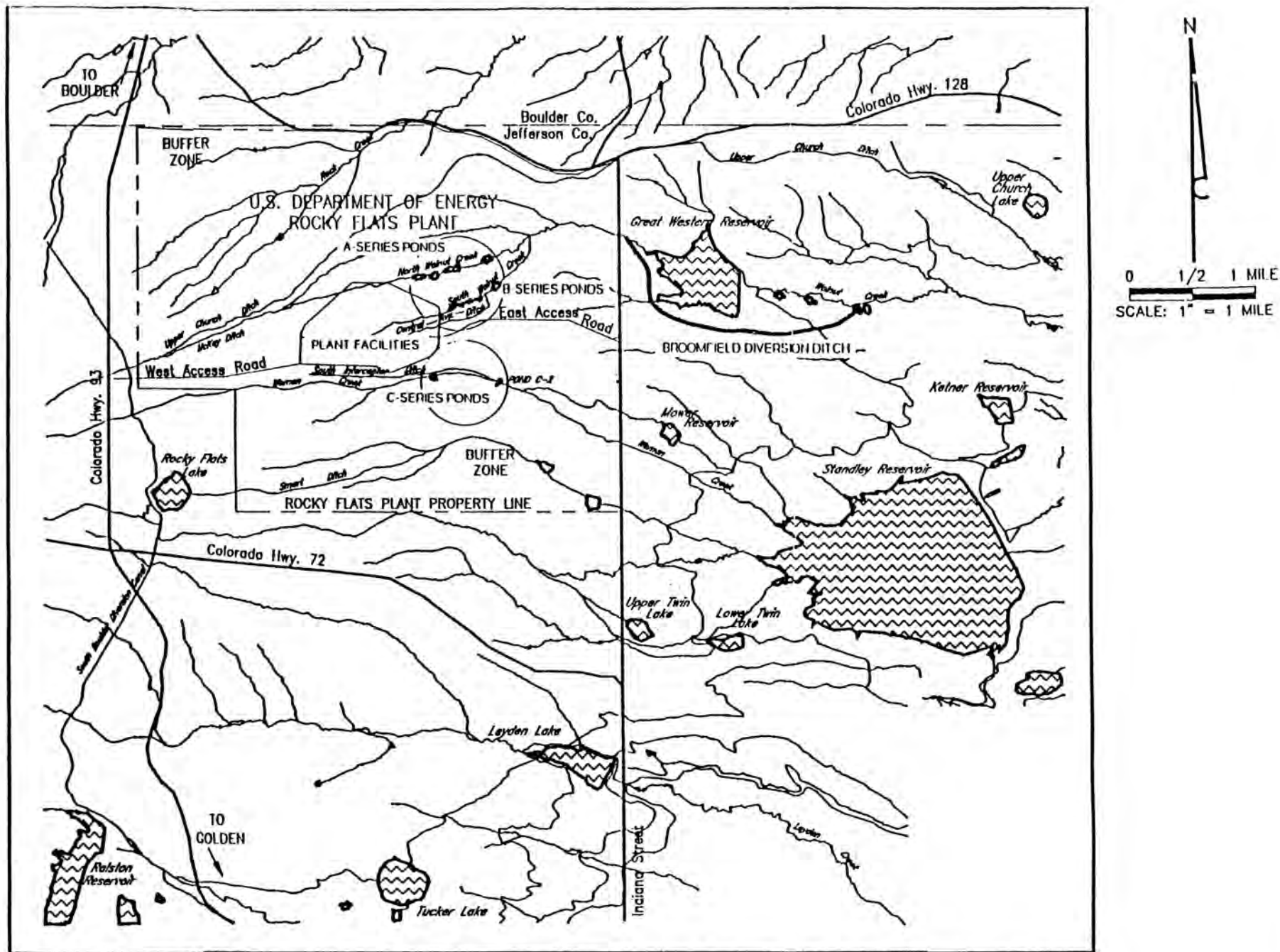


Fig. 1. Surface water drainage map illustrating the relationship between Rocky Flats Plant runoff water and neighboring downstream reservoirs and creeks.

