

## PROGRESSING FROM SURFACE WATER DETENTION TO ENVIRONMENTAL RESTORATION IN OPERABLE UNITS 5 AND 6 AT ROCKY FLATS PLANT

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### ABSTRACT

Three series of detention ponds were constructed within drainages at the Rocky Flats Plant (RFP) in the 1950's to allow for flood control and containment of plant generated, treated process waste water prior to discharge. Discharge of process waste water was a practice discontinued in 1973. The potential for water quality degradation due to surface water releases has resulted in a complex network of regulations, agreements, and procedures for water quality monitoring, treatment, and management at RFP. At present, these drainages have been identified as Operable Units (OUs) warranting remedial investigations and possible remedial actions. Water diversions and treatment systems have mitigated potential impacts on downstream water supply reservoirs while, in addition to these interim measures, environmental restoration (ER) activities have begun.

### INTRODUCTION

The detention ponds at Rocky Flats Plant (RFP) were originally constructed along Walnut and Woman Creeks to capture runoff and provide storage for plant generated, treated process 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. The treated process water and laundry waste water were subsequently impounded in the A- and B- series detention ponds and controlled by spray evaporation. At that time, waste water contained cooling tower blowdown, chrome and algicide from steam condensate, and treated process waste water from production buildings. From 1974 to 1983, water discharged off site consisted only of treated sanitary waste water and runoff. After 1983, significant upgrades were made in surface water management including the plant water reuse program to recycle treated process waste water for cooling water (1). The RFP has not discharged process waste water downstream since 1973.

At the time of construction, control measures and monitoring systems were considered advanced; however, the pond drainages in their natural state flow into Standley Lake and Great Western Reservoir, which provide irrigation storage and are drinking water sources for area residents (2). For this reason, water quality standards have become progressively more restrictive in response to public concerns. Today, the ponds are utilized for spill control, runoff capture, temporary storage, and as National Pollutant Discharge Elimination System (NPDES) discharge points.

The A- and B-series detention ponds are located in North and South Walnut Creek, and the C- series ponds in Woman Creek on the south side of the plant (Fig. 1). In addition to documented contaminant sources referred to as Individual Hazardous Substance Sites (IHSS), other contaminant sources or events may have impacted the ponds. These sources include wind dispersed soils containing low levels of radionuclides, debris from past fires in production buildings, and runoff from plant production facilities. Presently, 178

IHSS areas have been identified and consolidated into 16 OUs. The Woman Creek Drainage, OU5, contains ten IHSS including detention ponds C-1 and C-2. The North and South Walnut Creek drainage, OU6, contains twenty-one IHSSs, including the nine A- and B-series detention ponds. Runoff from these and other IHSSs are potential sources of pond water and sediment contamination. Figure 1 shows the aerial relationship between the detention ponds, drainages, and nearby IHSSs.

Until remedial investigations can be completed and restoration activities performed as needed, a comprehensive monitoring program to evaluate the nature and extent of contamination and ensure compliance with applicable laws and regulations will continue.

### REGULATORY REQUIREMENTS

Because two major water supplies, Great Western Reservoir and Standley Lake, are directly downstream of RFP, the quality of surface water flowing from RFP has been a cause of great concern to the public, the Department of Energy (DOE), EG&G, and federal and state regulatory agencies. This concern has resulted in a complex network of regulations, agreements, and procedures for water quality monitoring and management at RFP. The following is a summary of these requirements.

#### National Pollutant Discharge Elimination System (NPDES) Permit/Federal Facilities Compliance Agreement (FFCA)

Surface water discharges at RFP are administered under the NPDES permit. Since the RFP is a federal facility, its permit is written by the U.S. Environmental Protection Agency (EPA). The Colorado Water Quality Control Commission (WQCC) has the responsibility to certify the EPA-NPDES permits under section 401 of the Clean Water Act (CWA). In March 1991, the FFCA, an agreement between the EPA and DOE was signed, which amended a portion of the current NPDES permit.

