

# **NOTICE**

**All drawings located at the end of the document.**

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**DRAFT**  
**ECOLOGICAL FIELD SAMPLING PLAN**  
**AND**  
**ECOLOGICAL FIELD SAMPLING METHODS**  
**FOR**  
**OPERABLE UNIT 1**  
**881 HILLSIDE**

**JULY 5, 1990**

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**Submitted to:**

**EG&G, Rocky Flats, Inc.**  
**Rocky Flats Plant**

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**APPENDIX A**  
**ECOLOGICAL FIELD SAMPLING PLAN**

## TABLE OF CONTENTS

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	<u>Page</u>
<b>A.1.0 SITE BACKGROUND</b>	A-1
<b>A.2.0 SAMPLING OBJECTIVES</b>	A-3
<b>A.3.0 SAMPLE LOCATION AND FREQUENCY</b>	A-4
A.3.1 SAMPLE LOCATIONS	A-4
A.3.1.1 Vegetation	A-4
A.3.1.2 Animal Life	A-4
A.3.2 SAMPLE FREQUENCY	A-5
A.3.3 SAMPLE LOCATION RATIONALE	A-5
A.3.4 REFERENCE AREAS	A-5
<b>A.4.0 SAMPLING METHODS</b>	A-6
A.4.1 DESCRIPTIVE ECOLOGY	A-6
A.4.1.1 Vegetation	A-6
A.4.1.2 Wildlife	A-6
A.4.2 TISSUE SAMPLE COLLECTION	A-7
A.4.2.1 Vegetation	A-7
A.4.2.2 Periphyton	A-7
A.4.2.3 Benthos	A-7
<b>A.5.0 SAMPLING EQUIPMENT</b>	A-9
A.5.1 VEGETATION	A-9
A.5.2 TERRESTRIAL ANIMALS	A-9
A.5.3 AQUATIC SAMPLING	A-10
 <b><u>FIGURE</u></b>	
A-1 BIOLOGICAL SAMPLING LOCATIONS	A-11

The Rocky Flats Plant (RFP) is a government-owned and contractor-operated facility, which manufactures nuclear weapons components from plutonium, uranium, and other nonradioactive metals. In addition, the RFP reprocesses components for plutonium recovery after they are removed from obsolete weapons. In the production process, both radioactive and nonradioactive wastes are generated. Past waste handling practices included storage and disposal on site. Present practices involve onsite and offsite recycling of hazardous materials, onsite storage of hazardous and radioactive mixed-wastes, and offsite disposal of solid radioactive materials at another DOE facility.

Past environmental restoration investigations identified some of the past onsite storage and disposal locations as potential sources of environmental contamination. Two major studies were completed in 1986 to further characterize operational activities, practices, and site conditions that could result in adverse impacts to the environment. These investigations identified four areas that could be releasing contaminants to the environment. The 881 Hillside site was one of the four sites selected and given High Priority Site status because of volatile organic compounds detected in the ground water, the relatively permeable soils, and the proximity of the area to surface water drainage. In all, 12 sites within the 881 Hillside area have been identified as Solid Waste Management Units (SWMU) and are designated for further study during the Phase III Remedial Investigation (RI) because of their suspected relationship to ground water contamination.

Site-wide and site-specific data have been gathered at the 881 Hillside to better characterize the soils, geology, ground water, and surface water. Site-wide ecological studies have been conducted at the RFP, but no site-specific data have been collected at the 881 Hillside area. The 881 Hillside area, located on the south, southeastern edge of the RFP, slopes to the south towards Woman Creek. The southern border of the Operable Unit approaches the South Interceptor Ditch, which diverts water to Pond C-2.

Past ecological studies report that species common to the RFP are characteristic of the western plains. Vegetation consists of species represented in the floras of the short grass plains, tall grass prairie, lower montane, and foothill ravine regions. Wetlands have also been identified at RFP, at the 881 Hillside area these occur along the South Interceptor Ditch and Woman Creek.

