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UNITED STATES ENVIRONMENTAL PROTECTION AGENCY

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UPDATE OF THE HAZARDOUS WASTE GROUND-WATER TASK FORCE EVALUATION OF U.S. DEPARTMENT OF ENERGY - ROCKY FLATS PLANT

The Hazardous Waste Ground-Water Task Force (Task Force) of the United States Environmental Agency (EPA) in conjunction with the Colorado Department of Health (CDH) conducted an evaluation of the ground-water monitoring program at the U.S. Department of Energy (DOE) Rocky Flats Plant, Golden Colorado. The onsite evaluation was conducted from March 31 through April 16, 1987. The Rocky Flats Plant is one of 58 hazardous waste treatment, storage and disposal facilities (TSDFs) evaluated by the Task Force. The Task Force effort came about in light of concerns as to whether operators of hazardous waste TSDFs are complying with State and Federal ground-water monitoring requirements.

The objectives of the Task Force evaluation were to:

- Determine the facility's compliance with the interim status ground-water monitoring requirements of 40 CFR 265 and Part 265 of the Colorado hazardous waste regulations (6 CC 1007-3)
- Evaluate the ground-water monitoring program described in the RCRA Part B permit application for compliance with 40 CFR 270.14(c) and Part 100.41(c) of the Colorado hazardous waste regulations (6 CC 1007-3);
- Determine if the ground-water at the facility contains hazardous waste and/or hazardous constituents.

The Task Force prepared the accompanying report on its evaluation, which revealed a number of deficiencies in the ground-water monitoring well network and program at the Rocky Flats Plant. EPA Region VIII and CDH personnel had previously identified many of the deficiencies noted in the Task Force report. Because of the inadequacy of the monitoring system at the facility and known releases from the solar evaporation ponds, a Compliance Agreement between DOE, CDH and EPA was completed and signed in July 1986. The Agreement required an alternate ground-water monitoring program [265.90(d)] at the present landfill and the west spray field. An assessment ground-water monitoring program [40 CFR 265.93(d)] was required at the evaporation ponds. The purpose of this update is to summarize actions taken by EPA, CDH and DOE/Rockwell since the Task Force evaluation was conducted.

Installations of new wells in 1986 and 1987 were the first steps in upgrading the Rocky Flats ground-water monitoring program to meet the requirements of the regulations and the Compliance Agreement. Although new wells have been installed and monitoring procedures have been modified, the ground-water monitoring program at the regulated units is still inadequate.

Evaluation of the ground-water monitoring programs at the Rocky Flats Plant is ongoing and is being accomplished through review of DOE/Rockwell submittals and by frequent site inspections by the regulatory agencies. Since the Task Force compliance evaluation, reviews of the following documents, which address ground-water monitoring, were completed by CDH and EPA Region VIII:

- RCRA Part B Operating Permit Application, November 1986
- RCRA Part B Post-Closure Care Permit Application, November 1986
- Remedial Investigation for the High Priority Sites (881 Hillside), December 1987

CDH and EPA Region VIII issued a notice of deficiency (NOD) to the facility in September 1987 for the Operating Permit Application. A second NOD was issued in January 1988 for the Post-Closure Care Permit Application. Both NODs addressed ground-water monitoring program deficiencies, including those identified during the Task Force evaluation. DOE/Rockwell resubmitted the Operating Permit Application in December 1987. The ground-water monitoring section was omitted at the request of the regulatory agencies. This section is required only in the Post-Closure Care Permit Application, which is currently being revised by DOE/Rockwell and is scheduled to be submitted in September 1988.

Under the Compliance Agreement, the DOE is also required to investigate all areas of possible contamination. To date, DOE/Rockwell has implemented investigations at the 881 Hillside High Priority Area and the 903 Pad, Mound and East Trenches High Priority Areas. RCRA-quality ground-water monitoring wells were installed in these areas during 1987.

CDH and EPA recently reviewed work performed in the 881 Hillside, and CDH inspected ground-water sampling operations at the 881 Hillside in October and November 1987. The review revealed problems, primarily with sample collection and analysis, and quality control/quality assurance. CDH and EPA are requiring DOE/Rockwell to address these problems.

This completes the Hazardous Waste Ground-Water Task Force evaluation of the Rocky Flats Plant.

UNITED STATES ENVIRONMENTAL PROTECTION AGENCY
HAZARDOUS WASTE GROUND-WATER TASK FORCE

EPA-330/2-88-051

GROUND-WATER MONITORING EVALUATION
U.S. Department of Energy - Rocky Flats Plant
Golden, Colorado

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Steven Sisk
Project Coordinator
National Enforcement Investigations Center

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EXECUTIVE SUMMARY

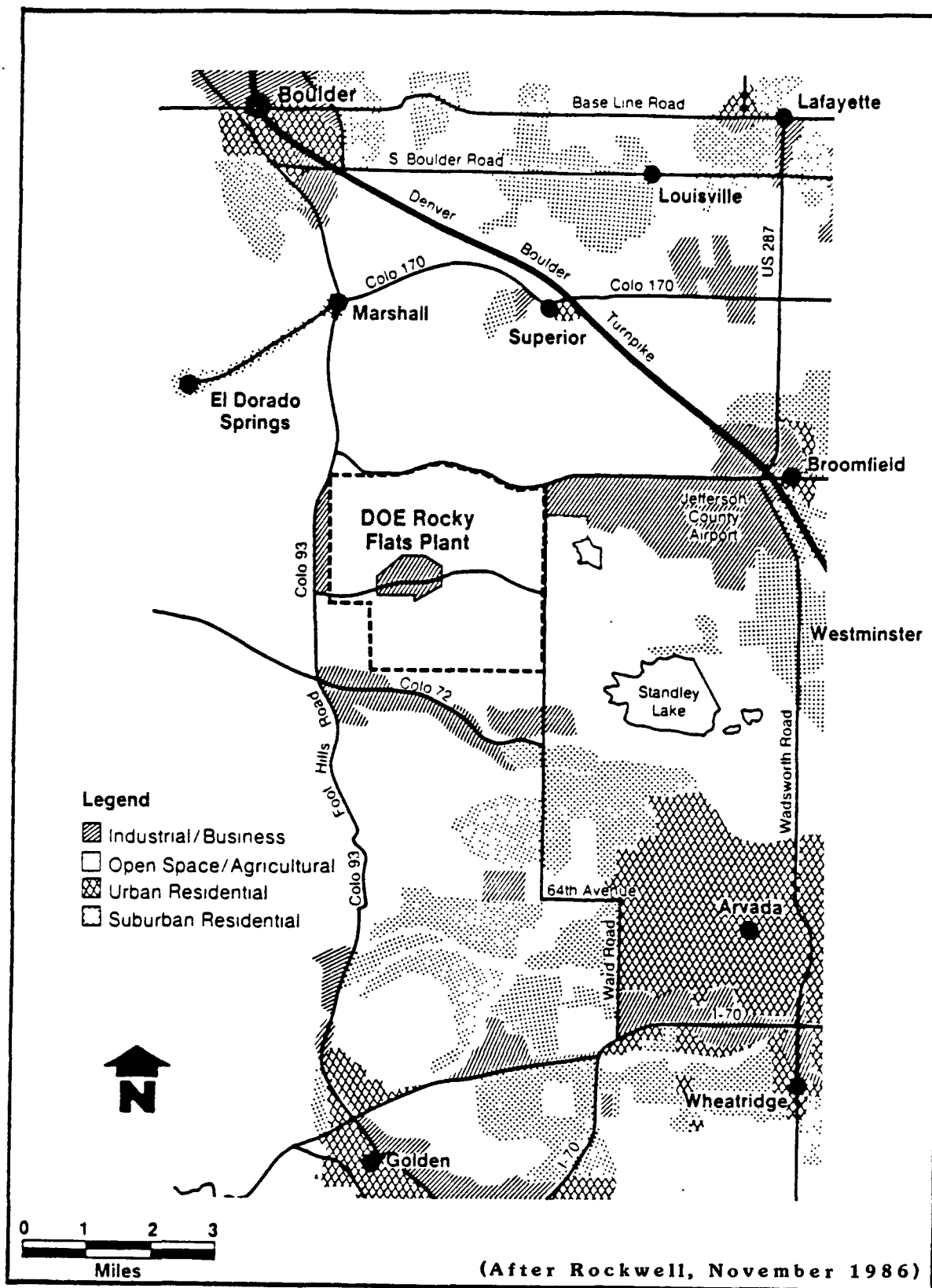
INTRODUCTION

Concerns have been raised about whether commercial and onsite hazardous waste treatment, storage and disposal facilities (TSDFs) are complying with the ground-water monitoring requirements promulgated under the Resource Conservation and Recovery Act (RCRA), as amended.* In question is the ability of existing or proposed ground-water monitoring systems to detect contaminant releases from waste management units at these facilities. The Administrator of the Environmental Protection Agency (EPA) established a Hazardous Waste Ground-Water Task Force (Task Force) to evaluate these systems and determine current compliance. The Task Force comprises personnel from the EPA Office of Solid Waste and Emergency Response, Office of Enforcement and Compliance Monitoring, National Enforcement Investigations Center (NEIC), Regional Offices and State regulatory agencies.

During the spring of 1987, the Task Force investigated the U.S. Department of Energy (DOE) Rocky Flats plant near Golden, Colorado [Figure 1]. The onsite inspection was conducted from March 31 through April 16, 1987 and was coordinated by NEIC personnel. The objectives of this investigation are similar to those for other Task Force investigations, namely:

- Determine compliance with the interim status ground-water monitoring requirements of 40 CFR Part 265, as promulgated under RCRA, and the equivalent Colorado regulations, as appropriate.
- Evaluate the ground-water monitoring program described in the RCRA Part B permit application submitted by the facility, for compliance with 40 CFR Part 270.14(c) and the equivalent Colorado regulations, as appropriate.
- Determine if the ground water at the facility contains hazardous constituents

* *Regulations promulgated under RCRA address hazardous waste management facility operations, including ground-water monitoring, to ensure that hazardous waste constituents are not released to the environment.*



The Rocky Flats plant is located on approximately 6,550 acres of Federally owned land in northern Jefferson County, Colorado, approximately 16 miles northwest of downtown Denver. The plant, constructed in 1951, is government-owned and contractor-operated (GOCO). Dow Chemical Company (Dow) began operations in 1952 under the direction of the Atomic Energy Commission. In 1975, responsibility for the plant was assigned to the Energy Research and Development Administration, which was succeeded by DOE in 1977. Dow was the prime operating contractor at the facility from 1952 until 1975, when Rockwell International (Rockwell) was awarded the contract.

The major plant structures, including all production buildings, are located within the plant security area of approximately 400 acres. The security area is surrounded by a buffer zone of approximately 6,150 acres. Production activities include fabrication of plutonium, uranium, beryllium and stainless steel components for nuclear weapons. Other activities include chemical recovery and purification of recoverable radionuclides, and research and development in metallurgy, machining, assembly, nondestructive testing, coatings, remote engineering, chemistry and physics.

Plant operations generate solid/liquid nonhazardous, hazardous,* radioactive,** mixed radioactive (includes both hazardous and radioactive components) wastes and polychlorinated biphenyl (PCB) waste material. These wastes are handled in various ways, depending on the hazardous and/or radioactive characteristics. Nonhazardous wastes, such as office trash, are disposed of in an onsite landfill. Hazardous and mixed radioactive wastes are currently either treated onsite to render them nonhazardous, reused within the plant, stored onsite, or shipped offsite for recycling, treatment, storage and/or disposal. Past disposal practices involved substantial onsite disposal of hazardous and mixed radioactive waste.

Waste management activities at Rocky Flats have historically included container storage, tank storage and treatment, surface impoundment storage

* As defined in 40 CFR 261

** Contains source, special nuclear or byproduct materials, as defined in the Atomic Energy Act

and treatment, land treatment, landfilling and incineration. Hazardous and mixed radioactive wastes are currently regulated by the Colorado Department of Health (CDH), which received final RCRA authorization in November 1984. Although CDH has been delegated final authorization, it has not been delegated authority to administer programs mandated in the RCRA Hazardous and Solid Waste Amendments (HSWA) of 1984.

DOE submitted a RCRA Part B permit application to EPA and CDH in November 1985 for waste handling operations at the Rocky Flats plant. CDH personnel determined that the application was not complete because the permit application did not acknowledge State authority over radioactive mixed wastes, and subsequently informed DOE that they intended to deny the permit. This action raised the issue as to what specific wastes/waste handling units were subject to State and/or EPA requirements, and resulted in negotiations between DOE, CDH and EPA. The negotiations resulted in a three-party Compliance Agreement, which was signed on July 31, 1986. As a result of this agreement, a revised Part B permit application was submitted to both EPA and CDH. The revised Part B was being reviewed by the regulatory agencies during the Task Force investigation.

On July 17, 1986 CDH submitted an application to EPA for formal approval to regulate the hazardous components of radioactive mixed wastes. CDH was granted the authority to regulate radioactive mixed wastes under Section 3006 of RCRA (42 U.S.C. Section 6926) on October 24, 1986. DOE submitted a revised Part B permit application to both EPA and CDH in November of 1986, which was under review during the Task Force investigation.

Treated wastewater discharges from the plant are regulated by a National Pollutant Discharge Elimination System (NPDES) permit (No. CO0001333) issued by EPA Region VIII. The Permit was issued pursuant to regulations promulgated under the Clean Water Act.

SUMMARY OF FINDINGS AND CONCLUSIONS

The findings and conclusions presented in this report reflect conditions existing at the facility in April 1987. Actions taken by the State, EPA Region VIII and DOE/Rockwell subsequent to April 1987 are summarized in the accompanying update.

GROUND-WATER MONITORING DURING INTERIM STATUS

Task Force personnel investigated the interim status ground-water monitoring program at the Rocky Flats plant for the period between November 1981, when applicable provisions of the RCRA regulations became effective and April 1987, when the Task Force inspection was conducted. The interim status monitoring program was administered by EPA from November 1981 until November 2, 1984, when the CDH was simultaneously delegated interim and final RCRA authorization. A RCRA-equivalent program was administered by CDH after receiving authorization.

The Task Force investigation revealed that the principal shortcoming of the interim status monitoring program was that a detection monitoring program (rather than an assessment monitoring program) was implemented in 1981. Although the detection monitoring program had substantial problems, DOE and Rockwell personnel were aware that the regulated units (evaporation ponds) had been leaking since the early 1960's. A ground-water quality assessment program should have been implemented in accordance with 40 CFR 265.93.* The release from the evaporation ponds was addressed by the July 1986 Compliance Agreement, and an assessment program was implemented in the fall of 1986, as part of a site-wide geological and hydrological characterization program.

The Task Force review of the detection monitoring program revealed numerous instances of noncompliance by DOE/Rockwell with EPA and CDH regulations. These included problems with the ground-water sampling and

* Hereafter, "40 CFR" will be omitted from citations of EPA regulations.

analysis plan, monitoring well construction and locations, and sample collection and analysis, as discussed below.

Ground-Water Sampling and Analysis Plan

Under the EPA-administered program, DOE/Rockwell developed a "Groundwater Monitoring Program Plan." The plan was submitted to EPA Region VIII in November 1981 and was, ostensibly, followed until mid-1985, when detection monitoring was suspended. After the Compliance Agreement was completed in 1986, the first phase of the assessment program plan for the evaporation ponds was presented in the "Draft Work Plan, Geological and Hydrological Site Characterization" dated July 21, 1986. Sampling and analysis procedures were described in a companion document titled "Draft Project Operations Plan, Geological and Hydrological Site Characterization," dated July 25, 1986. Ground-water monitoring procedures in the Draft Project Operations Plan (POP) superseded those in the 1981 plan.

Procedures in the 1981 plan were evaluated by Task Force personnel for compliance with RCRA regulations; the Draft POP procedures were evaluated for adequacy and completeness.

The 1981 plan did not comply with 265.92(a) because many necessary details regarding sampling and analysis were omitted. Rather than stating specific sampling and analysis procedures to ensure program consistency, the monitoring plan cites multiple references, which in turn contain multiple procedures for sampling and analysis. Neither the plan nor the cited references contain procedures for: (1) making the required water level measurements; (2) preserving samples for all required parameters and verifying samples are properly preserved; (3) analyzing samples for total organic halogen, pesticides and radionuclides; (4) shipping samples; and (5) chain-of-custody.

The 1981 plan also contained an outline for a ground-water quality assessment program. The "outline" was, essentially, a recitation of the regulations. It was, therefore, inadequate and did not comply with 265.93(a).

Although the 1986 POP was better than the 1981 monitoring plan, it was also incomplete and was being revised during the Task Force investigation. The plan contained details about sample collection, handling, preservation, shipping, analysis and chain-of-custody. More detail is needed, however, regarding procedures for sampling slow-recharging wells, which are common at the Rocky Flats plant. The POP needs to describe equipment decontamination procedures, where samples are preserved and by whom, and list the sample aliquots to be filtered. Also, the shipping procedures description needs to be expanded beyond just referencing Department of Transportation regulations.

Monitoring Well Locations and Construction

The 1981 monitoring plan designated 17 wells for the interim status program. The 17 wells were part of a 56-well network installed for other DOE monitoring programs. Task Force personnel determined that the 17-well network was inadequate for interim status monitoring and did not meet the regulatory requirements.

Three of the designated RCRA monitoring wells (5-60, 5-71, and 18-74*) were "dry" from at least 1975 through mid-1985, when detection monitoring was suspended. RCRA regulations [265.91(a)] require that the ground-water monitoring system must be capable of yielding ground-water samples for analysis. Thus, these three wells do not comply with the regulatory requirements and should not have been designated as part of the monitoring network.

The single designated upgradient well (1-66) is completed in a bedrock aquifer flow zone and is about 5,000 feet from the evaporation ponds. The uppermost aquifer at the Rocky Flats Plant includes the Rocky Flats Alluvium, which overlies the bedrock zone monitored by the upgradient well. The Rocky Flats Alluvium is monitored by several of the downgradient designated RCRA wells. RCRA regulations [265.91(a)(1)] require that the number, locations and depths of upgradient wells be sufficient to yield ground-water samples that are

* Wells are designated by a two-part numbering system, which includes a sequence number followed by the year the well was installed. For example, the designation 5-60 indicates well number 5 was installed in 1960.

representative of background ground-water quality in the uppermost aquifer near the facility. Therefore, the single upgradient well does not comply with the regulations because the alluvial flow zones are not monitored. Furthermore, because of the excessive distance to the well from the regulated units, samples from the well may not be indicative of background ground-water quality.

None of the downgradient wells were installed at the limit of the waste management area (defined as the waste boundary), as required by RCRA regulations [265.91(a)(2)]. The closest wells were at least 200 feet from the evaporation ponds.

The 17 designated RCRA wells were installed between 1960 and 1981. Construction records are available for only 3 of the 17 wells. Therefore, for 14 of the wells, DOE/Rockwell cannot document whether the wells were cased in a manner to maintain the integrity of the borehole, as required by 265.91(c). Further, the aquifer flow zone(s) monitored by the wells cannot be identified.

In 1986, DOE/Rockwell installed 70 new wells as part of the facility-wide site characterization program outlined in the Compliance Agreement. Construction documentation for the new wells is inadequate in some cases, and contradictory, incomplete or inaccurate in others. The borehole diameter may not be large enough to install an adequate sandpack in the annulus between the casing and hole wall. Well construction data should be reviewed, corrected if in error, and the adequacy of the wells evaluated before they are accepted as fulfilling the Compliance Agreement or RCRA permitting requirements.

Sample Collection and Handling Procedures

During the inspection, water levels were measured in 38 wells and samples were collected from 15 monitoring wells and one ground-water sump (wet well) in order to evaluate DOE/Rockwell sample collection and handling procedures. At each of the monitoring wells, Rockwell personnel measured the water level, calculated the purge volume, purged the well, and made field measurements for pH, specific conductance and water temperature.

The sample collection and handling procedures followed by Rockwell personnel are generally acceptable; however, Rockwell personnel were not following all of the procedures in the sampling and analysis plan and chain-of-custody procedures had not been implemented. The plan needs to be updated to include the field procedures actually used. Problems were found with field measurements for temperature and specific conductance. A noncalibrated thermometer was being used to measure temperature, and the readings were used for adjusting the conductance meter. This could result in erroneous conductance data. Further, the conductance meter was not being properly calibrated because the standards were found to be 15% to 30% below the true value.