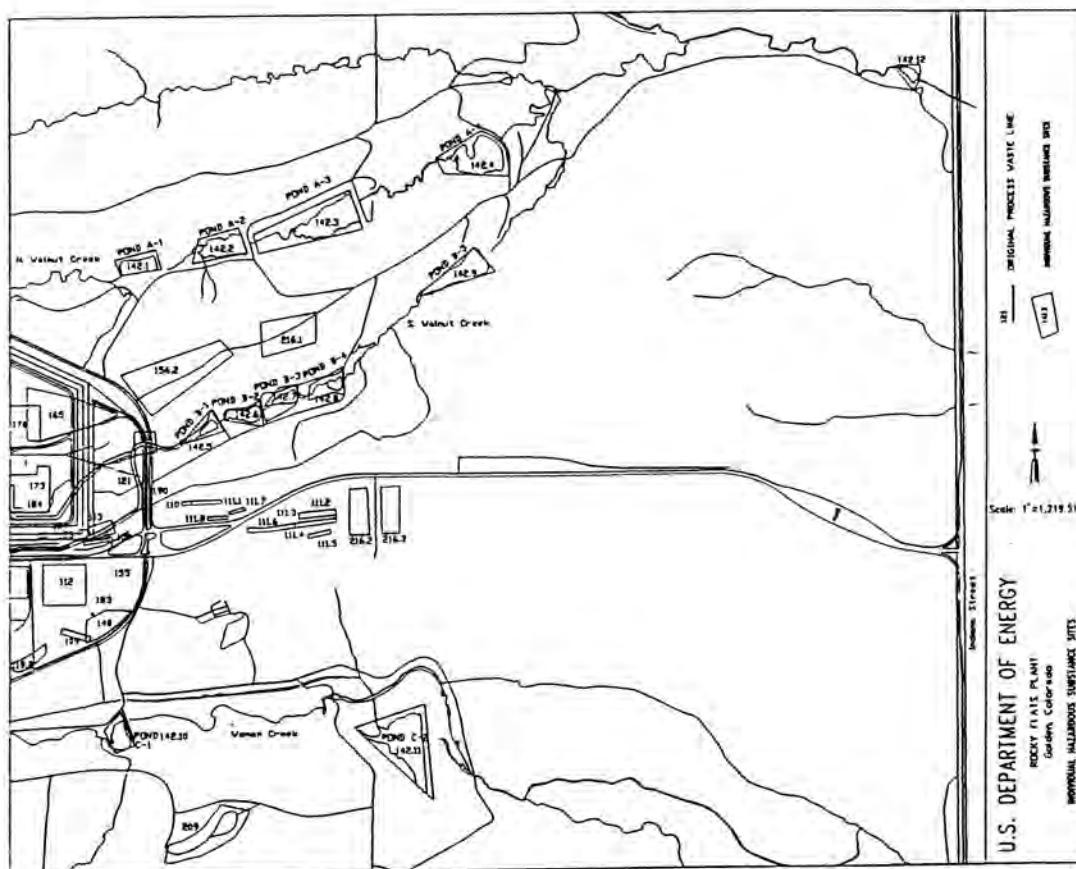


Fig. 1. Map showing aerial relationship between detention ponds, drainages and nearby IHSSs.

#### **Agreement in Principle (AIP)**

In August 1989, the AIP was signed between the DOE and the Colorado Department of Health (CDH). The AIP describes the role of each agency for sampling and analysis of surface waters at RFP and is the mechanism for enforcement of the WQCC standards for terminal pond discharges. DOE has the responsibility to ensure that replicate split samples are taken with CDH and/or 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.