Terrestrial and aquatic species are also characteristic of plains biota with influences from the western

foothills. It appears that no federally listed threatened or endangered species exist at the RFP, and the jurisdictional status of identified wetlands is still to be established.

The sampling program for the 881 Hillside ecological assessment has three broad objectives:

1. Describe the existing ecological setting in terms of habitats, vegetation, wildlife, and aquatic species. This will be accomplished through the use of established ecological field methodologies.
2. From the above data, identify key food chain species that likely represent the major flow of energy and, thus, the major pathways for contaminant transfer from physical environmental media to higher trophic-level ecological receptors. With key species identified, collect tissue samples for contaminant analysis. This sampling and analysis program is iterative: the first phase consists of collecting tissues of primary producer and lower trophic-level species to detect presence/absence of contaminants in tissues. Further collection and analyses of higher trophic-level species tissues will depend on results of the first phase analyses.
3. Utilizing contaminant data gathered during the Phase III RI and ecological assessment, perform an environmental risk assessment to determine whether a potential or real threat exists to key biological receptors from 881 Hillside contaminant releases.

The biological sampling requirement is that sampling take place within the period of July 1 through August 15 to accommodate site-wide EG&G program requirements and constraints. It is recognized that this sampling period captures only one season of ecological conditions and may or may not represent an ideal ecological picture for assessment. Differences between annual and longer-lived species may not be evident with one sample period.

### A.3.1 SAMPLE LOCATIONS

#### A.3.1.1 Vegetation

A random procedure will be utilized to identify sampling locations for the descriptive portion of the field study, both at the 881 Hillside and reference area. The randomization process will exclude buildings, parking lots, or structures associated with facilities. The objective is to sample vegetation in "natural" and disturbed areas not associated with structures.

Vegetation to be sampled for tissue analyses will be collected at designated locations near or within SWMUs 102, 107, 130, 119.1, and 119.2; surface water sampling locations SW-31, SW-32, SW-46, SW-70, and Pond C-2.

Periphyton samples will be collected at SW-31, SW-32, SW-70, and Pond C-2. Should periphyton be absent at a particular location, then the nearest location downstream supporting periphyton will be sampled and located on a map.

#### A.3.1.2 Animal Life

No terrestrial organism tissues will be analyzed for contaminant concentrations during the first phase of the assessment. Should the primary producer organism tissues contain contaminants, then appropriate higher trophic-level species will be analyzed.

Benthic organisms will be collected for tissue analyses at SW-31, SW-32, SW-46, and Pond C-2. Fish tissue analyses will be performed if benthic organisms indicate the presence of contaminants. Aquatic species data collected at the above locations will be used to describe the aquatic habitat of the South Interceptor Ditch, Woman Creek and Pond C-2.

### **A.3.2 SAMPLE FREQUENCY**

One round of sampling will occur between July 1, 1990 and August 15, 1990.

### **A.3.3 SAMPLE LOCATION RATIONALE**

The basis for selecting a random procedure of vegetation transect/plot location is to obtain as unbiased an estimator as possible of true population parameters for cover, density, and frequency. Locations for collection of biological tissue samples (terrestrial vegetation, periphyton, and benthos) are based on existing surface water, soil, and sediment sample locations and the need to correlate and compare past data with data collected during the Phase III RI and ecological assessment. In the case of SWMUs 119.1, 119.2, and 130, tissue sample collection locations are based on the location of selected potential contaminant release areas.

### **A.3.4 REFERENCE AREAS**

Reference areas will be selected for sampling and description that are similar to the 881 Hillside terrestrial and aquatic ecosystem but have not been impacted by any releases characteristic of 881 Hillside. These areas may be identified to the west of 881 Hillside and RFP.