Sample Analysis and Data Quality Evaluation

Ground-water monitoring data obtained by Rockwell between November 1981 and April 1987 was evaluated for quality and completeness. Most of the required RCRA analyses [265.92] conducted during this period were performed by the Rockwell general laboratory in building 881. The general laboratory was also evaluated during the Task Force inspection.

The evaluation of data and analytical procedures revealed numerous problems that have or could have affected data quality. Pre-1986 analytical data for parameters other than pesticides, total organic halogen (TOX) and phenols are unreliable because of the lack of sample preservation and protracted holding times. The data collected during the initial year of monitoring were inadequate to establish the background concentrations or values required by 265.92(c)(1).

Quadruplicate analyses for pH, specific conductance, TOX and total organic carbon (TOC) were not made on samples from the upgradient well during the initial year of sampling, as required by RCRA regulations [265.92.(c)(2)]. In subsequent years, required quadruplicate analyses were not made on samples from the downgradient wells.

GROUND-WATER MONITORING PROGRAM PROPOSED FOR RCRA PERMIT

In November 1986, a revised Part B permit application was submitted to EPA and CDH. The Part B proposed a detection monitoring program for a 10-well monitoring network, including four upgradient wells and six downgradient wells on the point of compliance. The wells were installed in 1986 as part of the site characterization program. The point of compliance is downgradient from not only the regulated units (closest one is about 5,000 feet), but also all of the solid waste management units being investigated under the site characterization program.

The proposed ground-water monitoring program does not comply with State regulations [264.95 and 100.42(c)(7)] because the point of compliance is improperly located; it needs to be adjacent to the regulated units (evaporation ponds, present landfill and west sprayfield). Furthermore, the proposed detection monitoring program, as defined in 264.98, is inappropriate for the evaporation ponds because releases have been detected. Rather, a compliance monitoring program, as defined in 264.99, or a corrective action program, as defined in 264.100, needs to be proposed. Also, the rationale for the proposed monitoring parameters is deficient and some improvements in the sampling and analysis procedures are needed.

TASK FORCE SAMPLING AND DATA EVALUATION

During the inspection, Task Force personnel collected samples from 15 monitoring wells and a wet well to determine if the ground water contained hazardous constituents* or other indicators of contamination [Figure 2]. The wells were located near the evaporation ponds, the west spray field, 881 hillside, active landfill and an old landfill near the southwest corner of the production area. Samples were drawn from the wells by Rockwell and EPA contractor personnel. Monitoring data from the Task Force samples were evaluated together with DOE/Rockwell data for indications of waste release.

* Hazardous constituents as defined in Appendix VIII of 40 CFR Part 261

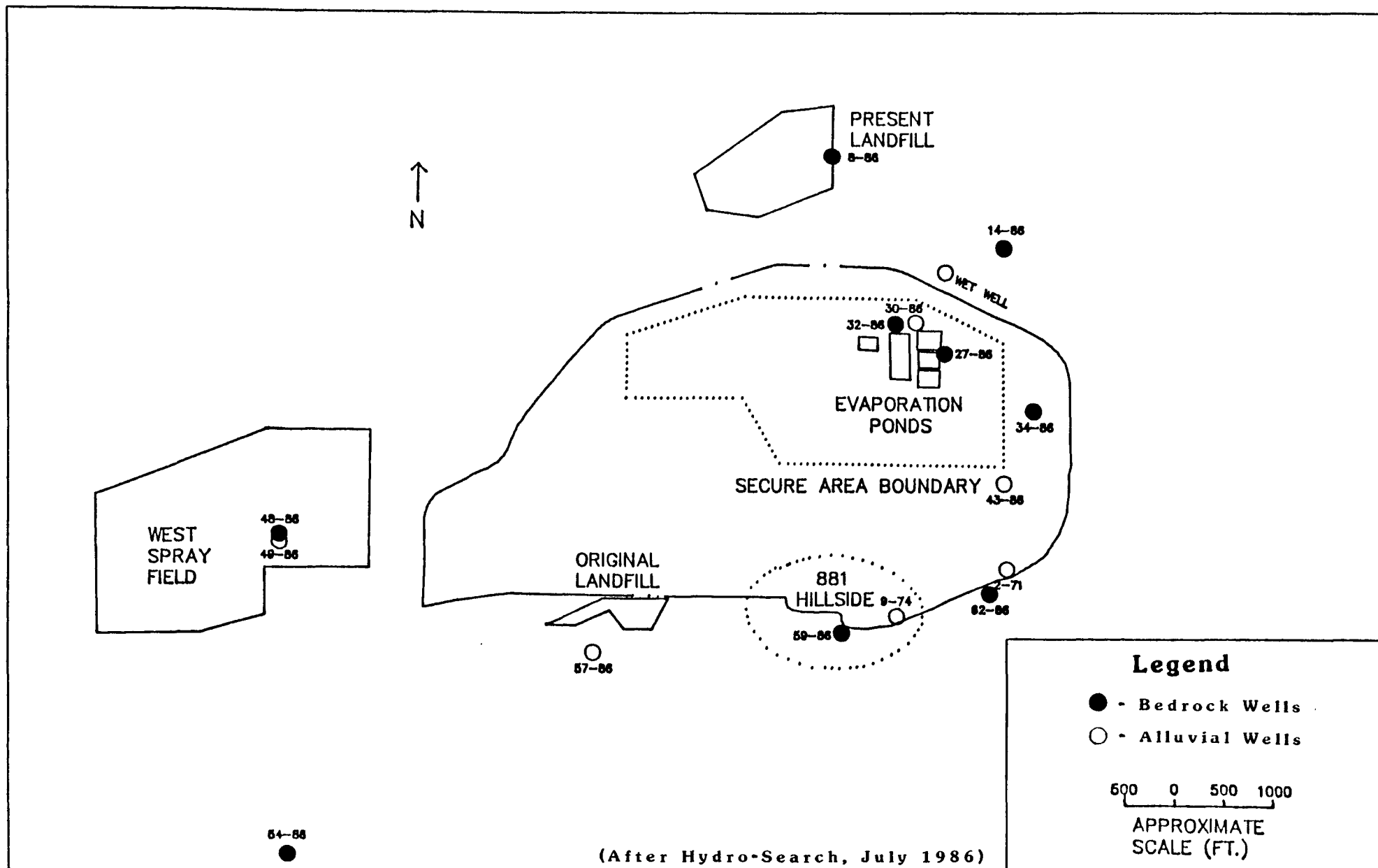


FIGURE 2

LOCATION MAP FOR SAMPLING STATIONS

Task Force and DOE/Rockwell data indicate releases of hazardous constituents from the evaporation ponds and unspecified sources on the 881 hillside. Task Force data from wells near the evaporation ponds show that four hazardous constituents (carbon tetrachloride, chloroform, trichloroethane and trichloroethene) were detected at low concentrations in the wet well. Four hazardous constituents (carbon tetrachloride, chloroform, trichloroethene and dichloroethene) were previously detected by Rockwell in well 22-86.

Both Task Force and Company data indicate that organic hazardous constituents are present in ground water downgradient from the 881 hillside area, including several chlorinated ethanes and ethenes. Ground-water contamination in this area had been previously identified by DOE. The extent and source(s) of the contamination were being investigated by Rockwell during the Task Force inspection.

The data are inconclusive regarding releases from the west spray field and the two landfills. Two of the wells sampled (8-86 and 62-86) by Task Force personnel had elevated pH levels that were inconsistent with other data and waste disposal information. These levels may be artifacts from well construction.

TECHNICAL REPORT

INVESTIGATIVE METHODS

The Task Force evaluation of Rocky Flats consisted of:

- Reviewing and evaluating records and documents from EPA Region VIII, CDH and Rocky Flats
- Onsite facility inspection conducted March 31 through April 2 and April 6 through April 16, 1987
- Evaluating the onsite Rockwell general laboratory
- Determining water level elevations and total depths in selected monitoring wells
- Sampling and subsequent analysis of ground water from selected monitoring wells and one wet well

RECORDS/DOCUMENTS REVIEW

Records and documents from EPA Region VIII and CDH offices, compiled by an EPA contractor, were reviewed prior to the onsite inspection. Onsite facility records were reviewed to verify information currently in Government files and supplement Government information where necessary. Selected documents requiring in-depth evaluation were copied by the Task Force during the inspection. Records were reviewed to evaluate facility operations, identify locations and construction details of waste management units and monitoring wells, and evaluate ground-water monitoring activities.

Specific documents and records reviewed and evaluated included the ground-water sampling and analysis plan, outline of the ground-water quality assessment plan, analytical results from past ground-water sampling, monitoring well construction data and logs, site geologic reports, site operation plans, facility permits, waste management unit design and operation reports, and the operating records showing the general types and quantities of waste disposed of at the facility and the disposal locations.

FACILITY INSPECTION

The onsite facility inspection included identification of waste management units (past and present); identification and assessment of waste management operations and pollution control practices; and verification of the locations, procedures and operation of the ground-water monitoring system.

Rockwell and DOE representatives were interviewed to identify records and documents of interest, discuss the content of the documents and explain (1) facility operations (past and present), (2) site hydrogeology, (3) ground-water monitoring system rationale, and (4) the ground-water sampling and analysis plan. Monitoring well locations were verified by comparing observed field locations with current maps.

LABORATORY EVALUATION

The onsite Rockwell general laboratory in building 881 was evaluated regarding its responsibilities under the ground-water sampling and analysis plan, and its ability to produce quality data. Analytical equipment and methods, quality assurance procedures and documentation were examined for adequacy. Laboratory records were inspected for completeness, accuracy and compliance with State and Federal requirements.

WATER LEVEL AND WELL DEPTH MEASUREMENTS

Task Force personnel observed Rockwell personnel measuring the water level and total well depth in 38 wells to verify past water level data and construction records and to evaluate their procedures [Figure 3]. Duplicate measurements were made at several wells to verify the reproducibility of the results. Additional water level measurements were made on the wells sampled prior to purging and before sampling.

SAMPLE COLLECTION

Ground-water samples were collected from 15 monitoring wells and a wet well* [Table 1 and Figure 4] to determine if the ground-water contains hazardous constituents. The sampling effort was focused on areas likely to be affected by waste management activities.

Rockwell personnel measured all the water levels and purged and bailed samples from most of the wells using their equipment. The wells were purged using either a Bennett® (furnished by Rockwell) or Johnson-Keck® (furnished by EPA) submersible pump or Teflon® bailers. The monitoring wells were sampled using Teflon bailers and the wet well was sampled using a stainless steel bucket.

Task Force samples were collected in containers provided by an EPA contractor. Split samples were provided to Rockwell personnel. Containers for Task Force and Rockwell samples for each parameter group, except volatile organics (VOAs), were alternately filled in sequence in increments of one-third of a bottle (or one-half of a bailer per bottle when insufficient water was available to fill one-third of each bottle). Duplicate VOA samples were collected in lieu of splits. Samples were collected from each well by the following procedures:

- EPA contractor monitored the open well head for chemical vapors (with an HNU® meter) and radiation.
- Rockwell personnel determined depth to water and total depth using either a Well Wizard® or an Olympia Actat® (Model 500) meter.

* The wet well serves as a sump for a ground-water collection system downgradient from surface impoundments previously used for treating hazardous wastes.

® Bennett, Johnson-Keck, Teflon, HNU, Well Wizard and Olympia Actat are registered trademarks and will appear hereafter without ®.

Table 1
PURGING AND SAMPLING DATA

Well Number	Diameter (inches)	Purging				Sampling*		
		Vol. Calc. (gallons)	Date	Time	Method/Comments	Date(s)	Time(s)	Comments
2-71	6**	108	04/09	1050-1130	Bennett pump, 40 gal. purged, pumped dry turbid (tan-green)	04/09 04/10	1635-1730 0935-1025	Organic aliquot collected Inorganic aliquot collected
9-74	6**	53.5	04/09	1405-1455	Bailer, 17 gal. purged bailed dry, clear (foamy)	04/09	1805-1830	Organic aliquot collected Field blank (RF-1) taken
8-86	2**	29.5	04/13	0945-1040	Bailer, 14 gal. purged, bailed dry, clear	04/13 04/14	1405-1500 0845-0915	Organic aliquot collected Inorganic aliquot collected
14-86	2**	23.5	04/15	0950-1030	Bailer, 12 gal. purged, bailed dry, tan-gray	04/15 04/16	1520-1610 0805-0835	Organic aliquot collected Lab matrix spike taken Inorganic aliquot collected
27-86	2**	15	04/15	0855-0900	Bennett pump, 2.5 gal. purged, pumped dry, gray	04/15	1350-1415	
30-86	2**	5.5	04/14	1240-1250	Bailer, 2.5 gal. purged, bailed dry, turbid (brown)	04/14 04/15 04/16	1625-1645 1100-1120 0935-0945	Organic aliquot collected Inorganic aliquot collected CN, Phenols collected
32-86	2**	33.5	04/14	1150-1210	Keck-Johnson pump, 14-gal. purged, pumped turbid (brown)	04/14 04/15 04/16	1115-1130 1530-1640 1105-1145 0945-1020	Field blank (RF-2) taken Organic aliquot collected Radionuclides aliquot collected Inorganic aliquot collected
34-86	2**	17.5	04/06	0910-0945	Bailer, 9.8 gal purged bailed dry, milky white	04/06	1145-1330	
43-86	2**	2.7	04/06	1035-1100	Bailer, 2.1 gal purged, bailed dry, slightly turbid (tan)	04/06	1535-1625	
48-86	2**	75	04/07	0845-1150	Keck-Johnson pump, 26.5 gal. purged, pumped dry, clear/opaque	04/07 04/08	1350-1515 0845-0855	Radionuclides, and tritium aliquots collected
49-86	2**	10	04/07	0900-1020	Bailer, very turbid (red-brown)	04/07	1045-1145 1340-1420	Organic aliquot collected Inorganic aliquot collected

Table (cont.)

Well Number	Diameter (inches)	Purging				Sampling*		
		Vol. Calc. (gallons)	Date	Time	Method/Comments	Date(s)	Time(s)	Comments
54-86	2**	24	04/08	0935-0945	Bennett pump, 11 gal. purged, pump dry, clear	04/08	1425-1450	Volatile organic aliquots collected
						04/09	0845-0935	Ext. Organics aliquots collected
							1435-1455	Partial radionuclides aliquot collected
						04/10	0920-1110	Inorganic aliquot collected
57-86	2**	0.85	04/08	1115-1135	Bailer, 0.5 gal purged, bailed dry, turbid (tan)			Finish collecting Radionuclide
							1425-1430	CN and Anions aliquots collected
						04/08	1335-1345	Organic aliquot collected
						04/09	0800-0810	Radionuclides aliquot collected
59-86	2**	2.6	04/09	0840-0900	Bailer, turbid (brown)		1405-1415	
						04/10	0850-1025	Phenol, Anions aliquots collected
62-86	2**	4.2	04/09	0940-1030	Bailer, 2 gal. purged, bailed dry	04/09	1010-1200	Lab matrix spike taken
						04/09	1525-1600	Organic aliquot collected
						04/10	0830-0900	Partial inorganic aliquot collected
Wet Well					No purge		1110-1125	Remaining inorganic aliquot collected
						04/13	0845-1000	Sampled using stainless steel bucket Triplicate sample taken

* Wells were sampled with teflon bailers; the wet well was sampled with a stainless steel bucket.

** Well casings at 2-71 and 9-74 are steel; the other wells sampled have stainless steel casings.

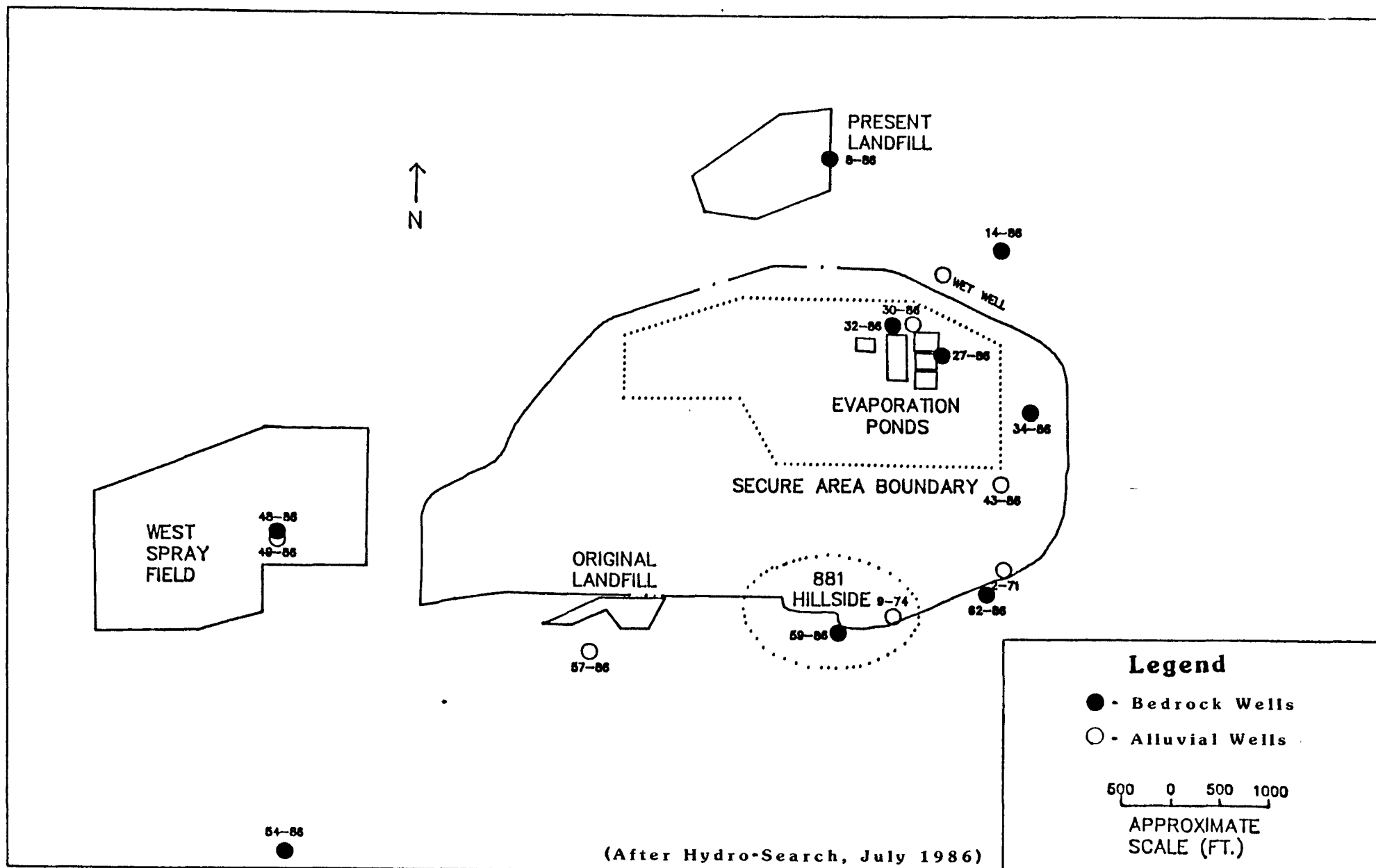


FIGURE 4

LOCATION MAP FOR SAMPLING STATIONS

- Rockwell personnel washed the water level meter probe and the uncoiled cable using a solution of Alconox® (soap) and water and then rinsed them with deionized (DI) water.
- Rockwell personnel calculated the height of the water column from the depth to water measurement and the well depth.
- Rockwell personnel computed the water column volume by multiplying the water column height (in feet) by a conversion factor (gallons per foot of casing).
- Rockwell personnel washed the Teflon bailers by brushing both inside and outside with a nylon bristle brush dipped in an Alconox solution. The wash was followed with a DI water rinse. If a pump was used for purging, the pump and the last 3 to 5 feet of tubing was cleaned (Alconox and water) and rinsed with DI water prior to use. The tubing was flushed with approximately 5 gallons of DI water after each use.
- Rockwell and/or EPA contractor personnel purged three water column volumes (or evacuated to dryness) using either a Bennett or Johnson-Keck pump or Teflon bailer. Purge water was collected in a graduated plastic bucket (approximately 4-gallon capacity) and disposed of on the ground nearby.
- Rockwell personnel collected sample aliquots and measured water temperature, pH and specific conductance (field parameters) at the beginning of purge and after each casing volume purged.
- After recharge, Rockwell bailed and an EPA contractor poured sample aliquots for another set of field parameters.