During the spring of 1990, water levels in the ponds began to approach design limits. With immediate discharge required, the responsibilities of DOE and CDH, as described in the AIP, evolved into a working relationship to ensure protection of downstream water quality. DOE, in conjunction with CDH, collected samples from ambient pond water and recycled treated effluent. DOE requested concurrence on the water quality and permission to discharge from CDH. Concurrence on the decision to discharge was granted by CDH, and this began the program which continues to date, involving at various times sampling, treatment, and water diversions.

#### **The Interagency Agreement (IAG) and Remedial Investigations (RI)**

Preparation of RCRA Facility Investigation (RFI)/Remedial Investigation (RI) Work Plans is a requirement of the Interagency Agreement (IAG) between the DOE, EPA, and the State of Colorado. These draft Work Plans have been completed for the Woman Creek (OU5) Priority Drainage which contains the C-series ponds and the Walnut Creek (OU6) Priority Drainage which contains the A- and B-series ponds. The RFI/RI schedules include Field Sampling Plans (FSP) which document the investigations planned to evaluate the presence or absence of contamination at IHSSs in the priority drainages.

#### **SURFACE WATER MANAGEMENT**

A Surface Water Management Plan (SWMP), providing a course of action for present and future surface water management and treatment at RFP was developed in 1991 (1). The Plan provides an extensive summary of all aspects of surface water management. A comprehensive monitoring program to evaluate the nature and extent of contamination and ensure compliance with applicable laws and regulations will continue.