#### A.4.1 DESCRIPTIVE ECOLOGY

##### A.4.1.1 Vegetation

Structural and compositional data for the 881 Hillside and reference area will be obtained by quantitative sampling. Shrubs will be sampled using a line-strip transect 3m by 20m in size. Shrub cover, density, and frequency are recorded for each species found within the transect. Herbaceous cover and frequency are obtained from a 1.0 m<sup>2</sup> quadrat, and herbaceous density from a 0.25 m<sup>2</sup> quadrat along the line-strip transect at 0, 10m, and 20m. A single line-strip transect and quadrat are sampled at each sample location. Trees encountered during the field study will be identified, counted and mapped. Sample adequacy will be based on shrub density: an adequate number of samples is obtained when the standard error of the mean density is equal to or less than ten percent of the mean density.

##### A.4.1.2 Wildlife

It is not the intent of this field survey to provide population data on wildlife, aquatic life, birds, or invertebrate organisms. The survey is planned to note the presence or absence of the above in order to identify potential contaminant pathways through the food chain. Survey procedures will include a systematic walk-through of the 881 Hillside area to record all ecological features such as animal sign, sightings, burrows, dens, nests, etc. Small mammals will be sampled by live trap transects placed in three locations for three nights. Each transect will consist of 25 traps baited with rolled oats and placed 50 m apart. Species, sex, life history stage and reproductive condition will be recorded and the animal released alive. A sweep net will be used to collect insects and other invertebrates found in the vegetation canopy. Ground-dwelling invertebrates will be noted as encountered. All invertebrates will be identified to family.

## A.4.2 TISSUE SAMPLE COLLECTION

### A.4.2.1 Vegetation

Terrestrial vegetation will be collected by clipping within a 1 m<sup>2</sup> quadrat or larger and separating selected species for tissue analysis. Triplicate samples will be taken at each location. One hundred grams of material (wet weight) will be collected per sample for analysis. Roots and above-ground tissues will be analyzed separately (one-half of the above-ground tissues will be washed with distilled water in the laboratory prior to analysis to separate deposition from accumulation). The material will be placed in a paper bag, labeled properly, and inserted in a sealed plastic bag. The plastic bag is then placed in a cooler with dry ice and prepared for shipment to the laboratory.

### A.4.2.2 Periphyton

Within the South Interceptor Ditch, Woman Creek channel, and Pond C-2, periphyton will be collected in a homogeneous area by scraping and removing the periphyton (floating or attached algal mats) from its substrate or from surface floating samplers (artificial substrate) placed in the sample location over a 28-day period. Triplicate samples of algal mats will be taken at each location. One-hundred grams of material (wet weight) will be collected per sample for analysis. The material will be placed in a glass jar provided by the laboratory and properly labeled. The samples are frozen using dry ice, packed in a cooler and kept frozen for delivery to the laboratory. Glass slides removed from artificial substrate device are scraped clean of periphyton and the material identified to genera.

### A.4.2.3 Benthos

Within the South Interceptor Ditch, Woman Creek channel, and Pond C-2, benthic organisms will be collected with a Surber sampler and/or Ekman grab. If sufficient flow exists, the Surber sampler will be used. If no flow exists, then the Ekman grab will be employed to sample benthos. Utilizing the Surber sampler, sample location will be approached from the side or downstream position. Larger stones and material within the square-foot frame are washed and discarded. The remainder of the area is gently churned to expose burrowing organism. Organisms retained in the net are sorted, identified, and counted. The sediment will be sieved through a standard screen, and retained macroinvertebrates will be sorted by species (or genera) and counted. Following this, they will be washed with distilled water, placed in a glass

jar, properly labeled, and frozen using dry ice. The samples will then be placed in a cooler and kept frozen for shipment to the laboratory. Thirty to one-hundred grams of tissue of a single species will be collected and prepared for analysis.