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- Rockwell and/or EPA contractor personnel drew water from the well with a Teflon bailer and the EPA contractor filled prelabeled sample containers in the order shown in Table 2.
- Rockwell and EPA collected sample aliquots to measure field parameters after collection of samples from the well.

The order of sample aliquot collection was modified from that specified in Table 2 when slow well recharge prevented collection of all aliquots during a single period. In some cases organics samples were collected immediately following recharge; the other aliquots were collected during subsequent sampling periods when recharge was sufficient for sample collection. In some cases, the less important sample aliquots were not collected.

After sampling each well, EPA contractor personnel took the samples to a staging area where aliquots for radionuclides, metals, TOC, phenols, cyanide and sulfides were preserved. The final pH was measured in samples preserved by acid or base addition.

Quality control/quality assurance samples were also prepared by the EPA contractor. Field blanks for each analytical parameter group (e.g., volatiles, organics and metals) were prepared twice during the investigation (near wells 9-74 and 32-86) by pouring distilled, deionized water into sample containers. In addition, one laboratory matrix spike, which consisted of two duplicate VOA vials and two 1-liter amber glass bottles, was collected per week (from wells 14-86 and 59-86). One trip blank for each parameter group was also prepared and submitted during the inspection. An equipment blank was prepared by pouring distilled, deionized water through one of Rockwell's Teflon bailers. An additional equipment blank was prepared by pouring distilled, deionized water in the stainless steel bucket used to sample the wet well. All blanks were submitted with no distinguishing labeling or markings to identify them as blanks. A laboratory triplicate of all parameter groups was collected at the wet well.

Table 2
ORDER OF SAMPLE COLLECTION,
BOTTLE TYPE AND PRESERVATIVE LIST

Parameter	Container	Preservative*
Volatile organic analysis (VOA)	2 40-mL VOA vials	
Purgeable organic carbon (POC)	2 40-mL VOA vials	
Purgeable organic halogens (POX)	2 40-mL VOA vials	
Extractable organics	6 1-qt. amber glass	
Total organic carbon (TOC)	1 4-oz. glass	H ₂ SO ₄
Total organic halogens (TOX)	1 1-qt. amber glass	
Radionuclides	1 1-gal. plastic container	HNO ₃
Tritium	1 1-qt. plastic container	
Total metals	1 1-qt. plastic	HNO ₃
Dissolved metals	1 1-qt. plastic	HNO ₃
Phenols	1 1-qt. amber glass	H ₂ SO ₄
Cyanide	1 1-qt. plastic	NaOH
Anions	1 1-qt. plastic	
Sulfides	1 4-oz. clear glass	Zinc acetate and NaOH

* All samples were cooled on ice after collection.

At the end of each day, Task Force samples were packaged and shipped to the two EPA contract laboratories according to applicable Department of Transportation (DOT) regulations (49 CFR Parts 171 through 177). Rockwell personnel were given receipts for all samples collected. Chain-of-custody procedures were followed during the handling, transfer and shipping of all samples.

FACILITY DESCRIPTION

Task Force personnel obtained information on past and present manufacturing and waste management activities to identify potential sources of hazardous waste released to the ground water and aid in interpreting ground-water monitoring data. Information pertaining to many plant processes and operations is considered by DOE to be Unclassified Controlled Nuclear Information (UCNI). DOE and Rockwell personnel have recently compiled and submitted to EPA and CDH, substantial information on the characteristics of waste streams generated at the facility and all known or suspected onsite disposal areas. Consequently, only general descriptions of plant processes and operations are presented in this report in most cases. Specific information on plant processes and operations at the Rocky Flats plant is available in EPA Region VIII and CDH offices. Waste handling units, which the State has identified as "regulated units" [as defined in 264.90(a)(2)], are described in more detail in this report.

GENERAL DESCRIPTION

The Rocky Flats plant is a GOCO facility, which is part of a nationwide nuclear weapons research, development and production complex administered by DOE. As previously discussed, the current prime contractor for DOE at the Rocky Flats plant is the North American Space Operating Group of Rockwell.

The primary function of the Rocky Flats plant is to fabricate nuclear weapon components from plutonium, uranium, beryllium and stainless steel. Process operations include metal fabrication, assembly, chemical recovery and purification of recyclable transuranic* radionuclides. Other activities include research and development in metallurgy, machining, nondestructive testing, coatings, remote engineering, chemistry and physics. Components manufactured at the plant are shipped elsewhere for final assembly.

*

As used herein, transuranic elements are those having an atomic number greater than that of uranium and present at concentrations greater than 100 nanoCuries/gram (nCi/gram) of material.

All plant production buildings are located in a 384-acre area surrounded by a security fence [Figure 5]. The plant is divided into separate operational complexes with buildings in each complex designated with a three-digit number, of which the first digit designates the area. Production operations are in the 300, 400, 600, 700, 800 and 900 areas.

WASTE PRODUCTION

This section provides a general description of the types of wastes generated at the Rocky Flats plant. The November 1986 Part B RCRA permit application indicates that over 1500 waste streams have been identified at the plant. More specific information has been submitted to EPA and CDH by the facility in a "Waste Stream Identification" document dated April 1987.

In general, Rockwell personnel identified five categories of waste generated at the plant:

1. Hazardous waste (as defined in 40 CFR 261)
2. Radioactive
3. Radioactive mixed
4. Sanitary waste
5. Nonhazardous/nonradioactive solid refuse

Hazardous Waste Generation

Typical hazardous wastes generated at Rocky Flats are shown in Table 3. Quantity and types vary depending on plant activities. Trichloroethylene was used at Rocky Flats (degreasing operations) prior to about 1975, when it was replaced with 1,1,1-trichloroethane.

Table 3
TYPICAL HAZARDOUS WASTES GENERATED AT ROCKY FLATS

Waste	EPA HW Numbers*
Acetone	F003,U002
Carbon tetrachloride	F001, U211
Methylene chloride	F001,U080
Ethanol	D001, U080
Hydrochloric acid	D002, D003
Magnesium	D001
Mercury	D009, U151
Methanol	D001, F003, U154
Nitric acid	D002, D003
Tetrachloroethylene	F001
Phosphoric acid	D002, D003
Sulfuric acid	D002, D003
Silver	D011
Toluene	F005, U220
1,1,1-Trichloroethane	F001, U226
Xylene	F003, U239
Used Oil	D001
Sodium cyanide	P106
Barium cyanide	D005
Sodium nitrate/potassium nitrate	D001
Etchant solution (acid)	D002, D003, U134
Used O&M paint solvents/sludge	D001
Waste/surplus O&M paint	D001
Bromine trifluoride	D002, D003
Chlorine trifluoride	D002, D003
Hydrogen sulfide	D001, D002, D003
Hydrogen chloride	D001, D002, D003, U135
Iodine pentafluoride	D002, S003
Tungsten hexafluoride	D003
Dioctyl phthalate	U028
Electrochemical milling (ECM) sludge	D007

* Listed and defined in Part 261

Radioactive Waste Generation

Rocky Flats processes large quantities of plutonium (PU^{239}), depleted uranium (U^{233} and U^{238}), americium (Am^{241}) and neptunium (NP^{237}). The facility has identified three categories of radioactive contaminated waste generated by this processing:

1. Low level
2. Transuranic
3. Special Category PCBs

Low Level

Low-level radioactive waste contains naturally occurring radioactive elements such as uranium and thorium and may have transuranics at less than 100 nanoCuries per gram (nCi/g) of material. Examples include plutonium and depleted uranium contaminated solids (plastic, metal and paper) and liquids (solvents and oils) some of which have hazardous properties, as defined by State and Federal regulations.

Transuranic

Transuranic waste contains plutonium or americium at concentrations greater than 100 nCi/g of material. Typical transuranic wastes generated, include sludges, plastics, rubber and metal equipment, filters, insulation and combustible material. Some transuranic waste generated at Rocky Flats has hazardous properties, as defined by State and Federal regulations.

Special Category PCBs

Special Category PCBs are radioactive PCB wastes generated from cleaning/retrofitting of PCB transformers, decommissioning of PCB capacitors and cleanup of PCB contaminated debris within the plutonium handling buildings.

Radioactive Mixed Waste Generation

Typical radioactive mixed wastes generated at Rocky Flats are shown in Table 4.

Sanitary Waste Generation

Sanitary wastes include shower water, janitorial, restroom and cafeteria wastes. The sanitary system also receives wastes collected from production cleaning operations (using soap and water), film processing and cooling tower blowdown. Rockwell personnel also reported that some hazardous wastes are entering the sanitary system. Studies are being conducted to identify the source of these wastes. In the past, wastewater from other plant processes were discharged to the sanitary sewers.

Nonhazardous/Nonradioactive Refuse

Refuse waste includes cardboard packaging, paper, construction rubble, soils from excavation and such "non-routine" waste as asbestos.

WASTE MANAGEMENT PROCEDURES

Waste management activities at the Rocky Flats plant have varied through the years. Past waste handling procedures included shallow burial at numerous locations around the site, discharge to the surface drainage, solar evaporation, spray irrigation and offsite disposal. Many of the wastes generated at the plant were probably disposed of using one or several of these methods. DOE and Rockwell have been studying facility waste management practices in an attempt to identify areas for remedial action. Some remedial action has begun at various plant sites. Historically, cleanup activities concentrated on removing soils/debris contaminated with radioactivity and not necessarily chemical contamination. Those activities included a plant-wide Radiometric Study and some cleanup in the 1970's.

Table 4
TYPICAL MIXED WASTES GENERATED AT ROCKY FLATS

Specific Mixed Wastes	EPA HW Numbers*
Chromic acid plating bath solution	D002, D007
Coolant/1,1,1-trichloroethane	F001, U226
Cadmium cyanide	F001, P030
Etchant solution (10% acid)	D002, U134
Fixer (radiographic solution)	D011
Waste acid mixture (HCl, HF, HN03)	D002
Iodomethane	U138
Barium chloride	D005
Sodium nitrate/potassium nitrate	
Sodium hydroxide	D002, D003
Niobium diselenide	D010
Oil with halogenated solvents	D001, F001, F002
Ox out	F007
Pentachlorophenol	U242
Pyridine	D001, U196, P075
Alkaline sludge from heat exchanger	D002
Sulfuric acid	D002
Tetraethyl ammonium perchlorate	D003
Scintillation cocktail	D001, D002, D003, F003, D005, U220, U239
Solar pond sludge	D007, F001, U226
Intercepted pond seepage water	U044, U228

* Listed and defined in Part 261

The following is a brief description of how each type of waste is managed at the Rocky Flats plant. Information on past and present waste management areas is provided later in this report. More specific information is contained in the November 1986 Part B permit application on file at both the EPA and CDH offices.

Hazardous Waste

Aqueous Waste

Aqueous hazardous wastes are sent to buildings 374 and 774, where they are mixed with other aqueous waste (radioactive and radioactive mixed) and treated through sedimentation, filtration and evaporation.

Organic Liquids

Organic hazardous waste (such as solvents) and miscellaneous chemicals are either stored onsite for future treatment or for offsite shipment for treatment, disposal or reclamation.

Solids

Hazardous waste solids are stored onsite for eventual shipment offsite for treatment or disposal.

Radioactive Waste

Aqueous Waste

Radioactive aqueous waste is treated onsite in buildings 374 and 774 to reduce radioactivity by sedimentation, filtration and evaporation. The treated liquids are used onsite for steam or cooling tower makeup. Some radioactive aqueous waste was stored in surface impoundments 207A and 207C, prior to treatment. This practice has reportedly been discontinued. Some radioactive aqueous waste from laundry operations had been discharged to the onsite

sanitary wastewater treatment plant. Process wastewater also went to ponds A1, A2 and B2 for storage, prior to onsite processing.

Solids generated from the treatment operations in buildings 374 and 774 are stabilized by mixing with cement and stored for eventual shipment for offsite disposal. Aqueous wastes which cannot be treated onsite are also solidified and stored for offsite disposal.

Solids

Radioactive waste solids are stored onsite until it is shipped for offsite disposal. This waste is normally stored in boxes, 55-gallon drums or stabilized in cement.

Special Category PCB Waste

These wastes are stored onsite, pending a decision by DOE/Rockwell and EPA on how they will be handled.

Radioactive Mixed Waste

Aqueous Waste

Radioactive-mixed aqueous process wastewater with hazardous waste properties are sent to buildings 374 and 774, where they are mixed and treated with the radioactive aqueous waste through sedimentation, filtration and evaporation.

Organic Liquid

Radioactive-mixed organic liquid waste is stored at the facility prior to treatment or disposal. Some transuranic wastes are treated onsite.

Solids

Radioactive-mixed waste solids are stored onsite for future treatment or for offsite treatment/disposal.

Sanitary Waste (with some process wastewater)

Wastewater collected in the facility sanitary system is treated in the onsite wastewater treatment plant (WWTP). Effluent from the WWTP: (1) has been discharged (intermittently) to the surface drainage (through an NPDES permitted discharge), (2) treated in the onsite reverse osmosis (R/O) treatment facility and used for cooling tower makeup or (3) spray irrigated onsite (east spray field). Sludge from the WWTP has been disposed of in the onsite landfill and trenches.

Nonhazardous/Nonradioactive Refuse

This waste material is disposed of at the onsite active landfill.

WASTE MANAGEMENT AREAS

A substantial quantity of information has been compiled by DOE and Rockwell regarding waste management areas at the facility. Table 5 summarizes much of this information and Figure 6 identifies the approximate location of each unit. More specific information on each of these units can be found in *EPA and State files*. *The major waste management units are described below.*

Table 5
SUMMARY OF WASTE MANAGEMENT UNITS

Reference Number*	Unit	Date(s) Operated	Materials Handled	Activity	Approximate Dimensions	Comments
101	207 Solar evaporation ponds	1953 to present	Liquids	Storage/evaporation	-	See text
102	Oil sludge pit	1958	30 to 50 drums oil sludge (No. 6 fuel)	Land disposal	50' x 80'	-
103	Chemical burial	Unknown	Unknown Chemicals	Land disposal	100' x 80'	-
104	Liquid dumping pit	Prior to 1961	Unknown liquids/ scrap metal/ empty drums	Land disposal	50' x 50'	-
105	Out-of-service fuel tanks 105.1 : westernmost tank, 105.2 : easternmost tank	1958-1976	Asbestos/possible oil sludge	Storage	30' x 50'	Waste mixed with concrete and placed in two out-of-service tanks
106	Cooling tower water discharge	1977	Cooling tower cleanout water	Wastewater discharge	50' x 350'	From bldg. 881 cooling tower
107	Hillside oil leak	1958-1976	No. 6 fuel oil	Storage	50' x 400'	Fuel oil seeps, possibly from storage tanks
108	Trench T-1	1954-1962	Depleted uranium chips/plutonium/ lathe coolant (hydraulic oil and carbon tetrachloride)	Land disposal	200' x 15' x 5' (deep)	25,000 kg in 125 drums
109	Trench T-2	1954-1968	Sanitary sewage sludge contaminated with uranium and plutonium/ flattened drums of contaminated oil	Land disposal	200'-300' x 15'-50' x 5' (deep)	Flattened drums contained uranium and plutonium contaminated oil
110	Trench T-3	1954-1968	Sanitary sewage sludge contaminated with uranium and plutonium/ flattened drums of contaminated oil	Land disposal	200'-300' x 15'-50' x 5' (deep)	Drums contained uranium and plutonium contaminated oil which was "burned out"

Table 5 (cont.)

Reference Number*	Unit	Date(s) Operated	Materials Handled	Activity	Approximate Dimensions	Comments
111	Trenches T-4 to T-11	-	-	-	-	-
	111.1 : Trench T-4	1954-1968	Sanitary sewage sludge/flattened drums contaminated with uranium/plutonium and uranium contaminated asphalt planking from solar evaporation ponds	Land disposal	15'-50'x 200'-300'x 5' (deep)	Sludge contaminated with uranium
	111.2 : Trench T-5	1954-1968	Sanitary sewage sludge/flattened drums contaminated with uranium/unknown metal	Land disposal	15'-50'x 200'-300'x 5' (deep)	Sludge contaminated with uranium
	111.3 : Trench T-6	1954-1968	Sanitary sewage sludge	Land disposal	15'-50'x 200'-300'x 5' (deep)	Sludge contaminated with uranium
	111.4 : Trench T-7	1954-1968	Sanitary sewage sludge/flattened drums contaminated with uranium	Land disposal	15'-50'x 200'-300'x 5' (deep)	Sludge contaminated with uranium
	111.5 : Trench T-8	1954-1968	Sanitary sewage sludge/flattened drums contaminated with uranium	Land disposal	15'-50'x 200'-300'x 5' (deep)	Sludge contaminated with uranium
	111.6 : Trench T-9	1977	Sanitary sewage sludge/flattened drums contaminated with uranium/unknown metal	Land disposal	50'x300'x 5' (deep)	Sludge contaminated with uranium
	111.7 : Trench T-10	1977	Sanitary sewage sludge/flattened drums contaminated with uranium/scrap metal	Land disposal	50'x300'x 5' (deep)	Sludge contaminated with uranium
	111.8 : Trench T-11	1977	Sanitary sewage sludge/flattened drums contaminated with uranium/plutonium and uranium contaminated asphalt planking from solar evaporation ponds	Land disposal	50'x300'x 5' (deep)	Sludge contaminated with uranium

Table 5 (cont.)

Reference Number*	Unit	Date(s) Operated	Materials Handled	Activity	Approximate Dimensions	Comments
112	903 Drum storage area	1958-1968	Plutonium and uranium contaminated lathe coolant (hydraulic oil with carbon tetrachloride)/trichloroethylene/perchloroethylene/silicone oils/acetone still bottoms	Storage	400'x400'	Some drums known to have leaked (estimated 5,000 gallons) to soil base, drums removed, area asphalt capped
113	Mound area	1954-1958	Uranium/beryllium/plutonium/lathe coolant/still bottoms/glass/concreted dry wastes	Land disposal	50'x160'	Drums excavated and removed in 1970
114	Present landfill	1968 to present	Nonhazardous/hazardous waste	Land disposal	Over 25 acres	See text
115	Original landfill	1952-1968	General plant wastes/20 kg depleted uranium ash/unknown chemical waste	Land disposal	Irregular, may be over 300'x650'	-
116	Multiple solvent spills	-	-	-	-	-
	116.1 : West loading dock area	Prior to 1979	Unknown solvents and hydrocarbons	Storage	50'x100'	Drums stored on loading dock thought to have leaked
	116.2 : South loading dock area	Prior to 1979	Unknown solvents and hydrocarbons	Storage	30'x50'	Drums stored on loading dock thought to have leaked
117	Chemical storage area	-	-	-	-	-
	117.1 : North Site	Prior to mid-1970s	Miscellaneous "warehouse" materials	Storage	200'x450'	-
	117.2 : Middle site	Prior to mid-1970s	Nonradioactive chemicals including acids/oils/soaps/solvents	Storage	200'x450'	Leaks and spills have occurred in this area

Table 5 (cont.)