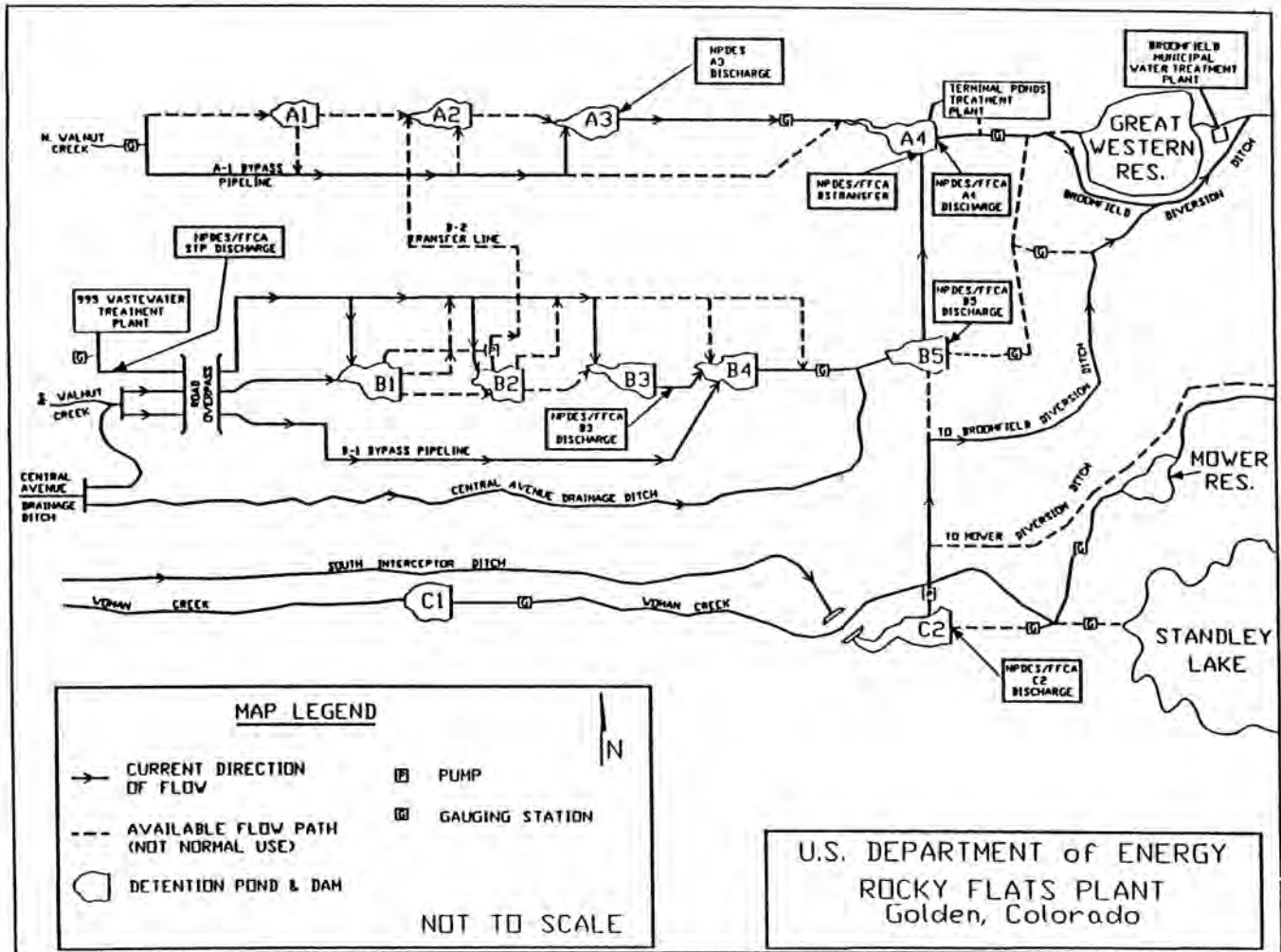


Fig. 2. Schematic flow and transfer network of the detention ponds at the Rocky Flats Plant.

### Monitoring

A two-part pond sampling program consists of analysis of (1) NPDES/FFCA-permitted pre-discharge and discharge water quality, and (2) ambient water quality in the terminal ponds. The program began in August 1990 in response to agreements between DOE, the State, and the EPA.

The monitoring required by the NPDES/FFCA permit consists of sampling discharge points (Fig. 2) on a daily, weekly, monthly and quarterly basis. The frequency and type of analytes collected vary by location. There have been relatively few changes to the NPDES/FFCA monitoring program over the past year, except those mandated by the FFCA.

The current ambient monitoring program reflects extensive changes based upon a review of data generated. A number of parameters have been eliminated and pond sampling frequencies have changed from weekly to monthly. Table I contains a list of parameters previously analyzed and indicates those that have been eliminated (3). Offshore depth composited samples are collected at three levels and field parameters are recorded in situ using a Hydrolab<sup>®</sup> Scout coupled with a 286 laptop computer. The Hydrolab<sup>®</sup> is used for pond pro-

fileing to determine dimensional stratification characteristics. If stratification is identified, discrete samples are collected from the stratified intervals. In this way vertical and horizontal heterogeneity as well as seasonal variations of the pond water can be identified.

### Surface Water Mitigation Measures

Mitigative measures to prevent the RFP runoff from reaching downstream surface waters have included stream diversions (Fig. 2) and water treatment.

#### Stream Diversion

Prior to 1989, North and South Walnut Creek flowed as Walnut Creek to Great Western Reservoir, the water supply for the City of Broomfield. In 1989, the City of Broomfield constructed a diversion ditch so that Walnut Creek flow is now diverted south around Great Western Reservoir into the drainage below the reservoir outlet.

Woman Creek flow can be diverted either to Mower Reservoir or Standley Lake. Mower Reservoir supplies irrigation storage and Standley Lake is the municipal water supply for the City of Westminster. Presently, only buffer zone