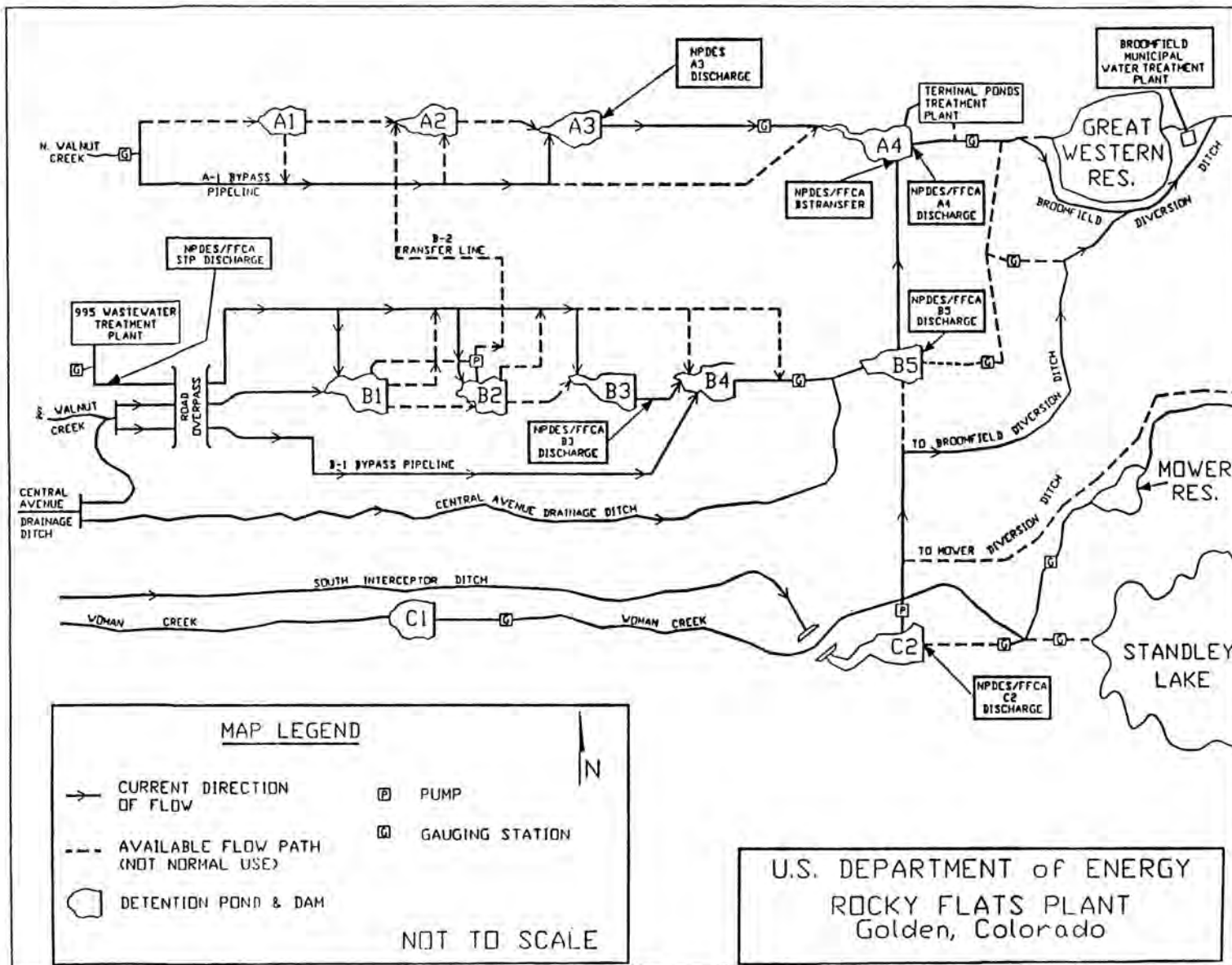


Fig. 2. Schematic flow and transfer network of the detention ponds at the Rocky Flats Plant.

agreements impacting the surface water program are summarized below.

Clean Water Act

Colorado surface water regulations, including the classification of waters and establishment of standards, are enacted by the Colorado Water Quality Control Commission (WQCC) and administered by the Colorado Department of Health (CDH). The entire State regulatory program is subject to review and approval by the EPA.

A Federal Facilities Compliance Agreement (FFCA) between the EPA and DOE has included requirements for the existing NPDES permit. An August 1989 Agreement in Principle (AIP) between DOE and the State of Colorado has added further water quality sampling requirements. The AIP is the vehicle utilized to enforce the WQCC standards for the site surface water drainage systems, including the terminal pond discharges.