Reference Number*	Unit	Date(s) Operated	Materials Handled	Activity	Approximate Dimensions	Comments
	117.3 : South site	Prior to mid 1970s	Pallets/cargo containers/new drums	Storage	200'x450'	-
118	Multiple solvent spills	-	-	-	-	-
	118.1 : West of Bldg. 730 (5,000-gallon tank)	Late 1970s, 1981	Carbon tetra-chloride/ possibly trichloroethylene	Storage	50'x180'	Leaks and spills during filling operations at below grade storage tank
	118.2 : South end of bldg. 776 (several tanks)	Late 1970s, 1981	Carbon tetra-chloride/ possibly trichloroethylene	Storage	30'x90'	Leaks from inside (bldg. 776) tanks pumped outside on ground
119	Multiple solvent spills	-	-	-	-	-
	119.1 : West area	1967-1971	Unknown solvents	Storage	100'x600' (irregular)	Spills and leaks may have occurred, waste oils sprayed on area roads
	119.2 : East area	1967-1971	Unknown solvents	Storage	100'x200'	Spills and leaks may have occurred, waste oils sprayed on area roads
120	Fiberglassing areas	-	-	-	-	-
	120.1 : North of bldg. 664	1972-1979 (?)	Polyester resin/ peroxide catalyst/ unknown solvents	Fiberglassing of waste packaging	100'x100'	Materials may have spilled during activity
	120.2 : West of bldg. 664	1972-1979 (?)	Polyester resin/ peroxide catalyst/ unknown solvents	Fiberglassing of waste packaging	100'x120'	Materials may have spilled during activity
121	Original process waste lines	1952-1984	Process waste-water (radioactive/nonradioactive compounds)	Transport of wastes through underground pipeline	Throughout site process areas (about 27,400 feet of pipe)	Leaks/breaks have contaminated soils will be closed under interim status
122	Underground concrete tank (3,000-gallon)	1953-1982	Process waste-water (nitrates/ possible radionuclides)	Storage	50'x50'	Tank may have leaked
123	Valve Vaults					
	123.2 : Valve Vault West of Bldg. 707 123.7 : Valve Vault 7	1952-1984	Possible uranium/ solvents/oils/ beryllium/ nitric and hydrochloric acids/fluorides	Pipeline	30'x30'	Vaults contain valves controlling waste lines, vaults have overflowed with process wastes

Table 5 (cont.)

Reference Number*	Unit	Date(s) Operated	Materials Handled	Activity	Approximate Dimensions	Comments
124	Reactive liquid waste storage tanks (south side of bldg. 774) 124.1 : 30,000-gallon tank (#60) 124.2 and 125 : 14,000-gallon tank (#66) 124.3 : 14,000-gallon tank (#67)	1952 to present	Plutonium/ americium/ possibly uranium/nitrates	Storage	30'x50'	Overflow/spills from waste storage tanks or pipelines in late 1970s and early 1980s
126	Out-of-service process waste tanks (north of bld. 771) 126.1 : Westernmost tank (20,000 gallons) 126.2 : Easternmost tank (20,000 gallons)	1953 to 1976 (?)	Unknown process wastes	Storage	50'x50'	Concrete underground tanks may have leaked waste when active, occasionally fill with groundwater which is treated onsite
127	Low-Level radioactive waste leak	Unknown	Process wastewater (nitrates/ plutonium)	Pipeline	20'x100'	Pipeline broke and leaked several times
128	Oil burn pit No. 1	August 1956	Waste oil with depleted uranium	Land disposal	50'x150'	Oil burned in pit and covered with soil
129	Oil leaks from underground tank (four tanks - 18,000 gal. each)	1952 to present	Fuel oil/1,1,1-trichloroethane	Storage	50'x100'	Known leaks/spills from tanks
130	Radioactive site - 800 area site #1	1969 to 1972	Plutonium contaminated soil/ asphalt/scrap metal	Land disposal	Triangle 550'x110'x 1080'	Shallow burial of contaminated debris
131	Radioactive site - 700 area site #1 (3 areas)	1969-?	Plutonium	Fire	100'x180' 30'x350' 50'x100'	Areas contaminated during 1969 fire
132	Radioactive Site - 700 Area Site #4 (four radioactive waste tanks)	Unknown-1982	Unknown radioactive compounds	Storage	20'x40'	Tanks held radioactive laundry waste and probably leaked, no longer used but fill with groundwater
133	Ash pits 133.1 : Ash pit I-1 133.2 : Ash pit I-2 133.3 : Ash pit I-3 133.4 : Ash pit I-4 133.5 : Incinerator 133.6 : Concrete wash pad	1952-1968	Office wastes/ depleted uranium chips/metal	Land disposal	8'x50'x 3' deep (each pit) wash pad is 40' diameter	Incinerator used to burn "general" wastes and some depleted uranium. Ashes placed in pits or pushed over hill to concrete wash pad and into Woman Creek drainage, pits currently covered with fill

Table 5 (cont.)

Reference Number*	Unit	Date(s) Operated	Materials Handled	Activity	Approximate Dimensions	Comments
134	Lithium metal destruction site	Unknown	Lithium metal	Land disposal	50'x150'	Lithium reacted with water in shallow trench covered with soil, area covered by bldg. 335
135	Cooling tower blowdown	Unknown	Chromates/ algicides	Storage	100'x150'	Disposal of cooling tower blowdown
136	Cooling tower ponds					
	136.1 : Northeast corner of bldg. 460	1963-1969	Chromates/ algicides/	Land disposal	25'x75'	Used to contain and evaporate cooling tower water. Also may have reacted lithium and disposed of depleted uranium
	136.2 : West of bldg. 460	1963-1969	lithium/ possible uranium/ hexavalent chromium	Land disposal lithium treatment	25'x75'	
	136.3 : S of Bldg. 460, W. of Bldg. 444	1963-1969		Land disposal lithium treatment	30'x100'	
137	Cooling tower blowdown - bldg. 774	Unknown	Chromates/ algicides	Land Disposal	50'x150'	Cooling tower blowdown discharge to ground
138	Cooling tower blowdown - bldg. 779	Dec. 1976	Chromates/ algicides	Land disposal	75'x75'	400 gallons cooling tower blowdown spilled
139	Caustic/acid spills					
	139.1 : Hydroxide tank area (1 5,400-gallon, 1 6,500 gallon tank)	Unknown	Potassium/sodium hydroxide	Storage	25'x250'	Leaks/spills from storage tanks
	139.2 : Hydrofluoric acid tanks (2 1,200-gallon tanks)	Unknown	Hydrofluoric acid	Storage	40'x60'	Leaks/spills from storage tanks
140	Reactive metal destruction site	1956-1970	Lithium/sodium/ calcium/magnesium/ unknown solvents	Land disposal	250'x350'	Destruction of various materials including 400-500 pounds metallic lithium-residues buried
141	Sludge dispersal	Prior to 1983	Sanitary sludge/ radioactive soil	Storage	200'x200'	Radioactive sludge dispersed by wind from sanitary drying beds
142	Retention Ponds (A,B,C-Series)	1952 to present	Nitrates/ plutonium and uranium	Storage (surface impoundments)	Varies, depending on season	These are surface impoundments located on North Walnut Creek (A), South Walnut Creek (B) and Woman Creek (C). Primarily used to retain surface runoff for sampling and analysis prior to release or reuse. Ponds A-1, B-1, B-2, B-3, B-4 and C-1 have received various wastes with nitrates and low level radioactivity
	142.1 : A-1 pond					
	142.2 : A-2 pond					
	142.3 : A-3 pond					
	142.4 : A-4 pond					
	142.5 : B-1 pond					
	142.6 : B-2 pond					
	142.7 : B-3 pond					
	142.8 : B-4 pond					
	142.9 : B-5 pond					
	142.10 : C-1 pond					
	142.11 : C-2 pond					

Table 5 (cont.)

Reference Number*	Unit	Date(s) Operated	Materials Handled	Activity	Approximate Dimensions	Comments
143	Old outfall (Process and/or laundry wastewater)	Mid 1950s to 1974	Sodium/plutonium sulfates/nitrates plutonium/unknown radioactive compounds	Storage	50'x50'	Process and/or laundry wastewater discharged to North Walnut Creek from bldg. 771. Some radioactive soil has been excavated
144	Sewer line break (Between bldg. 779 and 777)	Unknown	Sanitary/laundry wastewater (unknown radioactive compounds)	Leak	20'x50'	Breaks in a 6' PVC sanitary wastewater line
145	Sanitary wastewater line leak (South of bldg 881)	January 1981	Sanitary wastes/ unknown radioactive compounds	Leak	20'x150'	
146	Concrete process waste tanks 146.1 : 7,500-gallon tank (#31) 146.2 : 7,500-gallon tank (#32) 146.3 : 7,500-gallon tank (#34W) 146.4 : 7,500-gallon tank (#34E) 146.5 : 3,750-gallon tank (#30) 146.6 : 3,750-gallon tank (#33)	Late 1950s-1970	Plutonium/uranium/ acids/caustics/ sodium/potassium sulfur/nitrates	Storage	75'x75'	Leakage/overflow from process aqueous waste tanks - some contaminated soil removed. Tanks removed early 1980s and southern addition to bldg. 774 was built over tank area
147	Process waste leaks 147.1 : Maas Area 147.2 : Owen Area	Unknown	Unknown process wastes	Leaks	- 30'x250' 60'x60'	Process waste lines from bldg. 881 have leaked resulting in soil contamination
148	Bldg. 123 waste spills	Unknown	Unknown radioactive and chemical wastes/ nitrates	Spills	200'x200'	Several small spills outside bldg. 123
149	Bldg. 774 effluent pipe	Prior to 1980	Unknown radioactive materials/ acids/caustics	Leak	20'x550'	Effluent pipe from bldg. 774 to 207 solar evaporation ponds leaks. Some contaminated soil removed. Effluent pipe out of service
150	Radioactive liquid leaks 150.1 : North of bldg. 771 150.2 : West of bldg. 771 150.3 : Between bldg. 771 and 774 150.4 : East of bldg. 750 150.5 : West of bldg. 707 150.6 : South of bldg. 779 150.7 : South of bldg. 776 150.8 : Northeast of bldg. 779	Unknown	Unknown radioactive compounds/ liquid mixed wastes/acids/ caustics	Spills/leaks	- 50'x450' 70'x250' 100'x140' 120'x180' 150'x250' 100'x200' 100'x500' 80'x120'	Areas in the 700 area where liquid process waste has spilled/leaked. Includes leaking storage containers, broken lines and a May 1969 fire in bldg. 776-777. Radioactive soils reportedly removed

Table 5 (cont.)

Reference Number*	Unit	Date(s) Operated	Materials Handled	Activity	Approximate Dimensions	Comments
151	Fuel oil tank leak	1981	#2 fuel oil	Leak	30'x25'	200 gallons oil leaked from tank. Soil removed
152	Fuel oil tank spill	1952 to present	#6 fuel oil	Spill	50' diameter	1971 - 700 gallons spilled; 1979 - 400 gallons spilled. Soil removed
153	Oil burn pit No. 2	1957/1961-1965	Waste oil/ depleted uranium/ still bottom sands	Land disposal	50'x60'	Material from 1083 drums burned in two trenches, empty drums buried. Soil/material to a depth of about 5 feet removed in 1978
154	Pallet burn site	1965	Unknown chemical and radioactive compounds/wood pallets	Land disposal	50'x100'	Pallets, presumably with spilled material, burned; area "cleaned" in 1970s
155	903 lip area	Unknown	Plutonium/unknown mixed wastes	Storage	700'x1250'	Wind/runoff dispersal of contaminants from 903 area (#112). Some soil removed/radioactive contamination remains
156	Radioactive soil burial 156.1 : Bldg. 334 parking lot 156.2 : Soil dump area	Unknown -	Radioactive material	Land disposal	- 160'x280' 300'x850'	Plutonium-contaminated soil from around bldg. 774 placed in 156.1 area. Some soil removed to 156.2 area prior to construction of bldg. 334 parking lot
157	Radioactive site 157.1 : North area 157.2 : South area	Prior to 1973	Uranium/beryllium/ unknown chemicals (possibly solvents)	Spill/leaks	- 150'x300' 440'x520'	Soil around bldgs. 440, 442, 444, 447, 439 thought to be contaminated from facility activities. Some cleanup of radioactive materials occurred
158	Radioactive site - bldg. 551	1963-1970	Unknown wastes/ uranium	Spills from loading	200'x250'	Area used to load radioactive wastes onto railroad cars
159	Radioactive site - bldg. 559	1968 to present	Process waste- waters	Broken process waste lines	25'x75'	Several process line breaks; radioactive soil removed

Table 5 (cont.)

Reference Number*	Unit	Date(s) Operated	Materials Handled	Activity	Approximate Dimensions	Comments
160	Radioactive site - bldg. 444 parking lot	Unknown	Plutonium/uranium waste	Storage	480'x580'	Leaks from drums/boxes storing radioactive wastes; some soil removed; contamination believed to remain
161	Radioactive site - bldg. 664	Unknown	Plutonium/uranium waste	Storage	200'x250'	Leaks from drums/boxes storing radioactive wastes; some soil removed; contamination believed to remain
162	Radioactive site - 700 area Site #2	1974	Unknown radioactive compounds	Spills	50'x2,000'	Radioactive spots on 8th street; paved over
163	Radioactive site - 700 area Site #3 163.1 : Wash area 163.2 : Buried slab	Unknown	Unknown Radioactive compounds/ americium	Land disposal	60'x150' 50'x50'	Area used to wash radioactive contaminated equipment
164	Radioactive site - 800 area site #2 164.1 : Concrete slab	1958	Uranium/unknown radioactive compounds	Land disposal	50'x80'	Contaminated concrete disposal; some concrete and soil removed
	164.2 : Bldg. 886 spills	1958	Uranium/unknown radioactive compounds	Spills	100'x200'	Unknown materials may have infiltrated beneath bldg. 886
	164.3 : Bldg. 889 storage pad	1958	Uranium/unknown radioactive compounds	Storage	60'x60'	Temporary storage of uranium contaminated equipment
165	Triangle area	1966-1975	Plutonium contaminated wastes/acids; rubble from 1969 fire	Land disposal	400'x460'x250'	Leaks from drums (up to 6,000) stored in this area have contaminated soil. Some soil removed
166	Trenches 166.1 : Trench A 166.2 : Trench B 166.3 : Trench C	Unknown	Uranium/plutonium contained sanitary sludge and unknown chemicals	Land disposal	80'x230' 80'x230' 30'x100'	Sanitary sludge from treatment plant disposed in trenches A, B and possibly C
167	Landfill spray fields - three sites 167.1 : North area 167.2 : Pond area 167.3 : South area	1968(?) to present	Landfill runoff collected in landfill pond	Land treatment	200'x200' 300'x300' 400'x400'	Liquid from the landfill pond was sprayed onto the land in three areas. Spray irrigation presently only in pond area (167.2)
168	West spray field	1977-1985	Liquids from solar evaporation ponds	Land treatment	110 acres	See text

Table 5 (cont.)

Reference Number*	Unit	Date(s) Operated	Materials Handled	Activity	Approximate Dimensions	Comments
169	Waste peroxide burial (one 55-gallon drum)	Unknown	Hydrogen peroxide	Land disposal	25'x50'	One drum of hydrogen peroxide buried in chemical storage area
170	P.U. & D. storage yard - waste spills	1974(?) to present	Solvents, metal shavings with lathe coolants/used oils/battery acids	Storage	260'x1000'	Leaks from materials in storage have contaminated soil
171	Solvent burning ground	1960s-1970s	Unknown solvents	Training	50'x50'	Waste solvents burned on ground for fire training
172	Central Avenue waste spills	1968	Plutonium contaminated oils/lathe coolant (70% hydraulic oil - 30% carbon tetrachloride)	Spills	6000'x60'	Spills on road resulted during transport of drums from 903 storage area to treatment; asphalt seal-coated
173	Radioactive site - 900 area (Storage vaults and bldg. 991)	1952 to present	Uranium/plutonium/beryllium	Storage	220'x 340'	Leaks during storage of materials
174	Property Utilization and Disposal (P.U. & D.) container storage facilities	1974-1985	Oil with hazardous constituents/low level radioactivity	Storage	60'x60'	Container and dumpster storage areas; possible spills
175	Swinerator and Walberg (S&W) bldg. 980 container storage facility	1980 to present	Used oil/xylene	Storage	25x25'	Spills from containers
176	S&W contractor storage yard	1970-1985	Solvents/oils/toluene/mineral spirits	Storage	300'x400'	Spills from containers
177	Bldg. 885 drum storage area	Mid-1950s to present	Oils/solvents/low level radioactivity	Storage	2 10'x20' areas	Spills from containers
181	Bldg. 334 cargo container area	1984-1986	Oils/solvents/coolants/possible low level radioactivity	Storage	8'x20'	Drum storage in cargo container
182	Bldg. 444/453 drum storage area	Late 1960s to 1986	Oils/solvents/possible radioactives	Storage	1700 ft. ² (irregular)	Spills from containers
183	Gas detoxification area (Bldg. 952)	1982-1983	Nitrogen oxide/chloride/hydrogen sulfide/sulfur tetrafluoride/methane/hydrogen fluoride/ammonia	Treatment	20'x50'	Gases detoxified in bldg.; residual glassware was rinsed, disposed in landfill

Table 5 (cont.)

Reference Number*	Unit	Date(s) Operated	Materials Handled	Activity	Approximate Dimensions	Comments
184	Bldg. 991 steam cleaning area	1953-1978	Unknown radio-active compounds	Land disposal	50'x50'	Area may have been used to steam clean radio-active equipment and drums; effluent collected and treated
185	Bldg. 707 solvent spill	Nov. 19, 1986	1,1,1-trichloro-ethylene	Spill	30'x60'	Drum leaked about 5 gallons solvent; liquid collected with sorbent
186	Process line near valve vault 12	Oct. 24, 1986	Uranium contaminated process waste/unknown chemicals	Spill	30x100'	Both primary and secondary process waste lines broke and leaked waste. Some soils removed
187	Acid leaks (Bldg. 443/444)	1970	Sulfuric acid	Leak		1500 gallons acid leaked from bldg. 443, flowed eastward, several hundred gallons spilled north of bldg. 444
188	Acid leak (Bldg. 374)	1983	Nitric/hydrochloric acid	Leak		Leaked near east gate of bldg. 374
189	Multiple acid spills (Bldg. 881)	Unknown	Acids	Spill		Acid spilled north and west of bldg. 881
190	Caustic leak (400 area)	1978	Sodium hydroxide	Spill		Material released from steam plant catch basin; diverted to pond B-1 (South Walnut Creek); neutralized and pumped to solar evaporation pond
191	Hydrogen peroxide spill (400 area)	1981	Hydrogen peroxide	Spill		55-gallon drum ruptured; liquid confined in hole; covered with soil
192	Antifreeze discharge	1980	Ethylene glycol	Spill		Spilled through bldg. 708 floor drain; diverted to pond B-1
193	Steam condensate leak (400 area)	1979	Steam condensate/amines	Leak		Steam condensate line leaked; line out of service
194	Steam condensate leak (700 area)	1979	Steam condensate/amines	Leak		Leak near bldg. 707; liquid diverted to pond B-4

Table 5 (cont.)