TABLE I

## Field and Analytical Parameters

ANALYTES	RADIOCHEMISTRY
<ul style="list-style-type: none"> <li>- VOA-CLP</li> <li>* VOA 502.2</li> <li>* Semi-Volatile-CLP</li> <li>- CLP Metals Dissolved + Cs, Li, Sr, Sn, Mo, Si</li> <li>* CLP Metals Total + Cs, Li, Er, En, Mo, Si</li> <li>- Chrome VI</li> <li>- Total Suspended Solids (TSS)</li> <li>- Total Dissolved Solids (TDS)</li> <li>- Chlorine</li> <li>- Fluorine</li> <li>- Sulfate (SO<sub>4</sub>)</li> <li>- Carbonate (CO<sub>3</sub>)</li> <li>- Bicarbonate (HCO<sub>3</sub>)</li> <li>- Orthophosphate</li> <li>- Nitrate (NO<sub>2</sub>)</li> <li>- Nitrate/Nitrite as N</li> <li>- Ammonia</li> <li>* Total Phosphorous</li> <li>* Sulfide as H<sub>2</sub>S</li> <li>* Dioxin</li> <li>* Pesticides/PCBs</li> <li>- Triazine Herbicides</li> <li>* Polynuclear Aromatic Hydrocarbons (PAH)</li> <li>* Chlorinated Herbicides</li> <li>* Oil and Grease</li> <li>- Total Organic Carbon (TOC)</li> <li>- Dissolved Organic Carbon (DOC)</li> </ul>	<p data-bbox="842 312 1086 343"><b>** Total and Filtered:</b></p> <ul style="list-style-type: none"> <li>- Gross Alpha and if Gross Alpha is high then Ra 226, 228</li> <li>- Gross Beta</li> <li>- Pu 239/240</li> <li>- Am 241</li> <li>- U 233/234/235/238</li> <li>- Sr 89/90</li> <li>- Cs 137</li> <li>- Cm 244</li> <li>- Np 237</li> <li>- Th 230/232</li> <li>- Tritium</li> </ul> <p data-bbox="815 741 1098 772"><b>FIELD PARAMETERS</b></p> <ul style="list-style-type: none"> <li>- Dissolved Oxygen (mg/l)</li> <li>- pH</li> <li>- Chlorine (mg/l)</li> <li>- Alkalinity (mg/l)</li> <li>- Temperature (water and air) °C</li> <li>- Specific Conductance (us/cm)</li> </ul>
<p data-bbox="108 1168 1278 1199">* Samples for these analytes were previously collected on a monthly basis and have been discontinued.</p> <p data-bbox="108 1199 1430 1286">**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.</p>	

(the area surrounding the main plant facilities) surface runoff and natural groundwater seepage flow into the Woman Creek drainage.

The South Interceptor Ditch (SID) collects water from the 881 Hillside area and empties into C-2 pond which is then transferred to B-5 pond or discharged into the Broomfield Diversion Ditch (Fig 2).

#### Water Treatment

In March of 1990, RFP started treating collected surface water prior to downstream release in an attempt to meet proposed 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. New standards were included for plutonium (Pu), uranium (U), americium (Am), gross alpha, gross beta, and other radionuclides that have subsequently been incorporated into the IAG. To meet the new radiochemical standards, RFP assessed available data for contaminants of concern and evaluated treatment technologies potentially applicable for removal of radiochemical contaminants from pond water. Although some of this

research suggested that the primary radionuclides of concern (Pu and Am) were likely associated with suspended particulate or colloidal material (organics, silicates) in the ponds, further tests showed that radionuclide concentrations were already at or below the limits of detection and therefore may not be significantly reduced by treatment utilizing filtration to remove suspended solids (particulate matter greater than 0.45 micron).

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/or 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 permission from the State of Colorado to bypass the GAC treatment, unless analytical results indicate that treatment is warranted. This request was granted in October 1991 (4).