A February 1990 Colorado WQCC ruling greatly lengthened the list of substances targeted for regulation. WQCC standards submitted to the EPA in October 1991 (1) were intended to resolve all issues between the State of Colorado and EPA related to EPA CWA Section 303(c)(2)(B) compliance(4); however, EPA has not approved the standards, or written a new NPDES permit reflecting these standards. The RFP NPDES permit issued in December 1984, expired in June 1989, but has been extended by EPA. The permit authorizes discharge from seven locations; two of these locations are no longer operational. The remaining locations are ponds in the Walnut Creek drainage (Ponds A-3, A-4, B-3, and B-5), and in the Woman Creek drainage (Pond C-2)(Fig. 2). The FFCA specifies the STP effluent as an additional permitted discharge location. Monitoring requirements, including frequencies and parameters, for the compliance program are specified in the NPDES permit and the FFCA(5). Terminal Ponds A-4, B-5, and C-2 are closely monitored for compliance with the NPDES/FFCA and the AIP. Under the AIP, DOE is responsible for ensuring that replicate split samples are taken with CDH and municipalities prior to and during discharge. CDH has the responsibility of assuring that the water quality of discharges does not affect the safety of downstream water users.

DOE Orders

DOE Order 5400.1 "General Environmental Protection Program" requires that DOE facilities comply with state and federal environmental regulations and that the surface water monitoring network characterize physical and chemical properties of the water column and benthos. These additional DOE monitoring requirements recognize that compliance monitoring, while dealing with the current issues and concerns, typically does not anticipate future needs, and therefore, is not necessarily sufficient. The water discharged from the terminal ponds is characterized for specific radioisotopes in conformance with this order and DOE Order 5400.5, "Radiation Protection of the Public and the Environment." Much of the previous RFP site-wide ambient surface water and sediment sampling program was conducted to comply with these and related DOE orders (5).

EVOLUTION OF THE MONITORING AND CONTROL PROGRAM

Prior to 1989, the A-4, B-5, and C-2 terminal ponds discharged water off-site into Standley Lake and Great Western Reservoir. Great Western Reservoir is the water supply for the City of Broomfield. In 1989, the City of Broomfield installed a diversion ditch so that Walnut Creek drainage could be diverted south around Great Western into the drainage below the reservoir outlet (Fig. 2). Woman Creek flow can be diverted to either Mower Reservoir or Standley Lake. Mower Reservoir supplies irrigation storage and Standley Lake is the municipal water supply for the City of Westminster. All flow from Woman Creek is currently being diverted to Mower Reservoir. Current bypass and diversion activities are being coordinated with the State of Colorado and local communities to allow involvement of all affected parties in the decision-making process and promote better communication among all interested parties.

In February 1990, the Colorado WQCC set standards for Walnut and Woman Creeks and tributaries within the South Platte River Drainage. These standards greatly lengthened the list of substances targeted for regulation. As a result of Colorado WQCC actions, EG&G RFP initiated an extensive sampling and analysis program. The program included both weekly and monthly sampling and field parameter measurements at each terminal pond. Offshore samples were collected weekly as a depth composite from a single location at the deepest point in the pond and analyzed for all the parameters listed in Table I. Routine weekly split samples are collected with CDH and municipalities and during NPDES discharge events, effluent samples are collected daily.

In March 1990, RFP initiated treatment of surface water prior to discharge at pond A-4 in response to the new Colorado WQCC standards. The treatment system consisted of filtration followed by granular activated carbon (GAC) treatment and was designed to remove organics and radionuclides present in the terminal pond discharges.

An extensive review of validated 1990 analytical data collected from the terminal ponds (A-4, B-5, C-2), was conducted in 1991. The data show that most compounds of concern are below EPA CLP method detection limits, and Colorado WQCC standards for the RFP. Based on these data a number of changes to the terminal pond sampling program have been implemented. DOE requested from the State of Colorado that GAC treatment be bypassed, unless analytical results warrant treatment. This request was granted in October 1991, marking a major milestone in communication and cooperation between the State and DOE. At present, pond A-4 receives transferred water from ponds B-5 and A-3 until an approximate 50 percent capacity has been reached. Pond A-4 is then isolated and undergoes thorough pre-discharge sampling, including split samples taken with the State. As a final step, DOE submits the analytical sampling data to CDH for concurrence with recommendation to discharge with or without treatment. After obtaining concurrence from the State and approval from DOE, EG&G initiates discharge. A schematic for the current flow and water transfer network for the RFP detention ponds is shown in Fig. 2.