Reference Number*	Unit	Date(s) Operated	Materials Handled	Activity	Approximate Dimensions	Comments
195	Nickel carbonyl disposal	Unknown	Nickel carbonyl	Land disposal		Gas vented from bottles lowered into hole; several bottles buried
196	Water treatment plant backwash pond	1970s	Aluminum sulfate, lime, chlorine	Land disposal		Backwash disposed in surface impoundment on south side of bldg. 124; pond "destroyed" when surface drainage collection rerouted.
197	Scrap metal disposal sites	Pre-1980s	Unknown scrap metal possibly transformers	Land disposal		Metal buried in two locations southwest of bldg. 559; removed early 1980s

* Reference to Figure 6

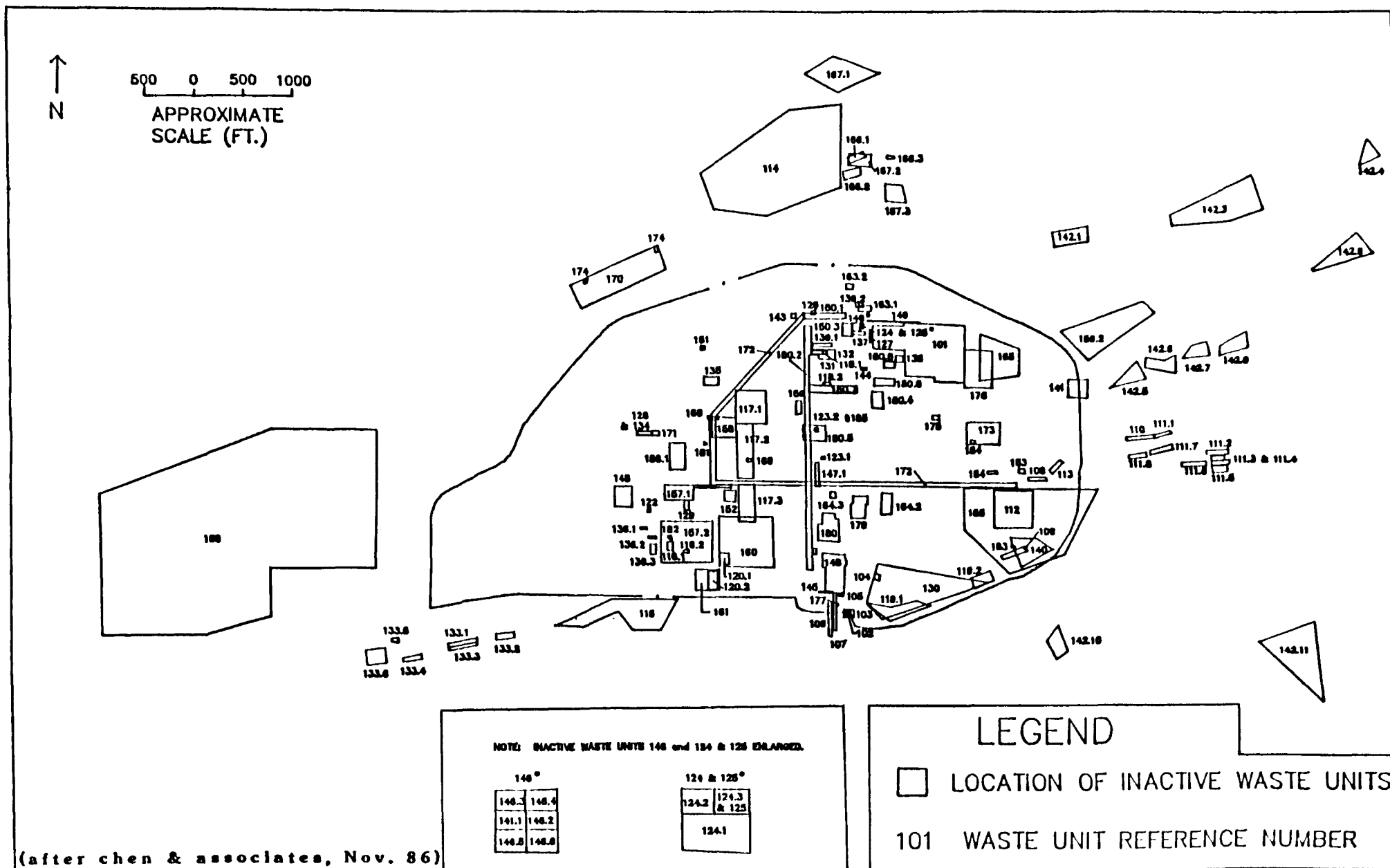


FIGURE 6

SOLID WASTE MANAGEMENT UNITS AT THE ROCKY FLATS PLANT

Units Requiring RCRA Ground-Water Monitoring

These are units requiring ground-water monitoring under State and Federal hazardous waste regulations at the time of the Task Force investigation and include:

- Solar evaporation ponds
- West spray field
- Active landfill

Solar Evaporation Ponds

Rocky Flats has used a series of surface impoundments for waste storage/evaporation. The first pond, constructed in December 1953, was about 100 feet by 200 feet, clay lined and located near 207C pond [Figure 6]. This pond was reconstructed in 1970 to form the present 207C pond. Impoundments 207A and 207B (a series of three ponds, designated as North, Center and South) were placed in service in 1956 and 1960, respectively. The 207 impoundments originally were lined with asphalt over wooden planking. These linings cracked and slumped (resulting in leakage) and were (with the possible exception of 207C) relined at least once with asphaltic concrete, PETROMAT®, burlap and asphalt. Pond 207B-South was relined with high density polyethylene of unspecified thickness.

Estimated operating dimensions and capacities for the evaporation ponds are given in Table 6.

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Table 6
SOLAR EVAPORATION DIMENSIONS
(from March 1987 Closure Plan)

Pond Designation	Liquid Coverage* (feet)	Maximum Depth* (feet)	Maximum Volume* (x10 ⁶ gallons)
207A	230 x 505	7.5	5.7
207B - north	175 x 245	6.5	1.7
207B - center	175 x 245	6.5	1.7
207B - south	175 x 245	5.5	1.5
207C	155 x 245	7.0	1.2

* With 2 feet freeboard

As a result of leakage from these impoundments, six interceptor trenches were installed in the 1970's in the hillside just north of the units to intercept leachate prior to any contamination reaching North Walnut Creek. Liquid collected in the trenches was pumped back to the 207A and B ponds. A french drain system, which drains to a wet well, was installed in 1980 and 1981 to replace the trenches (which are no longer used). Liquids collected in the wet well are currently pumped to the 207B-North and Center ponds.

Historically, the impoundments were used to store/evaporate various process aqueous wastes including those with low-level radioactivity, high nitrates, acids and aluminum hydroxide. Other wastes thought to have been placed in these units include sanitary sewage sludge from the onsite treatment plant, lithium metal, sodium nitrite, ferric chloride, lithium chloride, tertiary treated sanitary effluent, ammonium persulfite, hexavalent chromium, cyanide solution and hydrochloric, nitric and sulfuric acids. Low concentrations of various solvents used at Rocky Flats may also have been present in aqueous wastes placed in the impoundments.

Rocky Flats is in the process of closing these surface impoundments. Solids are being removed from 207A. Ponds 207B-North and Center are receiving leachate from the french drain collection system. Pond 207B-South

has not been used regularly since 1985/1986 and is for emergency use and evaporation of liquid from 207A.

The facility has conducted sampling and analysis of liquid/sludge from the surface impoundments. The results indicate the presence of both radioactive and hazardous constituents in both liquid and sludge portions of the surface impoundments.

Between 1977 and October 1985, liquid from 207B-North was sprayed on the west spray field (see following discussion).

West Spray Field

Rocky Flats spray irrigated liquid from the solar evaporation ponds (207B-north and center) onto an area west of the process facility [Figure 6] from 1977* (1982) to October 1985. Although direct application was made on 38.8 acres, DOE/Rockwell documents indicate that about 105 acres were probably affected due to wind-blown spray, runoff and runoff.

Liquid application has been by moving spray irrigation lines mounted on metal wheels, fixed irrigation lines and impulse cannons. Irrigation occurred intermittently whenever ponds 207B-North or Center reached storage capacity. The application rates were reportedly based on internal policy generally based on nitrate loadings and visual physical effects (erosion, runoff).

Although complete analysis of the constituents present in the irrigated liquid is not available, some general analyses were made in 1984 and 1985. Nitrates ranged from below detection limits to over 1,350 parts per million (ppm), pH ranged from 7.4 to 11.2, gross alpha activity varied between 59 and 323 pCi/L and gross beta between 74 and 163 pCi/L. Silver was found at 0.082 ppm and selenium at 0.02 ppm (both above primary drinking water standards of 0.05 ppm and 0.01 ppm, respectively). Organics, such as trichloroethane,

* April 1987 Waste Identification and Characterization Study Report indicates 1977 as the starting date while the facility RCRA Part B permit application Closure Plan cites the starting date as 1982.

trichloroethene, carbon tetrachloride, chloroform and acetone, have also been detected in "trace" amounts (1 to 3 ppb).

DOE and Rockwell have been studying contaminant distribution of the west spray field and have proposed to close the units according to a closure plan submitted in the November 1986 Part B permit application.

Active Landfill

Use of the present Rocky Flats landfill began in 1968 and is located in the western end of an unnamed tributary to North Walnut Creek, north of the process facility [Figure 6]. Prior to initial landfilling, the west end of the tributary was filled with soil (from onsite) to a depth of 5 feet across the width of the channel and about 20 feet in length. A surface water interceptor ditch was constructed to divert surface runoff around the landfill. In 1974, a ground-water/leachate collection system was installed around the base of the landfill (below the waste level) to intercept and divert ground water flowing toward the waste and remove any leachate generated within the landfill. Both systems were reportedly keyed to the underlying bedrock and discharged to the east or west landfill ponds (since removed).

Since 1981, the landfill has expanded beyond the confines of these collection systems. Two slurry walls (one north and one south of the landfill) were installed in 1981 to allow for expansion. The slurry walls, reportedly keyed into bedrock, are connected to the ground-water/leachate collection system on the west and extend about 700 feet eastward (the direction of landfill working face). No leachate has reportedly been collected in the leachate system.

Over 100,000 cubic yards of waste have been disposed of in the landfill, which covers more than 25 acres. The November 1986 RCRA Part B permit application for the Rocky Flats plant indicates that about 330 of the 1,500 waste streams known to be generated at the facility have been disposed of in the landfill. Of these, about 240 are considered to be nonhazardous items such as general office trash, empty containers, Kimwipes, rags, dried sludge and electrical components (wire, batteries, etc.). About 90 of the waste streams are

hazardous or have hazardous constituents. These include: Kimwipes and rags contaminated with paint, solvents; resins, filters (oil, water, paint, etc.); containers with acids, caustics and solvents; and metal cuttings and shavings with hydraulic oil and carbon tetrachloride. A tritium source has also been identified in the landfill. Daily monitoring of the disposed waste for radioactivity did not begin until 1973.

SITE HYDROGEOLOGY

The Rocky Flats plant is currently involved in a phased program of characterizing site geology, hydrogeology and water quality in suspected areas of contamination. These activities are being conducted under requirements of both the DOE Comprehensive Environmental Assessment and Response Program (CEARP) and the July 1986 Compliance Agreement between DOE, EPA and CDH. Unless otherwise specified, the information presented here is a summary of that reported in the November 1986 Part B and discussions with facility personnel and contractors during the Task Force inspection.

HYDROGEOLOGIC UNITS

The plant is on the northwestern flank of the Denver Basin [Figure 7], which is an asymmetrical syncline with a north-south trending axis. The syncline has a steep western flank and a more gently dipping eastern flank. Bedrock strikes from north to south and dips from 5 to 50° to the east in the vicinity of the plant. The most steeply dipping beds are west of the plant site. Beneath and east of the plant, dips are relatively constant, at approximately 10°. Surficial deposits are primarily the Rocky Flats Alluvium and colluvial materials; underlying bedrock includes the Arapahoe, Laramie, Fox Hills and Pierre Shale Formations.

The Rocky Flats Alluvium, mixed alluvial materials in the valleys and colluvium (slope wash) [Figure 8] were deposited in alluvial fans at the base of the Colorado Front Range Mountains. Following deposition, the material was partially removed by erosion and the resulting drainages were infilled with more recent sediments. The Rocky Flats Alluvium consists of poorly-sorted sand, gravel and cobbles. The largest materials are generally cobble-sized, but occasionally boulders are also present in the sand and gravel matrix. The alluvium is locally cemented with calcium carbonate. The thickness of the alluvium ranges from 100 feet, on the west, to less than 11 feet on the eastern edge of the plant. The alluvial deposits in the drainages comprise reworked and weathered Rocky Flats Alluvium and weathered bedrock. Colluvial materials cover most of the slopes between the top of the Rocky Flats Alluvium and the channel bottoms. These materials are derived from both the Rocky

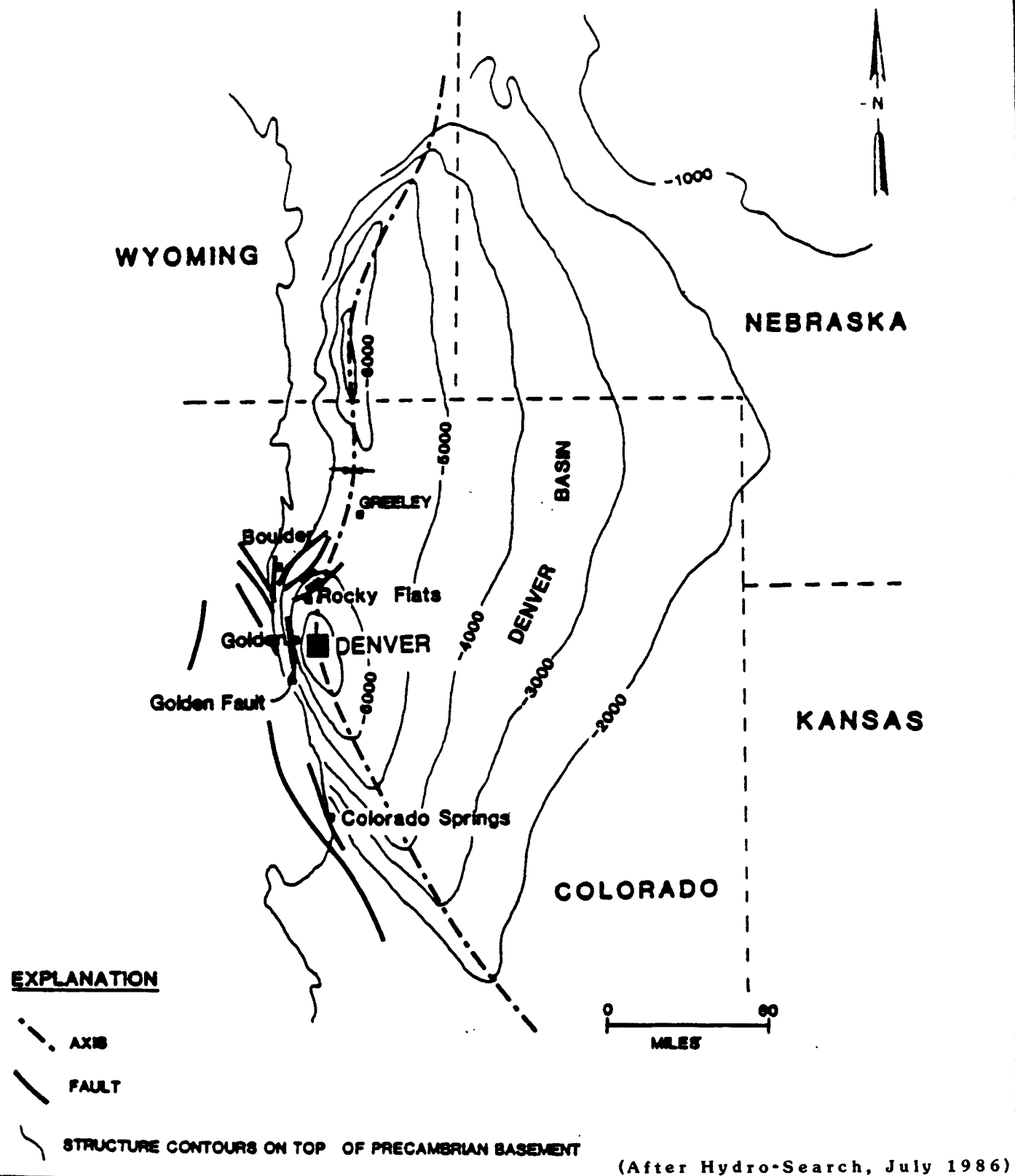
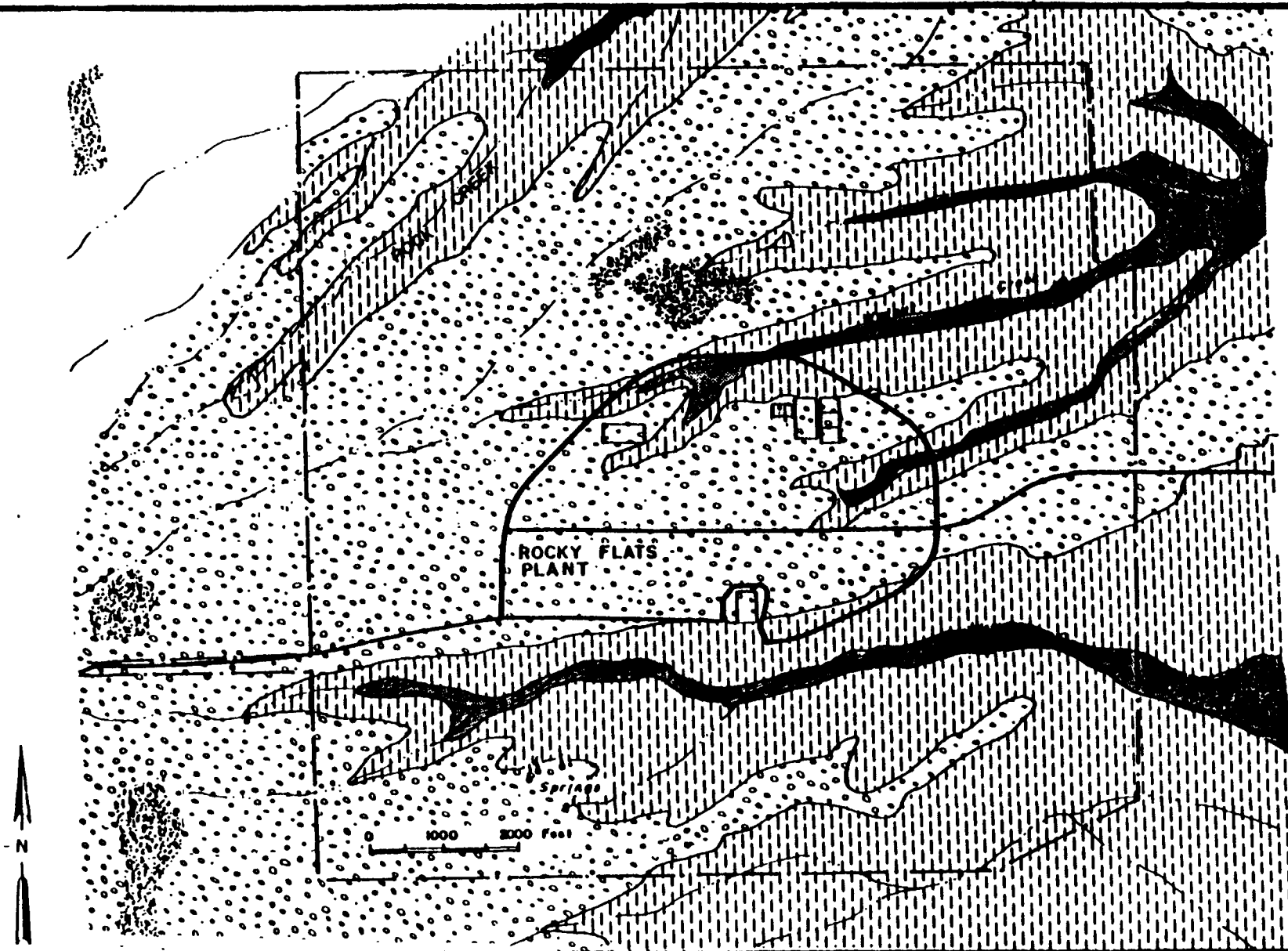


Figure 7

Structure of the Denver Basin






-  Rocky Flats Alluvium
-  Slope Wash
-  Valley Fill

Figure 8

Surficial Geology

(After Hydro-Search, July 1986)

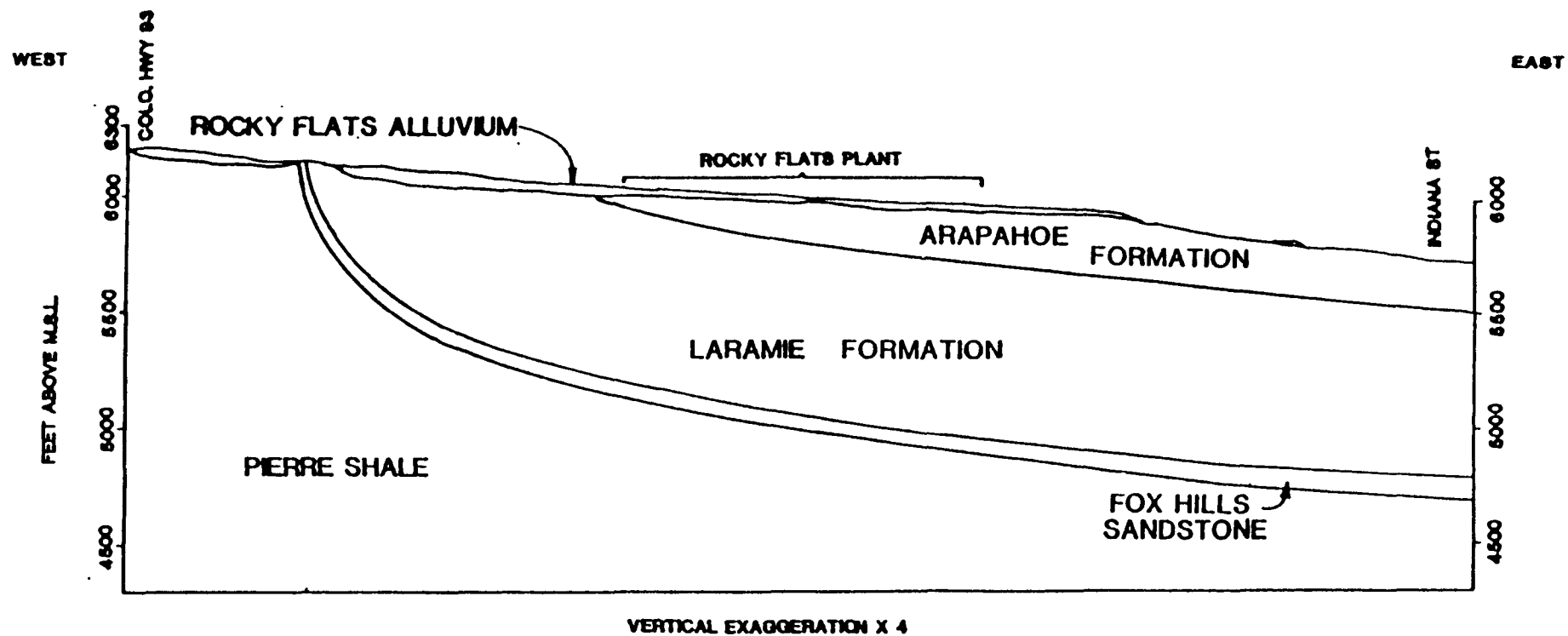
Flats Alluvium and the bedrock. They are generally fine to medium grained sands and silts with occasional gravel and boulders. The thickness ranges from 0 to 5 feet.