### Surface Water Management Program (SWMP) Options

The SWMP presents the water management options considered, the selected option, and implementation of both on-site and off-site improvements (1). Numerous potential alternatives for long-term management and disposal of surface water at RFP were evaluated to find a solution acceptable to all parties involved. The SWMP presents features of the selected alternative along with cost estimates at the appropriate planning level for decision making. The SWMP, a draft document, can be modified to reflect changing conditions and regulations at RFP and was developed with the following distinct purposes:

- To create an organizational framework that will facilitate water quality planning with involvement from local communities, the public, and federal and state regulators
- To explain surface water treatment, operations, and management
- To provide a complete description of current and planned surface water management activities at the Plant, including the long-range selected management option
- To assure that surface water management is conducted in compliance with all pertinent laws and regulations

SWMP alternatives were developed by two groups: (1) DOE/EG&G, and (2) Congressman Skaggs' Committee. The alternative selected is a combination of two options calling for (1) use of Great Western Reservoir for RFP water with provision of replacement water supply for Broomfield and protection of Standley Lake and (2) on-site water management improvements with minor modifications. The selected option includes three categories of components as follows:

1. On-site improvements for storage, treatment, and management of surface water to reduce the volume of water discharged and potential contaminants produced
2. Off-site improvements to protect Standley Lake water quality via the construction of a 100-year flood storage facility on Woman Creek at Indiana Street and a bypass canal around the north side of Standley Lake
3. Utilization of Great Western Reservoir for the storage and management of runoff from RFP and the acquisition of an equivalent water supply for the City of Broomfield

The selected alternative represents a mutually agreed-upon and technically feasible course of action to assure surface water management for the benefit of all involved parties and consistent with relevant laws and regulations.

The selected alternative represents a long-term, highly reliable plan for protection of water quality and nearby community drinking water supplies which is generally unrelated to the level of operating production at RFP. Selection of on-site components will involve negotiations and consultations with EPA and CDH.

### **ENVIRONMENTAL RESTORATION (ER) PROGRAM**

Environmental Restoration (ER) is a program designed to investigate and clean up contaminated sites at DOE facilities. The ER Program implemented through the RFI/RI is organized into five major activities: (1) Installation Assess-

ment, (2) Remedial Investigations (3) Feasibility Studies (4) Remedial Design/Remedial Action, and (5) Compliance and Verification Implementation (5)(6).

The schedule and the sequence of work for completing the OU5 and OU6 RFI/RI investigations is outlined in the IAG and specified in the Work Plans. The IAG states that OUs 5 and 6 may proceed through several phases of investigation depending on the information gathered to characterize the OU. The IAG specifies that the priority and schedule for Phase II RFI/RI investigations for OUs 5 and 6 will be determined after evaluating the Final Phase I RFI/RI Reports for the operable units. If EPA and/or the State determine that no further investigatory work is required for OU5 or OU6 after the Phase I investigation is complete, EPA and/or the State shall approve the Final Phase I RFI/RI Report as a Final RFI/RI Report. The field investigations for OUs 5 and 6 would, then, be considered complete upon approval of a Final RFI/RI Report. The data gathered would be used to determine areas in which environmental restoration activities are appropriate.

### Installation Assessment and Remedial Investigations

Activity 1 of the Phase I RFI/RI work, Installation Assessment, is close to completion with preliminary assessments and site inspections having identified potential environmental concerns. The initial step in the development of the RFI/RI work plans for OUs 5 and 6 was a review of existing information. Available historical and background data for each IHSS were collected through a literature search and a review of the Rocky Flats Environmental Database System (RFEDS).

Background research revealed that two major investigations were completed at the RFP in 1986. The first was the ER Program Installation Assessment, which included analyses and identification of then-current operational activities, active and inactive waste sites, current and past waste management practices, and potential environmental pathways through which contaminants could be transported. A number of sites were identified that could potentially have adverse environmental impacts. The second major investigation involved a hydrogeologic and hydrochemical characterization of the entire plant site. This study was conducted and reported by Rockwell International, the RFP contractor to DOE at that time. These two investigations led to the identification of the IHSSs included in OUs 5 and 6.

In addition to these past investigations are the current large-scale, ongoing monitoring programs, including sediment, surface water, and groundwater sampling along Woman and Walnut Creeks, the SID, and the Plant-Wide Ambient Air Monitoring Program.