The current monitoring program reflects extensive changes based upon a review of the 1990 data. A number of parameters have been eliminated and pond sampling

TABLE I

Field and Analytical Parameters

ANALYTES	RADIOCHEMISTRY
- VOA-CLP	** Total and Filtered:
* VOA 502.2	- Gross Alpha and if Gross Alpha is high then Ra 226, 228
* Semi-Volatile-CLP	- Gross Beta
- CLP Metals Dissolved + Cs, Li, Sr, Sn, Mo, Si	- Pu 239/240
* CLP Metals Total + Cs, Li, Er, En, Mo, Si	- Am 241
- Chrome VI	- U 233/234/235/238
- Total Suspended Solids (TSS)	- Sr 89/90
- Total Dissolved Solids (TDS)	- Cs 137
- Chlorine	- Cm 244
- Fluorine	- Np 237
- Sulfate (SO ₄)	- Th 230/232
- Carbonate (CO ₃)	- Tritium
- Bicarbonate (HCO ₃)	
- Orthophosphate	
- Nitrate (NO ₃)	
- Nitrate/Nitrite as N	
- Ammonia	
* Total Phosphorous	
* Sulfide as H ₂ S	
* Dioxin	
* Pesticides/PCBs	
- Triazine Herbicides	
* Polynuclear Aromatic Hydrocarbons (PAH)	
* Chlorinated Herbicides	
* Oil and Grease	
- Total Organic Carbon (TOC)	
- Dissolved Organic Carbon (DOC)	

*Samples for these analytes were previously collected on a monthly basis and have been discontinued.

**For the radiochemistry, total radiochemistry was collected monthly and filtered weekly. The collection of total radiochemistry has been discontinued and filtered radiochemistry is now collected on a monthly schedule. Filtered radiochemistry represents samples which have been filtered through a 0.45 micron filter.

frequencies have changed from weekly to monthly. Table I contains a full list of parameters previously analyzed and indicates those that have been eliminated under the current program. Today pond sampling is comprised of a two-part sampling and analysis approach consisting of pre-discharge and discharge water quality and ambient water quality in the terminal ponds. Depth composite samples are collected monthly from the ponds. Samples are composed of equal aliquots of water from the following depths: 0.5 meters below the water surface, midpoint, and 0.5 meters above the bottom. Field parameters are measured in situ at each sample depth using a Hydrolab[®] Scout, coupled with a Compaq 286 laptop computer. The Hydrolab[®] is used for pond profiling and collecting depth-specific parameters in conjunction with water-quality sample collection. If stratification is identified, discrete samples are collected from the stratified intervals. In this way dimensional characteristics of pond water may be evaluated to determine the vertical or areal heterogeneity or seasonal variations of the water in the pond. Downstream of the ponds, surface water quality is monitored to determine if

lower reaches of the creeks affect water quality. Also, up-stream stations are included in the sampling effort to establish a baseline water quality.

Table II lists the minimum, maximum, mean, and upper and lower bounds for the 95 percent confidence limits for selected compounds of interest from the A-4, B-5, and C-2 terminal ponds. Confidence limits are based on the student's "t" distribution. Field parameter results are presented for the period from November 11, 1990 to November 10, 1991. Analytical data are presented for the period from August 1, 1990 to July 31, 1991, the most recent 12 month period for which analytical data were available. For many of the compounds, particularly the organics, most results were below the limits of detection (Contract Required Quantitation Limit or Preferred Quantitation Limit). Less than detected values were considered to be present at one half the limit of detection for calculation purposes.

There have been relatively few changes to the NPDES/FFCA monitoring program over the last year, except those changes mandated by the FFCA. The frequency of