The underlying bedrock includes about 13,000 feet of sedimentary rock, deposited as a result of several episodes of mountain building, and several oceanic transgression and regression cycles. The sedimentary rock overlies the Precambrian basement [Figure 9].

The Arapahoe Formation underlies the Rocky Flats Aluvium. It consists of fluvial claystones with interbedded lenticular sandstones and siltstones deposited following major uplift of the Front Range and downwarp of the Denver Basin. The claystones are olive grey to dark grey, poorly cemented, silty and contain up to 15% organic material. The sandstones are light grey to yellowish grey, very fine to medium grained, with approximately 15% silt and clay. The siltstones exhibit the same coloration, constituents and sedimentary structures as the sandstones; however, they consist predominantly of silt-sized particles.

Weathering of the Arapahoe Formation has penetrated to depths ranging from 10 to 40 feet below the base of the surficial materials. The weathered zone is slightly fractured and mottled dark yellowish brown and contains iron oxide concretions. Unweathered bedrock generally occurs between 18 and 60 feet below ground surface and is also slightly fractured.

The Laramie and Fox Hills Formations contain sandstones, siltstones, claystones and coals deposited in fluvial-deltaic and lacustrine environments. The deposition of the Laramie was influenced and then stopped by the Laramide Orogeny, a major mountain building event that caused the uplift of the Colorado Front Range of mountains. The Laramie Formation is further divided into the upper claystone unit consisting of dark olive grey, poorly cemented claystones and the lower sandstone unit which consists of light to medium grey, very fine to medium grained, well sorted sandstones.



(After Hydro-Search, July 1986)

Figure 9

Generalized Geologic Cross-Section

The Fox Hills Formation is a marine sandstone deposited during the regression of the Cretaceous seaway from the Denver Basin. The sandstones are olive to light brown, fine-grained, well sorted, quartzose sands with up to 25% rock fragments. The sands are thinly bedded and display laminar or planar crossbedding. Marine fossils are predominant in the lower portions of the formation and terrestrial plant fossils are more abundant in the upper portion. The contact between the Fox Hills and Laramie Formations is gradational and determined by both the disappearance of marine fossils and the change in color from light brown to light grey.

The Pierre Shale is an olive grey to dark grey, fossiliferous marine shale. It consists of more than 5,600 feet of shales and siltstones. The contact between the Pierre Shale and the Fox Hills Sandstone is gradational and intertongued.

The Rocky Flats Alluvium has been identified as the uppermost aquifer in the November 1986 Part B and other hydrogeologic reports prepared by consultants for DOE. These documents also indicate that some units of the underlying Arapahoe Formation are hydraulically connected to the Rocky Flats Alluvium. By regulatory definition (Part 260.10), the "uppermost aquifer" means "...the geologic formation nearest the natural ground surface that is an aquifer, as well as lower aquifers that are hydraulically interconnected with this aquifer within the facility's property boundary."

DOE/Rockwell have not adequately documented whether the "uppermost aquifer" should include the Arapahoe Formation at the Rocky Flats plant. The extent of hydraulic connection between the Rocky Flats Alluvium and the permeable lenticular sandstones of the Arapahoe Formation, which may be discontinuous, has not been adequately defined near the waste management areas. For example, the hydrology and extent of sandstones in the Arapahoe Formation that outcrop beneath the surface impoundments are poorly defined. These sandstones should be considered as part of the uppermost aquifer for monitoring purposes if they are hydraulically connected to the Rocky Flats Alluvium and could provide pathways for migration of releases from the regulated units.

The extent of hydraulic interconnection between the sandstones of the Arapahoe Formation and the overlying materials is being studied as part of both the CEARP and Compliance Agreement activities.

GROUND-WATER FLOW, DIRECTIONS AND RATES

Although the facility has ongoing hydrogeologic studies, the following information was available regarding ground-water flow. Conflicting information regarding vertical gradients and hydraulic conductivities makes current information regarding flow directions and rates suspect. Further drilling and evaluation of existing and new wells is necessary to adequately characterize areas of interconnection, direction (i.e., downward or lateral ground-water flow directions), and the rates of ground-water flow.

Shallow ground-water flow occurs in the Rocky Flats Alluvium and other alluvial materials under unconfined conditions. The aquifer is recharged by infiltration of precipitation, irrigation and surface water diversion canals. In addition, retention ponds in the drainages onsite may recharge the alluvial aquifer. The alluvial aquifer is dynamic and exhibits large water level changes in response to precipitation and seasonal variations.

Flow directions in the alluvial aquifer generally follow the topography, flowing to the east and toward drainages. Flow is also influenced by the configuration of the top of bedrock. Plant operations, such as dewatering by foundation drains and heavy irrigation of small areas (spray fields) also modify ground-water flow in the alluvial aquifer.

Facility studies of the potentiometric conditions in the surface material identified large areas where there appears to be little or no saturated thickness. This is due to bedrock nonconformities that either divert ground-water or cause it to surface and flow over the surface. Other ground-water is lost to the atmosphere as either evaporation or transpiration. Because of these anomalies there are large areas of the facility where wells completed through the Rocky Flats Alluvium are dry.

The rate of ground-water flow in the alluvial aquifer has not been adequately characterized by DOE or Rockwell. Two 1986 hydrogeologic reports prepared for DOE/Rockwell* cited hydraulic conductivities and velocities which vary by several orders of magnitude using data from the same wells.

The hydrogeologic reports characterize a strong downward gradient between the alluvial and bedrock aquifers; however, data from paired bedrock and alluvial wells have variable vertical gradients ranging from 0.2 to 1.0. Additional wells need to be drilled near the regulated waste management units to further characterize areas of significant downward flow.

Ground-water flow in the bedrock aquifer of the Arapahoe Formation occurs in lenticular sandstones contained within the claystones. The sandstones are fine grained, silty and clayey units averaging about 5 feet in thickness. Recharge to the Arapahoe sandstones occurs where there is direct contact with the overlying alluvium or leakage through claystones in contact with the alluvium. The units are discontinuous along the strike (north-south) but may be continuous in the down-dip direction (east). Ground-water in the sandstone flows east toward the Platte River.

The hydraulic conductivity of the Arapahoe Formation has been estimated by Rockwell and contractor personnel to range from 1×10^{-7} centimeters per second (cm/sec) for the claystones to 2×10^{-6} cm/sec for the sandstones. The rate of ground-water movement through the sandstone has been estimated by the contractor to be 0.6 feet per year. Wells drilled as part of the CEARP and Compliance Agreement evaluations should also be tested to determine if these values are appropriate.

If the Arapahoe Formation is hydraulically connected to the alluvial aquifer, it should be monitored as part of the uppermost aquifer. The waste management units are completed into the uppermost aquifer and further study is necessary to determine their impact on both the alluvial and the bedrock components of the uppermost aquifer. The extent of the hydraulic connection

* The Draft Work Plan (Appendix E-2 in Part B permit application) titled, "Geological and Hydrogeological Data Summary," pages 14 through 22, dated July 21, 1986, and "Closure Plan for the West Spray Field," dated November 28, 1986

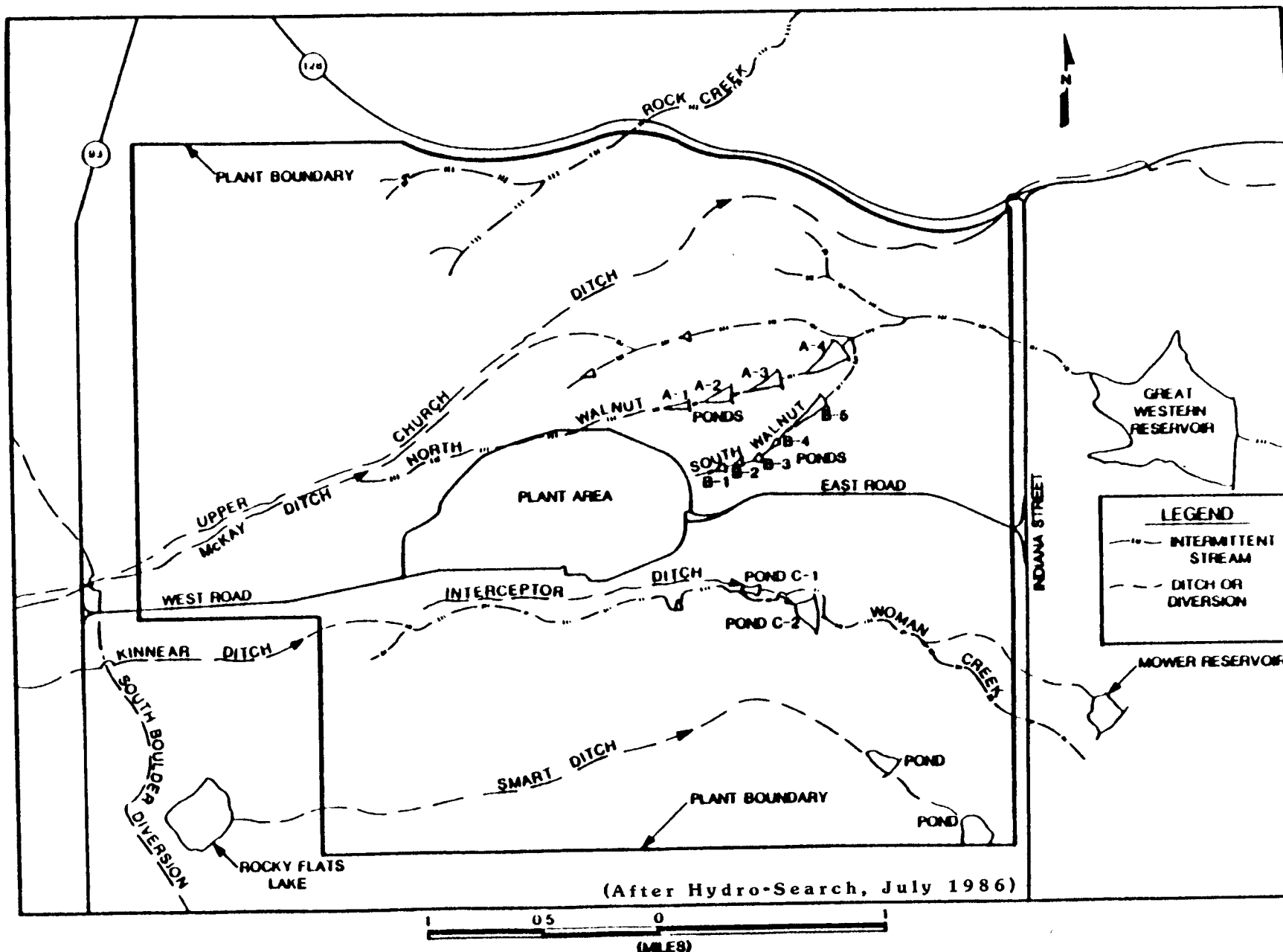
between the alluvial and bedrock aquifers should be further evaluated to determine the depth and geologic unit that monitoring wells need to be completed. Additional work is necessary to characterize ground-water flow in the uppermost aquifer and to determine the extent of any effects that waste handling have had on ground-water quality.

SURFACE WATER HYDROLOGY

The direction of surface water flow affects ground-water flow in the Rocky Flats Alluvium. Three intermittent streams drain the Rocky Flats Plant and flow generally from west to east [Figure 10], the same direction as ground-water flow. Ground water recharges the surface seeps and streams in portions of the property, while surface streams feed ground-water flow in other portions of the facility. Rock Creek drains the northwestern corner of the facility and flows to the northeast in the buffer zone to its confluence with Coal Creek. Woman Creek drains the southern portion of the plant and flows eastward to Standley Lake. North and South Walnut Creeks and an unnamed tributary drain the remainder of the site. The three forks of Walnut Creek join in the buffer zone and flow to Great Western Reservoir approximately 1 mile east.

A series of dams, retention ponds and diversion ditches have been constructed at the plant to control surface water. A series of 11 retention ponds are located in the drainages of Walnut and Woman Creeks and are designated as A, B and C series ponds. These ponds are for surface water run-off control and spill control. Another retention pond is located on the unnamed tributary of Walnut Creek, downstream of the present landfill. Following analysis to determine whether the pond water meets the NPDES permit limitations, the water is spray irrigated in an area south of the landfill.

The Church and McKay diversion ditches cross the northern portion of the facility. Both carry water diverted from Coal Creek to the Great Western Reservoir. A diversion structure has been built in northern Walnut Creek upstream of the plant to divert McKay ditch out of the drainage. The ditches parallel each other north of the present landfill and enter Walnut Creek drainage downstream of the confluence of the north and south forks. There are also a number of runoff control ditches in the vicinity of the plant.



Map of Surface Drainage and Retention Ponds
at Rocky Flats Plant

Figure 10

GROUND-WATER MONITORING DURING INTERIM STATUS

Ground-water monitoring at the Rocky Flats plant has been conducted under the requirements of State and Federal interim status regulations. The RCRA program in Colorado was administered by EPA from November 18, 1981 until November 2, 1984, when CDH became authorized. During this time, however, CDH and EPA had a Memorandum of Understanding, dated December 21, 1981, which specified that the two parties would enter into a Cooperative Arrangement for administration of the program in Colorado.

The objective of the Cooperative Arrangement was to transfer authorities of the Federal RCRA program to the State with a gradual progression of responsibility, enabling EPA personnel to train and oversee State implementation until State regulatory authority could be enacted. Colorado Hazardous Waste Regulations (6 CCR 1007-3) became effective on November 2, 1984 and CDH was granted final authorization for the RCRA program (RCRA equivalents to 40 CFR Parts 264, 265 and 270) on the same day.

DOE challenged the applicability of the Federal RCRA requirements to DOE facilities operating under the Atomic Energy Act (AEA) of 1954 because of interpreted inconsistencies of the RCRA regulations with the AEA. On February 22, 1984, the Secretary of the Department of Energy and the Administrator of the EPA signed a Memorandum of Understanding [Appendix A] regarding respective responsibilities for management of hazardous and radioactive mixed waste.

In this agreement, DOE agreed to require AEA facilities that treat, store or dispose of hazardous waste or radioactive mixed waste onsite, to comply with the requirements of 40 CFR Part 265, until EPA issued a Hazardous Waste Compliance Plan (HWCP - equivalent to a RCRA permit) to the facility. EPA was required to consult with affected states in issuing an HWCP and concerning any violations of standards, appropriate remedies and compliance schedules. In addition, a Federal Court ruling in Tennessee, Legal Environmental Assistance Foundation (LEAF), Inc. v. Hodel on April 13, 1984 determined that

the RCRA program was not inconsistent with the AEA and required DOE to comply with RCRA for hazardous waste management [Appendix B].

DOE submitted a ground-water monitoring program plan to EPA Region VIII on November 19, 1981 for the Rocky Flats plant. The submission stated the DOE position regarding inconsistencies of the RCRA program with AEA. However, the letter stated that "...DOE intends to provide an essentially equivalent program as a matter of interagency cooperation to demonstrate the existence and adequacy of the Rocky Flats ground-water monitoring program."

The submission of this "essentially equivalent" program plan is consistent with DOE internal orders dated December 13, 1982 (DOE Order 5480.2 issued by DOE headquarters) and October 31, 1983 (AL Order 5480.2, subsequently issued by the Albuquerque Operations Office to the Rocky Flats Plant). The orders required DOE facilities to establish ground-water monitoring systems, in accordance with 40 CFR 265, Subpart F, and that these systems be in compliance with the technical requirements of 40 CFR 260 through 265. This is also consistent with the 1984 MOU, the LEAF decision, and the way in which other EPA programs are administered at DOE facilities.

The interim status ground-water monitoring program implemented in 1981, was a "detection monitoring" system. Documents reviewed during the inspection revealed that the 1960 and 1971 series of wells were drilled to determine the extent of the migration of contaminants leaking from the solar impoundments. When an owner or operator knows that ground-water monitoring for indicator parameters, in accordance with 265.91 and 265.92, would show statistically significant differences when compared to background values [265.93(b)], he may install, operate and maintain an alternate monitoring system [equivalent to a ground-water quality assessment program, as described in 265.93(d)(4)]. Although contaminants had been documented in ground water downgradient from the solar impoundments, DOE proposed a detection monitoring program for the facility. This action should have only delayed implementing a ground-water quality assessment program for about 1 1/2 to 2 years (when the statistical comparison would have been made). However, the assessment program was not implemented until after the compliance agreement was signed in 1986.

The following is an evaluation of the interim status ground-water monitoring program between November of 1981, when the ground-water monitoring provisions of the RCRA regulations became effective, and April 1987, when the Task Force investigation was conducted. This section addresses:

- Regulatory requirements
- Ground-water sampling and analysis plan
- Monitoring wells
- Sample collection and handling procedures
- Sample analysis and data quality assessment
- Ground-water Quality Assessment Program Outline

REGULATORY REQUIREMENTS

The RCRA interim status program was administered by EPA from November 1981 until November 1984, when CDH was delegated final authorization. Interim status ground-water monitoring requirements under the EPA program are contained in 40 CFR Part 265, Subpart F. Equivalent requirements under the CDH program are in Part 265 of the Colorado Hazardous Waste Regulations. The State regulations are titled and numbered the same as the Federal counterparts, and are nearly identical to the Federal regulations. However, there is no provision for receiving a waiver from the ground-water monitoring requirements under the CDH program.

GROUND-WATER SAMPLING AND ANALYSIS PLAN

Under the EPA-administered program, DOE/Rockwell developed a plan titled "Groundwater Monitoring Program Plan." The plan was submitted to EPA Region VIII in November 1981 and was, ostensibly, followed until mid-1985, when detection monitoring was suspended. After the Compliance Agreement was completed in 1986, the first phase of the assessment program plan for the evaporation ponds was included in the "Draft Work Plan, Geological and Hydrological Site Characterization" (Work Plan) dated July 21, 1986. Sampling and analysis procedures were described in a companion document

titled "Draft Project Operations Plan, Geological and Hydrological Site Characterization," dated July 25, 1986. Ground-water monitoring procedures in the Project Operations Plan (POP) superseded those in the 1981 plan.

Procedures in the 1981 plan were evaluated by Task Force personnel for compliance with RCRA regulations; the POP procedures were evaluated for adequacy and completeness.

1981 Sampling and Analysis Plan

The 1981 plan addressed all the requirements in Part 265.92(a). It did not, however, contain or reference necessary details of the techniques used and procedures to be followed; therefore, the 1981 plan is inadequate. The plan was followed during interim status sampling in February, May, August and December of 1982 (initial year); November and June of 1983; May, June and August of 1984; and March, April and July of 1985.

The 1981 plan cites a Rockwell sampling manual* and EPA procedures manuals for sample collection, sample preservation and handling, analytical procedures and chain-of-custody. The Rockwell sampling manuals are inadequate for ground-water sampling and the referenced EPA manuals (EPA-530/SW-611, dated August 1977; and EPA-600/4-79-020, dated March 1979), contain multiple procedures for sample collection, preservation and analysis, each of which can yield different results. The referenced documents contain multiple methods for both purging and sampling wells. The cited references do not include procedures for water level measurements, field measurements (pH, conductivity and temperature) or quality assurance/quality control measures (i.e., field and equipment blanks or duplicate samples).