### A.5.1 VEGETATION

For the descriptive survey the following equipment will be utilized:

- 30 m flexible tape
- 1 m rule
- 1 m<sup>2</sup> quadrat frames
- 1/4 m<sup>2</sup> quadrat frames
- Survey stakes or rebar for transect locations
- Small sledgehammer
- Field forms and clipboards
- Plant press

For tissue sampling the following equipment will be utilized:

- 1 m<sup>2</sup> quadrat frames
- Shears for tissue clipping
- Small spade for root collection
- Knife
- One gallon plastic zip-loc bags
- Large paper sacks
- Permanent markers
- Dry ice
- Coolers

### 5.2 TERRESTRIAL ANIMALS

For the descriptive survey the following equipment will be utilized:

- Binoculars

- Smith Live traps
- Sweep nets
- Killing jar
- Absorbent material
- Field forms and clipboard
- Pill boxes

### 5.3 AQUATIC SAMPLING

The following equipment will be utilized for the descriptive and tissue collecting survey:

- Surber sampler
- Ekman grab
- Artificial substrate rack with glass slides
- Styrofoam floats
- No. 35 mesh brass screen
- No. 60 mesh brass screen
- Forceps and glass vials
- 70% ethanol
- Dry ice and sample coolers
- Permanent markers
- One gallon zip-loc plastic bags

**APPENDIX B**

**ENVIRONMENTAL SAMPLING PROCEDURES FOR ECOLOGICAL ASSESSMENT**

## TABLE OF CONTENTS

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	<u>Page</u>
<b>B.1.0</b>	<b>VEGETATION SURVEY</b> B-1
<b>B.2.0</b>	<b>COLLECTION AND ANALYSIS OF VEGETATION SAMPLES</b> B-3
	B.2.1 PREPARATION B-3
	B.2.2 COLLECTION OF VEGETATION SAMPLES B-3
	B.2.3 SAMPLE PREPARATION FOR ANALYSES B-4
	B.2.4 REFERENCES B-4
<b>B.3.0</b>	<b>PERIPHYTON SAMPLING</b> B-5
<b>B.4.0</b>	<b>SAMPLING OF BENTHIC MACROINVERTEBRATES</b> B-7
 <u>TABLE</u>	
<b>B.1-1</b>	<b>MODIFIED BRAUN-BLANQUET COVER CLASS RANGES</b> B-2

For purposes of inventorying the vegetation community at the 881 Hillside and reference area, a line-strip transect method will be used to quantify species density, cover, and frequency.

- The study areas will be gridded and transects 3m x 20m will be selected by a random procedure within each grid; and herbaceous sample plots will be located at 10m intervals along the transect. A 1-m<sup>2</sup> quadrat will be used to estimate cover and frequency. The cover classes are listed in Table B.1-1. The cover value is recorded for each species present in each plot. Shrub cover, density, and frequency data are obtained from the 3m x 20m line-strip transect.
- In areas where trees (stem diameter > 10cm at 1.4m above ground) are found, a 10m X 10m plot will be established. For each tree within the plot, the species and DBH will be recorded.
- Within the 10m X 10m plot, a 2m X 2m subplot will be established for categorizing the shrub layer (all woody stems < 10cm DBH).
- Data are summarized by calculating mean values for cover and density and by determining frequency values for each species.
- Report: 1) Relative cover (% of total cover); 2) Relative frequency (% of total plots of occurrence); 3) Relative density (% of total individuals) and; 4) Importance value ( $\Sigma$  relative cover, frequency and density).
- Reference:

EPA, 1989a. Ecological Assembly of Hazardous Waste Sites. EPA/600/3-89/013.

**Table B.1-1 Modified Braun-Blanquet Cover Class Ranges**

<b>Class Contribution to Total Cover</b>		
<b><u>Cover Class</u></b>	<b><u>Range, in %</u></b>	<b><u>Mean, in%<sup>a</sup></u></b>
5	75 to 100	87.5
4	50 to <75	62.5
3	25 to <50	37.5
2	5 to <25	15.0
1	1 to <5	3.0
+	<1	0.5
r	Observed but so rare as to not contribute measurably	

<sup>a</sup> Note: the algebraic mid-point of the cover class range is routinely used in calculations, even though the values do not carry as many significant figures as implied.