Activity 2, Remedial Investigations (RI), was initiated in 1991, with the writing of the RFI/RI Work Plans and will continue into 1992 with the implementation of the RI work.

The ER Program Activity 2, RI, includes implementation of sampling programs to delineate the magnitude and extent of contamination at specific sites, evaluation of potential contaminant migration pathways, performance of baseline risk assessments, and environmental evaluations. After assessing the available information for OUs 5 and 6, the following objectives of the Phase I RFI/RI were identified in the RFI/RI Work Plans:

- Characterize the physical and hydrogeologic setting of the IHSSs

- Assess the presence or absence of contamination at the sites
- Characterize the nature and extent of contamination at the sites, if present
- Support the Phase I Baseline Risk Assessment and Environmental Evaluation for the OUs

Within these broad objectives, site-specific data needs have been identified based on preliminary identification of contaminants potentially present at each IHSS, data needs for the Phase I Baseline Risk Assessment, and environmental evaluations. FSPs are based on the data needs and the requirements of the IAG. The FSP for each IHSS requires a combination of screening activities; sampling of soils, sediment, surface water and groundwater; and well installation. Site-specific FSPs are presented in the Work Plans.

Data collected during the Phase I RFI/RI will be used to better define site characteristics, source characteristics, and the nature and extent of contamination; to support the baseline risk assessment and environmental evaluation; and to evaluate potential remedial alternatives during activity 3, Feasibility Studies. The baseline risk assessment and environmental evaluation identify the existing or potential risk that may be posed to human health and the environment in the absence of any remedial action. The assessment and evaluation will provide the basis for determining whether or not remedial actions will be necessary, and the justification for performing future studies and remediations.

#### Future Remedial Activities

Based on the findings of the baseline risk assessments and environmental evaluations, remedial investigations and activities may be required. These activities include:

- Activity 3, Feasibility Studies, will evaluate remedial alternatives and develop remedial action plans, as needed.
- Activity 4, Remedial Design/Remedial Action, includes design and implementation of site-specific remedial actions selected on the basis of Activity 3, Feasibility
- Activity 5, Compliance and Verification, implements monitoring and performance assessments of remedial actions and then verifies and documents the adequacy of remedial actions carried out under Activity 4

#### **SUMMARY**

Since construction in 1952, a complex network of regulations and agreements have been promulgated to govern monitoring, treatment, and management of surface water at RFP. These regulations include the following:

- The EPA-mandated, CDH-certified NPDES pond water monitoring program
- The FFCA amending the NPDES permit
- The AIP between DOE and CDH defines the roles of each agency for sampling and analysis of surface water at RFP and is the enforcement vehicle for the Colorado WQCC
- The AIG between DOE, EPA and the CDH outlines the requirements for the RFI/RI Work Plans in the

Woman Creek, OU5, (C- series ponds), and the Walnut Creek, OU6, (A- and B-series ponds).

The existing pond water monitoring program is a two-part sampling program guided by the above federal and state requirements. The NPDES/FFCA permit requires water sampling and analysis at regulated discharge points on a routine basis. The NPDES monitoring program has been slightly modified over the last year to incorporate changes required by the FFCA. The ambient water quality monitoring program has been greatly reduced and now calls for collection on a monthly, rather than weekly basis.

Several mitigation measures involving diversion of discharges around downstream drinking water supplies have been taken and others are under consideration. Other mitigation measures have involved the treatment of pond water discharges. However, since the levels of many of the parameters of interest are near or below the analytical limits of detection it is not yet clear if the treatment is providing a positive impact for many of the parameters.

A SWMP has been developed to assure the management of RFP surface water in a technically sound manner consistent with relevant laws and regulations. Future activities and options implemented under this plan will depend, to some extent, on RFI/RI findings and remedial actions implemented under the ER program.

#### **ACKNOWLEDGEMENTS**

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