The 1981 sampling and analysis plan stated that the facility sampling procedures manual (EA-S-3) would be updated to include appropriate ground-water sampling procedures, but this was not done. The equipment list in EA-S-3 does not include bailers, or submersible pumps for sampling wells;

* Internal procedures manual titled, "Rocky Flats Plant Environmental Analysis and Control Sampling Procedure - Surface Waters and Ground Water EA-S-3," updated in 1982, 1984 and 1986 and given new document number EAC-S-3.

rather, it contains equipment primarily for surface water sampling. In addition, the sampling and analysis plan does not indicate whether sampling equipment is reused or dedicated to a well, nor does it include decontamination procedures.

The plan also indicated that sample preservation and shipment procedures were to be included in an updated EA-S-3 manual, but they were not included until the 1986 revision. The revised sample preservation section was to be in accordance with recommendations under sections 6.4 and 6.5 in EPA 530/SW-611. The referenced sections do not contain preservation methods for several of the required monitoring parameters including TOX, pesticides and radionuclides. Therefore, the plan does not comply with 265.92(a)(2).

The 1981 plan states that analytical procedures followed for the ground-water samples are to be in accordance with EPA-600/4-79-020 "Methods for Chemical Analysis of Water and Wastes;" however, this document does not contain procedures for analysis of pesticides, radionuclides and TOX. Therefore, not all of the analytical procedures are referenced, as required by 265.92(a)(3). The analytical procedures cited are EPA methods; however, the referenced document contains multiple procedures for several of the sampled parameters (e.g., two procedures for both iron and manganese, three for both chloride and phenol and four for sulfate). Different methods can result in different analytical biases. To ensure uniform analytical procedures during required monitoring, the specific methods used need to be listed in the sampling plan.

Chain-of-custody procedures were also supposed to be incorporated into a revised EA-S-3 manual. However, revisions in 1982, 1984 and 1986, did not include chain-of-custody procedures. Rockwell laboratory personnel stated that chain-of-custody procedures were not used until recently. An updated chain-of-custody form had been drafted, but had not been put into use by the time of the Task Force inspection.

The plan specifies that analytical results of the ground-water monitoring program were to be reported by Rockwell to DOE via the annual report. When

Rockwell personnel were requested to identify the referenced annual reports, they identified a series of documents titled "Annual Environmental Monitoring Report." These reports for 1981 through 1986 were reviewed as part of the inspection. The reports did not comply with 265.94 because they do not contain the required water level measurements or required analytical results for the designated RCRA wells [265.94(a)(1)].

1986 Sampling and Analysis Plan

The 1986 sampling and analysis plan (POP) was better than the 1981 sampling plan; however, it was incomplete and was being revised during the Task Force inspection. The POP contained more detail about sample collection, handling, shipping and chain-of-custody; however, several important details were missing. The plan needs to include details about purging and sample collection including procedures for sampling slowly-recharging wells and very low yield wells, which are common at the Rocky Flats plant.

The 1986 plan does not specify whether dedicated equipment is used in the wells. Decontamination of water level instruments and sampling equipment is mentioned; however, the procedures are not described. The plan states that all sample bottles will be rinsed with well water before filling. In wells of low yield, as most of the facility wells are, water is lost in rinsing bottles and a full complement of samples is not taken. Rinsing bottles may not be appropriate for several aliquots particularly metals and VOA. According to Rockwell personnel, sampling bottles are prepared by the laboratory with preservatives prior to sampling. Rinsing sample containers with sample water in the field may wash out the preservatives.

Filtering procedures are included in the plan; however, the sample aliquots to be filtered are not specified. Likewise, the sample preservation procedures need to indicate where/when samples will be preserved.

MONITORING WELL NETWORK

The monitoring well network for the interim status "equivalent" ground-water monitoring program, submitted by DOE to EPA on November 19, 1981 consisted of 17 existing wells [Figure 11]. The wells were drilled as part of a 56-well ground-water monitoring network established by DOE between 1960 and 1981 for detecting radioactivity.

DOE and Rockwell personnel knew that the solar impoundments leaked before the detection monitoring program was implemented and had ample data showing elevated levels of nitrates and total dissolved solids in the wells in the vicinity of the solar impoundments. Documents reviewed during the inspection indicate that the 1960 series of wells "were drilled...to check for movement of materials from the solar evaporation ponds."* This included wells 1-60, 2-60, 3-60, 4-60, 5-60 and 6-60. The 1971 series "...were drilled to determine if significant migration of radioactivity was occurring from the holding ponds" (includes wells 3-71, 5-71 and 6-71).*

Seventy new wells were installed in 1986 as part of the investigations specified in the Compliance Agreement. The following is an evaluation of the 1981 well network for compliance with RCRA regulations for a detection monitoring system. The 1986 well network is evaluated for construction adequacy.

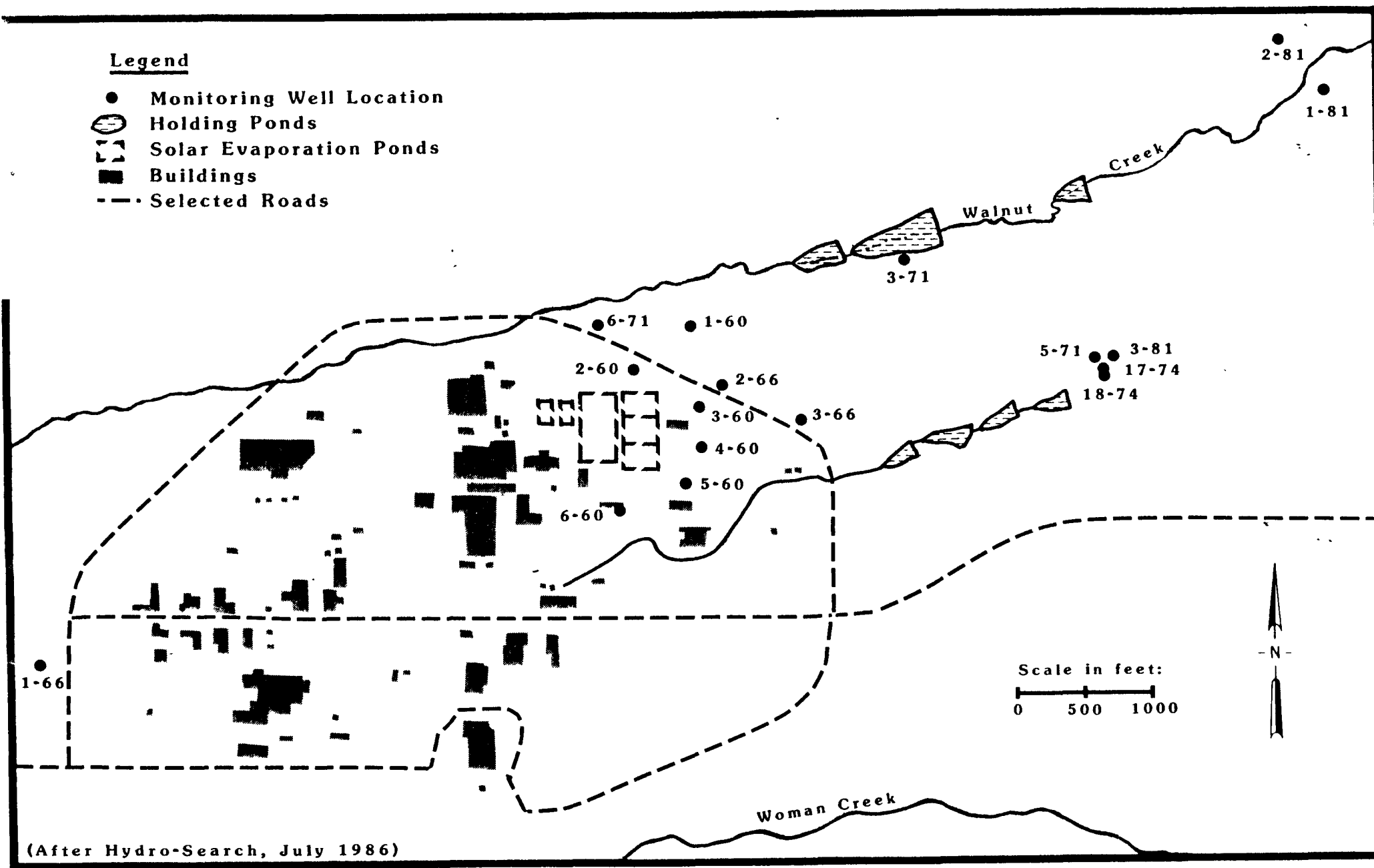
Number, Location and Construction of Monitoring Wells

1981 Monitoring Well Network

The 1981 monitoring well network fulfilled the minimum requirements for the number of detection monitoring wells, one upgradient and three downgradient; however, the locations of these wells were not in compliance with RCRA requirements [265.91(a)(1) and (2), and (b)].

*

"An Historical Evaluation of Radiological and Chemical Properties of Water from Hydrologic Test Wells at Rocky Flats" EA-376-81-231, N.D. Hoffman Environmental Analysis, April 15, 1982, page 1



Interim Status Monitoring Well Network
Figure 11

The single designated upgradient well (1-66) is completed only in a bedrock aquifer flow zone and is about 5,000 feet from the evaporation ponds. The uppermost aquifer at the Rocky Flats Plant includes the Rocky Flats Alluvium, which overlies the bedrock zone monitored by the upgradient well, and is monitored by several of the downgradient designated RCRA wells. RCRA regulations [265.91(a)(1)] require that the number, locations and depths of upgradient wells be sufficient to yield ground-water samples that are representative of background ground-water quality in the uppermost aquifer near the facility. Therefore, the single upgradient well does not comply with the regulations because the alluvial flow zones are not monitored. Furthermore, because of the excessive distance to the well from the regulated units, samples from the well may not be indicative of background ground-water quality.

The other 16 wells were designated as downgradient wells and ranged in depth from 7 to 153 feet. The wells were chosen to monitor both the solar impoundments and the retaining ponds. The solar impoundments were the only waste management unit designated by DOE/Rockwell as requiring ground-water monitoring during interim status. The retaining ponds never received hazardous wastes, according to Rockwell personnel; however, they were used before 1979, to hold various wastes containing nitrates and low levels of radioactivity. Only 4 of the 16 wells are near the perimeter of the waste management area. The 4 wells are located nearly 200 feet from the impoundments and are not at the limit of the waste management area, as required by 265.91(b).

Of the 17 wells included in the interim status program, 3 wells (numbered 5-60, 5-71 and 18-74) were not capable of yielding ground-water samples, as required by 265.91(a). These wells were reported to be "dry" during 1975 through 1979, yet were included in the RCRA monitoring program. They were also dry during interim status monitoring.

Construction records were available for only 3 of the 17 wells in the interim status monitoring network. Therefore, DOE/Rockwell cannot adequately document compliance with 265.91(c), which requires that the wells be cased in a manner that maintains the integrity of the well bore. In addition, only six of the

wells have lithologic logs; therefore, the monitored aquifer flow zone(s) is not known with certainty.

Where construction reports for the interim status wells were available, the records were not complete. The records include the length of casing and the casing type, but do not include the screened interval, slot size or specifications of the gravel or sand pack (i.e., length, volume, grain size, etc.). In addition, nothing indicates the type or quantity of material used to grout the wells.

A contractor's evaluation of the interim status monitoring well network reported that "because of poor documentation of well construction, both water quality and water level data collected from the wells are questionable." The contractors recommendation was to plug the existing wells and drill new monitoring wells.

1986 Monitoring Well Network

The new well network for the site characterization program was completed in the summer of 1986 and consists of 96 wells. Of the 96 wells, 70 were installed in 1986 and 26 were installed between 1960 and 1982. The 26 older wells were included to provide some continuity with the previous site-wide monitoring program. The new well network has significant construction problems.

The 70 new wells were reportedly completed in accordance with procedures in the Work Plan and POP. The drilling and completion procedures in the Work Plan and expanded in the POP were generally adequate; however, they were not always followed. Some of the well construction is suspect because of conflicting reports on construction methods or poor drilling practices. The bottom of numerous holes, according to construction diagrams, were not backfilled with bentonite pellets (wells 7-86, 10-86, 11-86, 17-86, 20-86, 22-86, 25-86, 28-86, 29-86, 35-86, 42-86 and 43-86). These wells may be receiving water from multiple water-bearing zones. The hole diameter proposed may not

* *Hydrogeologic Characterization of the Rocky Flats Plant, Golden, Colorado, prepared by Hydro-Search, Inc., December 9, 1985, Page 11*

be large enough to ensure placement of a proper filter pack, even with centralizers on the screen (1 inch of filter pack, at most, around the screen). The grain size analysis performed by the consultant was not included with the construction information and DOE/Rockwell personnel do not have records of the results. Therefore, Task Force personnel could not determine whether the sand/gravel distribution for the screen slot size used was adequate. Several wells were turbid when sampled by the Task Force, suggesting problems with either the filter pack or the development of the wells.

Task Force samples from two wells (wells 8-86 and 48-86) were turbid (milky white) and had elevated pH (samples from both wells had a pH of 11), suggesting problems with the bentonite seal and/or the cement grout. Construction records also indicate loss of cement circulation during completion. Rockwell personnel reported that well 49-86 has similar problems.

Many of the well logs are either incomplete or inaccurate. Numerous wells do not have completed well diagrams; therefore, DOE/Rockwell personnel cannot document whether wells comply with the Work Plan. Numerous well diagrams were also found to be inaccurate when the hydrogeologic contractor was questioned during the Task Force inspection. Still other wells have questionable construction, either due to incomplete field notes or contradictory completion information. For example, completion data for well 12-86 indicates that, if completed as described, the well is screened 11½ feet into the bentonite seal. Well 25-86 has a similar problem, with the recorded well screen extending from 59 to 82 feet, filter pack from 66 to 83 feet and bentonite seal from 64 to 66 feet. If accurate, this would indicate that the upper 7 feet of screen extends through the entire length of the bentonite seal with an additional 5 feet extending into the cement grout. The well may be contaminated with cement and/or bentonite.

Several wells have screens set at, or very near, the surface (wells 30-86, 38-86, 57-86) and could be contaminated by surface runoff if the cement seals are inadequate. The construction records for well 38-86 indicate that the screen extends from the ground surface to a depth of 11 feet. This well could not have adequate surface seals and could not be adequately protected from surface contamination if the screened interval is accurate.

Several of the new wells did not have locking well caps. Still, other wells did not have concrete pads around the surface casing. Some of the wells with surface pads had cracks in the pads. Each of these problems has the potential to lead to contamination of the monitoring wells.

In summary, many of the new wells also have construction deficiencies. Well construction data must be reviewed, corrected if in error and the adequacy of the wells evaluated before they are accepted as fulfilling the Compliance Agreement requirements.

ROCKWELL SAMPLE COLLECTION AND HANDLING PROCEDURES

During the inspection, water levels were measured in 38 wells and samples were collected from 15 monitoring wells and 1 wet well, as discussed in the Investigative Methods section. At each of the monitoring wells sampled, Rockwell personnel measured the water level, calculated the purge volume, purged stagnant water, and made field measurements for pH, specific conductance and water temperature. These procedures were evaluated by the Task Force.

The evaluation revealed that the sample collection and handling procedures are generally acceptable; however, some problems were found with field measurements for water temperature and specific conductance. Furthermore, Rockwell personnel are not following all the procedures referenced in the sampling and analysis plan. The sampling and analysis plan needs to be updated to include the actual field procedures being followed by Rockwell personnel. The Rockwell sampling procedures are described and assessed in the following discussion.

Water Level Measurements

At the wellhead, the first step in collecting samples is to measure depth to water from the top of casing using one of two electronic water level indicators; an Olympia Actat Model No. 500, with a 500-foot cable, was used in the deeper wells and a Well Wizard, with a 150-foot cable, was used at the remaining wells. Both of these indicators consist of a reel with a control panel, cable and sensor.

A two-conductor cable, which is marked in sequential increments (0.5 inch on the Well Wizard; 5-foot on the Actat), connects the control panels to the sensors. When the sensor makes contact with the water, an indicator light and/or buzzer on the control panel are activated.

The cord and sensor are lowered into the casing until the sensor reached water. The probe is raised and lowered in the well until the exact point of contact is determined. The cable at the top of the casing is pinched by the sampler's fingers and the distance from the bottom of his fingers to the next lower cable marker is measured with a measuring tape. This distance is added to the cable marker value to determine the depth to water. Following this measurement, the probe is lowered to the bottom of the well to determine the total depth for calculation of the water column volume. The probe is then removed and the cable and the probe are brushed and washed with a nylon bristle brush dipped in an Alconox and water solution, and rinsed with deionized water.

Water level measurements were made on 38 monitoring wells before any sampling activities were initiated. Duplicate water level measurements were made on four of the wells. At three wells, the duplicate measurements were identical to the first and differed by only 0.04 feet in the other one. The reproducibility of the measurements was good and the procedure described above is acceptable.

Purging

The volume of water in the casing (casing volume) is calculated by multiplying the height of the water column by a conversion factor. Purge volumes are then calculated by multiplying the casing volume by three.

Purge water is measured in a graduated plastic bucket. Slowly-recharging wells are evacuated to dryness, all other wells are purged of three casing volumes of water before sampling.

In wells where the calculated three-casing volumes is greater than 20 gallons, a Bennett pump is used to evacuate the water. Wells with less than 20

gallons of water to be purged are bailed with Teflon bailers. The pump and the last 3 to 5 feet of tubing are thoroughly cleaned (Alconox and water) and rinsed with deionized water prior to reuse. Approximately 5 gallons of deionized water are flushed through the tubing after a well has been purged. The bailers are cleaned thoroughly with Alconox and water and rinsed with deionized water prior to reuse. New polyethylene rope is cut for each well every time the well is purged and sampled.

Purge water is disposed of on the ground near the well without being tested to determine if it contains contaminants. If analytical data from the well indicate that the water contains hazardous constituents, purge water from further sampling of the well should be drummed and disposed of properly. Otherwise, purging procedures are adequate.

Sample Collection and Preservation

After purging, Rockwell personnel remeasure the water level in each well to determine if it has recharged sufficiently for sample collection. A well is deemed technically dry by DOE/Rockwell if there is insufficient volume to complete the volatile organic sample aliquots within 24 hours after the well has been purged. Immediately before and after sample aliquots are collected, an aliquot is collected for measuring field parameters including pH, conductivity and temperature. Although the sampling and analysis plan also includes field procedures for measuring dissolved oxygen, Rockwell personnel are no longer making this measurement.

The pH is measured with a Van Waters and Rodgers Scientific Model 47 Mini-pH meter. The meter is calibrated first with a pH 7.0 buffer solution and then with either 4.0 or 10.0 buffer solution depending on the expected range of the sample. Conductivity is measured with a Cole Palmer model 1484-10 meter. The conductivity meter is field-calibrated at each well with standards prepared at the beginning of each day in the Rockwell general laboratory.

According to the 1986 sampling and analysis plan, temperature is to be measured using a thermometer calibrated weekly against a National Bureau of Standards certified thermometer in the onsite lab. Temperature discrepancies

of up to 4 °C were observed between the field measurements made by the EPA contractor and Rockwell personnel. Investigation revealed that there was no laboratory record indicating that the field thermometer, used by Rockwell personnel, had ever been calibrated. Accurate water temperature readings are essential as they are used to calculate the temperature compensation of the specific conductivity to 25 °C to meet the reporting requirements.

After sampling at each well, field personnel thoroughly cleaned (Alconox and water) and rinsed (deionized water) the bailer and placed it in a plastic garbage bag.

Field personnel maintained a log of sample collection and field measurements (e.g., water levels, pH, conductivity, temperature and calibrations) in a bound and numbered notebook.

Shipping and Chain-of-Custody

All sample aliquots were placed in a cooler containing ice and reportedly delivered to the Rockwell onsite laboratory within 3 hours after collection. EPA field personnel initiated a sample chain-of-custody form and Rockwell personnel ensured proper transfer of the form and samples to laboratory staff. According to Rockwell personnel, no chain-of-custody procedures were followed before 1986, even though they were required by RCRA regulations [265.92(a)(4)].