TABLE II

Confidence Limits for Selected Compounds

POND LOC	COMPOUND	UNITS	NO. ANALYSES	NO. DETECTS ^a	REPT. LIMIT ^b	MIN ^c	MAX ^c	MEAN ^d	95% CI BOUNDS ^d	
									UPPER	LOWER
Radionuclides ^e										
A-4	Am-241	pCi/L	5	4	NA ^f	-.006	.014	.005	.030	.020
B-5	Am-241	pCi/L	6	5	NA	-.013	.0070	.000	.014	-.014
C-2	Am-241	pCi/L	5	4	NA	-.001	.08	.022	.085	-.041
A-4	Pu-239/240	pCi/L	5	5	NA	.003	.013	.008	.014	.002
B-5	Pu-239/240	pCi/L	6	6	NA	.001	.015	.005	.010	.0005
C-2	Pu-239/240	pCi/L	5	5	NA	.000	.006	.002	.041	-.037
Organics										
A-4	Atrazine	μg/L	29	29	.15	.18	1.60	.50	.61	.38
B-5	Atrazine	μg/L	28	25	.15	.15U	1.10	.48	.59	.37
C-2	Atrazine	μg/L	25	19	.15	.15U	1.00	.26	.35	.17
A-4	Simazine	μg/L	29	1	.18	.18U	.26	.10	.11	.08
B-5	Simazine	μg/L	28	4	.18	.18U	.25	.11	.13	.09
C-2	Simazine	μg/L	25	2	.18	.10U	.18	.09	.10	.09
A-4	Methylene Chl.	μg/L	30	1	5	2.0U	5.0	2.25	2.40	2.10
B-5	Methylene Chl.	μg/L	26	2	5	2.1U	5.0	2.43	2.69	2.16
C-2	Methylene Chl.	μg/L	29	3	5	1.0U	5.0	2.20	2.37	2.03
Metals and Anions										
A-4	Beryllium	μg/L	35	1	5	1.0U	2.0U	.61	.69	.53
B-5	Beryllium	μg/L	32	1	5	1.0U	2.3	.63	.77	.51
C-2	Beryllium	μg/L	32	0	5	1.0U	2.0U	.56	.63	.50
A-4	Chromium	μg/L	35	4	10	2.0U	10.0	3.1	3.8	2.4
B-5	Chromium	μg/L	32	3	10	2.0U	10.0	2.9	3.4	2.3
C-2	Chromium	μg/L	32	2	10	2.0U	10.0	2.7	3.2	2.2
A-4	Chromium VI	μg/L	19	0	.01	.008U	.02U	.005	.006	.004
B-5	Chromium VI	μg/L	17	0	.01	.008U	.02U	.004	.005	.003
C-2	Chromium VI	μg/L	14	0	.01	.008U	.02U	.005	.006	.004
A-4	Mercury	μg/L	34	2	.2	.2U	.60	.12	.15	.09
B-5	Mercury	μg/L	31	1	.2	.2U	.23	.10	.11	.10
C-2	Mercury	μg/L	31	3	.2	.17U	.60	.12	.16	.09
A-4	NO ₃ /NO ₂	μg/L	28	27	.1	.1U	5.0	2.6	3.0	2.1
B-5	NO ₃ /NO ₂	μg/L	27	27	.1	.17U	4.5	3.1	3.4	2.8
C-2	NO ₃ /NO ₂	μg/L	24	7	.1	.02	1.0	.11	.19	.02

TABLE II

(Cont.)

POND LOC	COMPOUND	UNITS	NO. ANALYSES	NO. DETECTS ^a	REPT. LIMIT ^b	MIN ^c	MAX ^c	MEAN ^d	95% CI BOUNDS ^e	
									UPPER	LOWER
Field Parameters										
A-4	pH	std	47	47		6.88	9.18	8.40	8.54	8.26
B-5	pH	std	43	43		7.61	9.54	8.52	8.65	8.39
C-2	pH	std	44	44		7.61	8.54	8.19	8.26	8.12
A-4	Sp. Cond.	μ mhos/cm	46	46		321	690	497	525	469
B-5	Sp. Cond.	μ mhos/cm	42	42		303	690	520	549	491
C-2	Sp. Cond.	μ mhos/cm	41	41		429	733	546	570	522
A-4	Alkalinity	μ g/L	47	47		70	153	112	118	106
B-5	Alkalinity	μ g/L	42	42		76	144	109	113	104
C-2	Alkalinity	μ g/L	44	44		145	222	176	182	170

^a All values greater than zero are reported as detected values.

^b Reporting Limit.

^c A "U" following the value indicates the compound was not detected and the detection limit is the result listed. The maximum value listed is the maximum detected value.

^d For statistical calculations undetected values are assumed to be present at one-half the nondetected value.

^e All radionuclide results are for total radionuclide activities.

^f Not applicable

sampling and analytes collected is dependent on the NPDES sampling point and whether or not discharge is occurring (3). Only two of the six active NPDES points currently discharge waters off of the RFP. These are the A-4 Pond discharge and C-2 Pond discharge. All other NPDES discharge points ultimately flow into the A-4 Pond. Both C-2 and A-4 ponds are sampled weekly for the six weeks prior to discharge, then again during discharge. Pond C-2 discharges once or twice a year and A-4 nine to twelve times a year. The monitoring frequency at the remaining NPDES sampling sites continues to be daily, weekly, monthly or quarterly and is dependent on the analyte and the location (4).