**B.2.0**

**COLLECTION AND ANALYSES OF VEGETATION SAMPLES**

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Plant tissues can become contaminated by metals, organics, and radionuclides released from spill sites or routine facility operations. The concentration of contaminants in grass can provide a means by which to assess the potential for the transfer of materials to higher levels in ecological food chains. The type of plant and/or plant tissues collected for analysis will depend on site conditions. Routinely, only 30 grams (wet) of plant tissue are needed for analysis, but the number and type of analyses required will determine how much material must be collected, and in this case, approximately 100 grams of material may be needed for the metals and radionuclide analyses. The laboratory performing the analysis will inform the collector of the amount of material needed and any special handling methods required. The following steps should be followed when collecting vegetation samples.

**B.2.1 PREPARATION OF SAMPLING**

- Select an area with ample grass available for sample collection.
- Measure two 1-m<sup>2</sup> areas about 3m apart on each side of the station and at 90° angles to each other.

**B.2.2 COLLECTION OF VEGETATION SAMPLES**

- Remove the grass from the selected areas by clipping with scissors or clippers and place the clippings in a clean 1-gallon paper bag. Clip by species.
- Remove dead vegetation and other debris from the grass. Keep only the fresh, clean blades of grass for analysis. Enough sample must be collected to yield 100g of material. The sample should be split since one portion will be oven dried and one will not.
- Label the bag with the date, collection site, name(s) of collector(s), and analysis; e.g., rad and metals, volatiles, etc.

- The bag is stapled or clipped shut, labeled with the identification numbers, and placed in a larger plastic bag. The plastic bag is then placed in a cooler with ice, ice packs, or dry ice. Care is taken to keep cooler water from contacting collected plant material. Samples remain in coolers for transporting to the laboratory.

### **B.2.3 SAMPLE PREPARATION FOR ANALYSES**

- The analytical laboratory may instruct the collector not to provide any sample preparation prior to submitting the sample to the laboratory, in which case samples need only be transported to the laboratory. If, however, the sample for radiological or metal analyses needs to be prepared prior to shipping, the following step should be taken.
  - Dry the sample at 110°C for 24 hours and place approximately 100g of the material in a 1-gallon paper bag with the original label information.
- The analyses should conform essentially with Method 3050, (EPA, 1986).

### **B.2.4 REFERENCES**

EPA, 1986. Test Methods for Evaluation of Solid Waste, SW-846, Third Edition, Office of Solid Waste and Emergency Response, U.S. Environmental Protection Agency, Washington D.C.

EPA, 1987. A Compendium of Superfund Field Operations Methods. EPA/504/P-87/001.

Periphyton communities can be sensitive tools to detect changes in aquatic environments that result from the introduction of contaminants. Monitoring can involve sampling either natural or standardized artificial substrates. Taxonomic composition and relative abundance of periphyton are more variable on natural substrates than on standardized artificial substrates; therefore, artificial surfaces will be used. On hard artificial substrates, data on algal abundance, biomass, and species composition can be obtained by removing the substrate and by scraping or brushing the flora from a measured area into a container.

The following method will be employed at the selected locations along the Woman's Creek and the South Interceptor Ditch:

- Surface-floating samplers within styrofoam and a submerged rack containing six plexiglass slides will be used to collect periphyton. The upper end of the vertically suspended slides is to be placed about 30cm below the surface of the water. During low-flow periods, the samplers will be suspended at a 45° angle instead of vertically. To anchor the sampler in place, a sufficient weight will be attached at the end of a cord from the bottom of the sampler (cord length varied depending upon the depth at the sampling site). The exposure period in the field will be  $28 \pm 0.1$  days.
- For direct cell counts (identification and enumeration), the algal growth will be scraped from both sides of the slide with a neoprene policeman and rinsed with distilled water. After the sample is diluted, as necessary, and preservative added, a subsample will be taken and allowed to settle for approximately 12 hours in a sedimentation cylinder. The dilution volume (usually 200ml to 1000ml) and the volume of the subsample (1ml to 5ml) are dependent upon the amount of growth on the slide. Organisms will be identified to genus and enumerated with an inverted microscope at about 320X.
- Biomass determinations will be made by scraping the growth from both sides of the slide into a preweighed crucible. The residue is to be dried at 105°C for 12 hours (or until a constant weight was obtained), weighed, then ashed in a muffle furnace at

600°C for 1 hour and weighed again. The difference between the two weights is the ash-free dry weight or organic weight of the sample.