Future surface water and sediment sampling programs include support to RCRA and CERCLA remedial investigations (RI), interim remedial actions, and corrective measure study activities. The Interagency Agreement (IAG) between DOE, EPA and the State of Colorado identifies sixteen OUs containing 178 Individual Hazardous Substance Sites (IHSS) at the RFP. The Walnut Creek Drainage, OU6, contains 21 IHSSs along or within the Walnut Creek Drainage system (6). The Woman Creek Drainage, OU5, contains 10 IHSSs along or within the Woman Creek Drainage system (7). These area sources must be evaluated to determine the extent to which they are contributing contaminants to the ponds. Field sampling plans (FSP) developed for compliance with the IAG will require characterization of the surface water and sediments in the Walnut Creek and Woman Creek drainages, including the terminal ponds.

An intensive pond sediment characterization program will be implemented in the summer of 1992. This characterization program will utilize an EPA-recommended stratified

random sampling design to identify sample collection points in order to fully characterize the sediments in the pond. It is anticipated that stratified random sampling will look at both the vertical and horizontal extent of contamination in the sediments.

SUMMARY

The RFP pond water monitoring programs have been evolving since the construction of the DOE facility in 1952. Extensive water monitoring programs have been developed over the years through guidelines and regulations enacted by the Colorado WQCC, administered by the State of Colorado and subject to review by the EPA. The FFCA augments the existing NPDES permit as does the AIP between the State of Colorado and DOE.

EG&G RFP has designed sampling programs to satisfy federal, state and local requirements as well as provide background information on water quality. RFP surface water is managed through the A-, B- and C-series detention ponds constructed in the drainages of Women and Walnut creeks. The data collected to date show that the levels of contaminants being discharged from the terminal detention ponds are, in most cases, below EPA-CLP method detection limits and WQCC, RFP standards. However, because of the concerns about some of the compounds and materials utilized on the RFP site, such as plutonium and americium, public concern remains high. Control measures have been implemented to divert RFP drainages around the local drinking water supplies.

RFP's two-part sampling and analysis program is subject to constant upgrades and revisions in response to evolving

data quality objectives and regulatory requirements. Changes to the monitoring program are a result of evaluating the data gathered over the past two years in an effort to streamline the program while optimizing the use of the data for multiple objectives. The current program will take the following course in 1992:

- EG&G will continue to monitor the terminal ponds for WQCC parameters
- EG&G will expand or reduce the program, based on data analysis, budgetary considerations, and federal and state mandates
- Technical improvements in monitoring and characterizing the pond water and sediments will be incorporated into the program, where possible

ACKNOWLEDGEMENTS

The authors wish to express their gratitude for assistance in compiling the information presented in this paper to their colleagues in the Surface Water Division (SWD) at EG&G, Rocky Flats Plant.

REFERENCES

1. EG&G ROCKY FLATS, INC. "Draft Rocky Flats Surface Water Management Plan," Volume I, March 1991.
2. M.R. REHMANN, G. LITUS, P. FOLGER, and J. DICK, "Sampling of Detention Ponds in Support of the Environmental Restoration Program at Rocky Flats," Proceedings of the Symposium on Waste Management at Tucson, Arizona, February 24-28 1991, Volume II, Arizona Board of Regents, 1991.
3. FEDERAL REGISTER, Volume 56, No. 223, Tuesday, November 19, 1991, pages 58420-58478.
4. EG&G ROCKY FLATS, INC. "Catalogue of Monitoring Activities," November 1991.
5. U.S. DEPARTMENT OF ENERGY, ROCKY FLATS PLANT, "Control of Radionuclide Levels in Water Discharges from the Rocky Flats Plant," Environmental Management Program, September 1991.
6. U.S. DEPARTMENT OF ENERGY, ROCKY FLATS PLANT, "Phase I RFI/RI Work Plan, Rocky Flats Plant, Walnut Creek Priority Drainage (Operable Unit 6)," Volume I, September 1991.
7. U.S. DEPARTMENT OF ENERGY, ROCKY FLATS PLANT, "Phase I RFI/RI Work Plan, Rocky Flats Plant, Woman Creek Priority Drainage (Operable Unit No.5)," Volume I, August 1991.