- To determine the concentrations of chlorophyll a and phaeophytin a, both sides of the slides will be scraped and rinsed with 90% acetone, resulting in extract volumes of 20 to 50ml. After the extract is homogenized and steeped for a minimum of 12 hours, it is to be clarified by centrifuge tube. The absorbance (optical density) of the extract is to be read at 750 and 630 nm in a spectrophotometer. If dilution is necessary, 2ml of the extract will be added to 10 ml of 90% acetone. The amount of phaeophytin a, a natural degradation product of chlorophyll a, will be determined by examining the optical density at 633 nm before and after acidification.
- All analyses should be completed within 5 days of the collection of the slides from the field (EPA, 1987).
- Periphyton samples (floating or attached algal mats) selected for contaminant analysis will be collected in a homogeneous area by scraping and removing from the substrate. One-hundred grams of material (wet-weight) will be collected per location. The material will be washed with distilled water, placed in a glass jar, labeled, frozen using dry ice, and shipped in a cooler to the laboratory for analysis.
- References:

EPA, 1989b. Ecological Assessment of Hazardous Waste Sites. EPA/600/3-89/013.

B.4.0

SAMPLING OF BENTHIC MACROINVERTEBRATES

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Benthic invertebrates are the most common fauna used in ecological assessments of contaminant release and are defined as the invertebrates retained by screens of mesh size greater than 0.2mm.

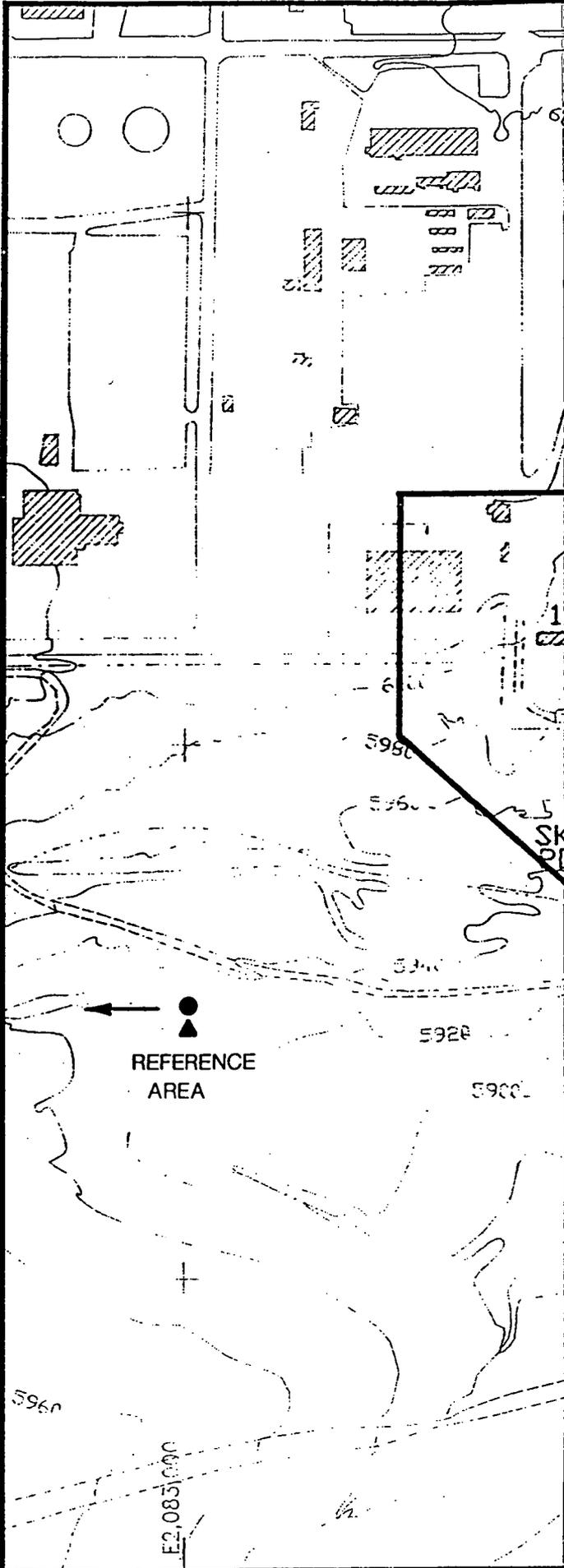
Two types of sample collectors are to be used to obtain samples as follows:

- At those stations where shallow riffle habitats dominate the stream, a Surber sampler (0.09m<sup>2</sup> or 1ft<sup>2</sup>) with a 253-um mesh net will be used. Triplicate samples are to be taken on a transect upstream and within a 10m distance. Samples will be placed in small plastic jars and reference specimens preserved in 70% isopropanol. Those selected for tissue analysis will be washed, frozen with dry ice and shipped to the laboratory for analysis. Supplemental data on the time the sample are collected, weather conditions, water temperature, depth and general nature of the substrate for each sample, and width of to stream at the transect also will be recorded.
- At stream locations where the water may be shallow and the bottom soft mud or silt with little current, a pole-mounted Ekman grab sampler will be used. The Ekman may also be used in ponds with a remote messenger to trigger the sampler. Once the sample is obtained, the entire contents will be placed in a large plastic bag and returned to the laboratory where the contents are to be sieved through a No. 35 mesh (500- $\mu$ m) brass screen. The sample is to be washed from the screen and reference specimens preserved in a 70% isopropanol.
- In the laboratory, all samples are to be washed (or rewashed) using a standard No. 60 mesh (250- $\mu$ m) sieve and placed in a large white tray. Organisms are to be separated from the debris with forceps under a table-mounted magnifier. Specimens are to be preserved in vials containing 70% ethanol. Identification and enumerations, generally to genus, are to be made using dissecting microscopes (Loar, 1989).
- Specimens selected for tissue analysis will not be preserved. Thirty to one-hundred grams of the species selected for tissue analysis will be washed with distilled water,

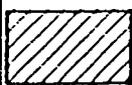
placed in a glass jar, labeled, frozen using dry ice, and shipped to the laboratory for analysis.

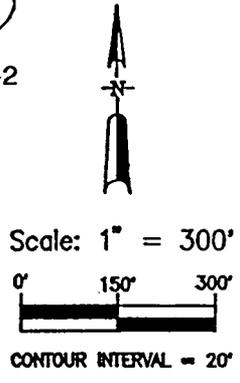
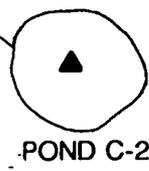
- **References:**

Loar, J.M., ed. 1989. **Third Annual Report on the ORNL Biological Monitoring and Abatement Program. Draft. ORNL-TM. Oak Ridge National Laboratory. Oak Ridge, TN 37830.2.**



EXPLANATION

-  Solid Waste Management Unit (SWMU)
- 145** SWMU Designation
-  Seepage from SWMU 102 Based on Aerial Photographs Dated 05/11/55.
-  Maximum Extent of SWMU 119 Barrel Storage Based on Aerial Photographs dated 04/29/67, 04/10/68, 05/24/69, and 03/30/71.
-  Vegetation Tissue Sample Location
-  Periphyton/Benthos Tissue Sample Location



U.S. DEPARTMENT OF ENERGY  
 Rocky Flats Plant  
 Golden, Colorado

OPERABLE UNIT NO. 1  
 PHASE III RI/FS WORK PLAN

SOLID WASTE MANAGEMENT  
 UNIT LOCATIONS

FIGURE A-1

BIOLOGICAL SAMPLING LOCATIONS

January, 1990

RF300F.MB122889

E2,083,000