SAMPLE ANALYSIS AND DATA QUALITY ASSESSMENT

This section provides an evaluation of the quality and completeness of ground-water monitoring data obtained by Rockwell for the Rocky Flats plant from November 1981 to the end of April 1987. Most of the sampling and analysis during this period was managed by Rockwell. At the time of the Task Force inspection, the Rockwell general laboratory in building 881 was responsible for performing most of the RCRA analyses listed in 265.92 and the 1986 Compliance Agreement. Prior to 1986, the Health Safety and Environmental (HSE) laboratory, located in building 123, was primarily responsible for analyzing samples from the RCRA wells. Samples analyzed for pesticides and herbicides

after 1983 and TOX analyzed in 1982 and 1983 were subcontracted. During the last quarter of 1986, Roy F. Weston, Inc. (Weston), was contracted to collect and analyze required ground-water samples. All 1987 work reviewed during this evaluation was performed by the Rockwell general laboratory.

The Rockwell general laboratory was evaluated concurrently with the onsite Task Force inspection of the facility. During the laboratory evaluation, operating and analytical procedures, internal data reports, raw data and quality control records were reviewed and analytical equipment was examined.

A review of ground-water monitoring data and procedures revealed problems that have or could have affected data quality. Pre-1986 analytical data for parameters other than pesticides, TOX, phenol (1984 and 1985) are unreliable because of questionable sample preservation and holding techniques. All specific conductance results could be biased low because they were not corrected for the cell constant of the instrument. Also, most pre-1986 data represent concentrations of dissolved rather than total constituents and may be biased low.

The analytical methods used for cadmium and chromium prior to 1986 would not ordinarily quantitate these metals at the maximum contaminant levels (MCLs) specified for ground-water protection and are, therefore, inappropriate. Levels of gross alpha radiation above the MCL of 15 pCi/L were reported for a number of monitoring wells prior to 1986; however, confidence limits associated with this data often exceed this level. Levels of selenium as high as 50 times the MCL of 0.01 milligrams per liter (mg/L) have been reported.

The following is an evaluation of sample analyses and data quality during the initial year of RCRA monitoring (1982) and three subsequent time periods (1983 through 1985, 1986 and 1987). These periods reflect changes in both analytical requirements and laboratories performing the analyses.

Analyses During Initial Year of Monitoring (1982)

Under the sampling and analysis plan submitted to EPA in 1981, the facility was to conduct the analyses specified in 265.92. Quarterly monitoring of

all wells during the initial year is required to establish background values. The initial year of monitoring was conducted in 1982. According to the 1981 sampling and analysis plan, quarterly monitoring during the initial year was to include quadruplicate measurements of the four parameters specified in 265.92 as indicators of ground-water contamination, pH, total organic carbon (TOC), TOX, and specific conductance on the upgradient well, 1-66. These analyses were performed, but not in quadruplicate.

Analytical results for RCRA parameters reported during 1982, with few exceptions, are unreliable because of sample handling and/or analytical problems. Although total constituent analyses should have been performed, most samples were filtered, and thus the reported results reflect dissolved concentrations. The holding times recommended by EPA were frequently exceeded, and EPA recommended preservation procedures were not followed.

Measurements of pH may contain systematic error due to excessive holding times, filtration and storage at room temperature. The cited EPA references in the 1981 sampling and analysis plan recommend a 6-hour maximum holding time before analysis for pH. Site records indicate that holding times were much longer than recommended. For example, wells 1-60, 2-60 and 4-60 were sampled on August 18 through August 20, 1982 and not analyzed for pH until October 5, 1982. All samples were filtered, which causes degassing of the sample. This may change the carbonic acid equilibria, which affects pH. Storage at room temperature for extended periods would allow reaction of hydrogen ions with other constituents in solution, thus changing the pH.

Other samples were held for undetermined lengths of time before filtration occurred. This practice allows the various chemical species in the sample to redistribute between the solid and liquid phases present prior to filtration. Consequently, the quantities present at the time of analysis may be different from those originally present. Once filtered, metals samples were not preserved. This practice allows metals species to leave solution because of various phenomena such as sorption and precipitation, thereby yielding results that do not represent the initial concentrations in the sample and are probably biased low.

Sample preservation practices led to other potential problems. EPA recommends refrigeration at 4 °C for all types of samples except those collected for radiation and metal parameters. All samples, with the reported exception of TOX, were unrefrigerated both before and after filtration. Biochemical and chemical reactions may significantly transform the composition of samples at higher ambient temperatures. TOC and the other organic parameters including pesticides and herbicides are particularly vulnerable to sample degradation under these conditions. Specific conductance is also unreliable for this reason.

TOC data, in some cases, contain large relative errors. TOC was analyzed by subtracting inorganic carbon from total carbon. This approach is not reliable for samples where inorganic carbon is substantially greater than the organic carbon component of a sample. This difference and the resultant data become statistically unreliable. As an example, on April 28, 1982 a sample from well 3-66 was analyzed in duplicate. The first analysis measured total carbon at 42.9 mg/L and inorganic carbon at 36.1 mg/L for a net difference of 6.8 mg/L (TOC). The second analysis measured total carbon at 46.1 mg/L and inorganic at 36.1 mg/L resulting in a net difference of 10 mg/L. The difference between 10 and 6.8 mg/L is 3.2 mg/L or 38 percent relative to their average, 8.2 mg/L.

A more reliable method for TOC is to separately determine purgeable organic carbon (POC) and nonpurgeable organic carbon (NPOC), then add the results. The long sample holding times at room temperature would have allowed TOC samples to degrade. For example, TOC analysis on well sample 1-60 collected February 23, 1982 was performed May 28, 1982. The EPA maximum recommended holding time for TOC was 24 hours in 1982 and is currently 28 days under refrigerated and acidified conditions. These samples were neither refrigerated nor acidified and the sample may be expected to degrade more rapidly than if they had been preserved. In addition, samples were filtered, therefore the results reported actually represent dissolved organic carbon (DOC) rather than TOC.

Specific conductance measurements were not corrected for the cell constant of the instrument. The results obtained may be biased slightly low

because of this. This relative error is expected to be less than 10% of the reported values.

Most of the metals samples were analyzed, after digestion, by atomic absorption spectroscopy (AA) methods, which are accepted by EPA. Arsenic and selenium concentrations were determined by furnace AA, without prior digestion of the sample with hydrogen peroxide. This procedure may reduce measurement sensitivity but probably not to an unacceptable degree. Lead and silver were determined by Direct Current Emission Spectroscopy (DC E-Spec) achieving acceptable sensitivity in the sample results. All other metals were generally determined by flame AA. Flame AA methods do not normally achieve the detection limits required to reliably monitor MCLs* for the elements cadmium and chromium and are, therefore, inadequate.

The gross alpha and beta results are also unreliable at the MCLs specified for ground-water protection. Data such as a gross alpha of 22 +/- (plus or minus) 60 pCi/L and a gross beta of 19 +/- 47 pCi/L were found in the bench records for well 1-60 for a sample analyzed October 18, 1982. The sample results for gross alpha and gross beta are calculated by subtracting a background count rate from the sample count rate. If the counting times for the sample and/or background are inadequate, negative sample values may result. Such was the case for the second, third and fourth quarters of 1982, where values of -9.9, -14.3 and -14.4 pCi/L, respectively, were reported for well 6-71. The MCL for gross alpha is 15 pCi/L, thus, the method was unable to reliably assess contaminants at this level. Gross alpha and beta results are further qualified because samples were being filtered. Reported data therefore, at best represents "dissolved" gross alpha and gross beta.

Some of the reported nitrate data for samples collected during the second quarter may be unreliable. The second quarter result for well 17-74 was 64 mg/L while results from other quarterly sampling were 1.4 mg/L or less. Corresponding conductivities do not show this variation, which suggests analytical problems with this parameter.

* *Maximum contaminant levels as established under the Safe Drinking Water Act and incorporated into Appendix III of Part 265.*

Some of the 1982 chloride data appear to be discordant. For instance, the third quarter result for well 2-60 was 80 mg/L, for the second quarter 371 mg/L, whereas, for the first and fourth quarters, 1,050 mg/L, and 1,050 mg/L, respectively, were reported. Reported concentrations of other anions and cations, together with the conductivity values, did not indicate a possible variation of this magnitude.

Except for some of the radionuclide measurements, no assessment of recovery (spiked samples) and precision was routinely made in the remainder of the analytical procedures, according to laboratory personnel. These assessments are essential to validate the quality of reported data.

The 1981 sampling and analysis plan specified that the sample handling and preservation procedures would be in accordance with sections 6.4 and 6.5 of EPA 530/611. The plan was not followed because those sections in the EPA document specify refrigeration of some samples at 4 °C, onsite filtration for dissolved constituents and parameter specific chemical preservation at the time of sample collection. These procedures were either not performed or were not performed in a timely manner. The sampling and analysis plan was also not followed when certain analytical procedures were used. The plan states that procedures in accordance with "Methods for Chemical Analysis of Water and Wastes," (EPA-600/4-79-0202, dated March 1979) would be used to analyze samples. The DC E-Spec method used by Rockwell for lead analysis is not listed in this publication. Neither are the methods used for TOX, pesticides, gross alpha, gross beta and radium.

Analyses During January 1983 Through December 1985

Most of the analytical data produced between January 1983 and December 1985 are unreliable for the same reasons as the data for the initial year of monitoring. The sample handling and preservation procedures used during 1983 through 1985 were mostly the same as during 1982, as well as the problems associated with them.

During this period the indicator parameters, TOC, TOX, pH and specific conductance were again not analyzed in quadruplicate. TOX was not reported

after 1983. Analytical results reported for this period represent dissolved constituents with the possible exception of the TOC, phenols, purgeables, pesticide, herbicides collected in 1984 and 1985 and TOX in 1983. Consequently, most data are probably biased low.

Some of the analytical procedures changed, however. Records for at least one set of lead data for samples collected in September 1983, show the use of the furnace AA method, which is an acceptable procedure. Generally, the use of the DC E-Spec method for lead was continued from 1982 through 1985. Samples collected during the period from 1983 through 1985 for fluoride, chloride, nitrate and sulfate samples reportedly were analyzed by Ion Chromatography (IC). IC methods are not presented in the methods manual referenced in the 1981 sampling and analysis plan ("Methods for Chemical Analysis of Water and Wastes", EPA 600/4 79 020, March 1979). IC should not be used for fluoride analysis without confirmation with potentiometric or colorimetric procedures. Rockwell laboratory staff raised concerns that because of high nitrate in some of the samples, which may partially obscure the chloride peak when IC is used, that chloride results may not in all cases be accurate. Sulfate data reported for samples collected in November 1983 and, possibly, May 1984 appear to be biased low based upon cation/anion balance and conductivity.

Before 1985, TOC analyses were reportedly performed on aliquots taken from a composite sample held in a large plastic container. During 1985, Rockwell began collecting TOC samples in separate containers. However, TOC samples were reportedly not refrigerated or acid preserved until 1986. This procedure would probably result in inaccurate data and is not in accordance with the analytical references cited in the 1981 sampling and analysis plan. In addition, TOC results from samples collected during 1983 to 1985 were still being calculated by the difference method previously described.

Before the fourth quarter of 1984, phenol analyses were reportedly performed on aliquots taken from a composite sample held in a large plastic container. Composite samples were reportedly not refrigerated after collection, which is essential for reliable results. Beginning with the fourth quarter of 1984, phenol samples were collected in separate containers and acid preserved. The

records do not indicate whether the phenol samples were taken in glass containers, as specified in the procedures referenced in the 1981 sampling and analysis plan.

Analyses During 1986

Weston sampled the RCRA wells and analyzed all but the radiation parameters during the last quarter of 1986. The radiation parameters which included gross alpha, gross beta, americium, plutonium, uranium and tritium were analyzed by Accu-labs of Arvada, Colorado. Although the Weston laboratories were not evaluated during the Task Force inspection, data generated by the laboratory were reviewed.

The thallium determination may be subject to uncorrected spectral interference. Selenium was reported in a number of wells at levels above the MCL of 10 µg/L.

Analyses During 1987

Rockwell resumed monitoring responsibilities in 1987. The sampling, sample holding and sample analyses procedures used were much improved over those used previously. Samples were both refrigerated and preserved in accordance with EPA protocols. Reportedly, samples collected for dissolved metals were filtered in the field; the other samples were not filtered.

At the time of the Task Force inspection, samples for the first quarter of 1987 had been collected and most analyses were either in progress or completed. Of the elemental constituents, only mercury and potassium had been analyzed. Other elemental constituents were to be analyzed by Atomic Absorption Spectroscopy or Inductively Coupled Argon Plasma Optical Emission Spectroscopy (ICP), by methods acceptable to EPA. Laboratory personnel had apparently become aware of the limitations of flame AA for cadmium and chromium, and more appropriate techniques were being planned.

The pH and specific conductance measurements were being performed in the field, which eliminated the sample degradation problems for these two parameters, as previously discussed. The procedure used, however, did not adequately compensate for temperature. Although the field meter had a temperature compensation dial, it was not adjusted for sample temperature. Rather than adjusting the dial, Rockwell personnel attempted to alleviate the need for temperature correction by maintaining calibration standards at a temperature which would approximate sample temperatures. The procedure used to do this was unreliable and could produce an error on the order of 0.1 pH unit which is significant when assessing ground-water contamination. The pH meter is capable of achieving accuracies on the order of 0.01 pH units.

Specific conductance measurements were biased low because the field meter was incorrectly calibrated. During the onsite Task Force inspection, the values of the field standards used to set the field conductivity meter were found to be 15 to 30 % below the true value. Sample measurements during this time frame are expected to be biased low by about the same percentage.

Reported total dissolved solids (TDS) results may be biased high and therefore unreliable. The oven used for TDS at the time of the inspection was not at the correct temperature. The procedure specifies that samples are dried at 180 degrees Celsius; at the time of inspection samples were being dried at approximately 150 °C.

Anions were being analyzed by manual methods acceptable to the Agency. Chloride was analyzed by the mercuric nitrate method; nitrate by the brucine sulfate method and sulfate by the turbidimetric method. Assessment of recovery through spiking of samples with known amounts of the respective analytes is recommended as part of the quality control for these procedures. At the time of inspection spiking was not being performed.

Cyanide, not required before 1987, was being analyzed potentiometrically, using an Orion selective ion electrode following distillation. Sulfide is a potential interferent which can eliminate any cyanide present through the formation of thiocyanate. The presence of sulfide should be checked but was not. The detection limit reported is not the true detection limit of the method

which properly should be calculated statistically. Rather, the laboratory personnel use the concentration value of the lowest standard which they feel can be consistently reproduced.

Gross alpha, gross beta and radium results are unreliable at the MCLs specified for ground-water protection. The reliability of the data is dependent upon the sample aliquot size and the length of counting times for both the sample and the background. Background counting times and sample counting times were too short to provide the necessary reliability. Also, the confidence limits reported with gross alpha and beta do not appear to account for counting times, as they should. If this is true, the confidence limits reported represent the data to be more precise than they actually are.

Gross alpha results for 1987, when compared to earlier results may be slightly lower because of a change in the calibration standard used. Efficiency corrections are dependent on the alpha emitting isotope used to calibrate the measuring instrument. The alpha standard in use was changed from U^{238} to Pu^{239} in 1987. The EPA method prescribes the use of Am^{241} . Results based on U^{238} (those prior to 1987) may be as much as twice those based on Am^{241} after correcting for counting efficiencies. Results based on Pu^{239} would be somewhat lower than those based on U^{238} , but still more than those based on Am^{241} . Results when compared to the specified MCLs should be viewed in this light as the MCLs consider the EPA method.

Prior to 1986, plutonium, americium and uranium samples were filtered, and not required. This was no longer the case in 1987.

The isolation procedures used for Pu, Am and U were changed from electrodeposition to chemical separation. Analyses were, in contrast to those prior to 1986, performed on total samples using a digestion. Except where levels were unquantifiable, the actual levels of plutonium, americium and uranium may be higher than what is reported. Data are uncorrected for the percentage recovery of the analyte. Recoveries, reportedly, are 70 to 80%, 50 to 70% and 30 to 40%, respectively, for Pu, U and Am. Am^{243} , U^{232} and Pu^{242} are used respectively in the Am, U and Pu procedures as internal standards to determine percent recovery of the other isotopes.

The quality of the volatile organic data for the first monitoring period of 1987 could not be assessed. EPA methods 601 and 602 were referenced as the procedures used for volatile organic determinations. These methods prescribe the use of spikes and control samples at a frequency of 10% of total samples analyzed. These control measures were not performed on the 1987 first quarter samples. The EPA methods also specify that performance records to document data quality are to be kept. The Rockwell performance records did not include values obtained for standards and blanks analyzed concurrently with the samples.

GROUND-WATER QUALITY ASSESSMENT PROGRAM OUTLINE

RCRA interim status regulations [265.93(a)] require a facility to prepare an outline of a ground-water quality assessment program by November 19, 1981. CDH regulations (same as RCRA citation) also require preparation of an outline. Both sets of regulations require that the outline describe a more comprehensive program than the one for routine interim status monitoring and be capable of determining:

- Whether hazardous waste or hazardous constituents have entered the ground water
- The rate and extent of migration of hazardous waste or hazardous constituents
- The concentrations of hazardous waste or hazardous constituents in the ground water

The "outline" on file at the facility was a section of the 1981 sampling and analysis plan, previously discussed, which was titled "Groundwater Quality Assessment Program. The section is, essentially, a recitation of the regulations; it contains no program outline. Specifically, it does not address:

- Whether or how data triggering assessment would be evaluated to confirm the apparent contamination

- How the apparent source would be determined
- Whether or how additional hydrogeologic data would be collected
- How the rate and extent of contaminant migration would be determined
- Which aquifer zones would be monitored
- How a monitoring plan would be developed and what the projected sampling frequency would be
- Which analyses would be conducted on ground water, surface water and soil samples to identify contaminants of concern
- Analytical methods to be used on samples
- How the data would be evaluated to determine if more work is required or the facility could return to the indicator evaluation program required by 265.92
- Approximate schedules for sampling, analysis, data evaluation and report preparation

GROUND-WATER MONITORING PROGRAM PROPOSED FOR RCRA PERMIT

In November 1985, DOE submitted a RCRA Part B application to both EPA and CDH, which had been delegated final authorization for a RCRA equivalent program in November 1984. As discussed in the introductory section of this report, the State subsequently issued a Notice of Intent to deny the permit. In July 1986, a Compliance Agreement (Agreement) between EPA, CDH and DOE was completed and, as required by the Agreement, a revised Part B was submitted to EPA and CDH in November 1986.

The point of compliance (POC) identified on Plate E-7 of the Part B is about 5,400 feet from the solar evaporation ponds and more than 6,000 feet from the landfill, which are the two closest regulated units. Rockwell personnel stated that the POC was drawn so as to be downgradient from all solid waste management units (SWMUs) rather than just the regulated units.

The POC designated in the Part B does not comply with the location criteria specified in State regulations [264.95], which requires that it be adjacent to regulated units. If the POC had been properly located (e.g., adjacent to the solar evaporation pond), the hazardous constituents detected in ground water would have triggered development of a compliance monitoring program [100.41(c)(7)].

The ground-water monitoring program proposed in the revised Part B does not comply with State regulations [264.95 and 100.41(c)(7)] because the point of compliance is improperly located and a detection monitoring program (264.98) is proposed rather than the required compliance monitoring (264.99) or corrective action (264.100) program. Also, the rationale for the proposed monitoring parameters is deficient and some improvements in sampling and analysis procedures are needed.

The monitoring parameters proposed for the detection monitoring program are to be based on site characterization work conducted pursuant to the Agreement (Schedule 3, Task 3.1). Section E-5d of the Part B states that initially, well samples will be analyzed for the parameters listed in Table 7. After the first year of monitoring, samples are to be analyzed for the "...same

Table 7
GROUND-WATER MONITORING
PARAMETERS

Indicators

Temperature
pH
Specific conductance
Total dissolved solids (TDS)

Metals

Hazardous substances list metals
Cesium
Molybdenum
Strontium

Anions

Bicarbonate
Carbonate
Chloride
Cyanide
Nitrate
Sulfate

Organics

Hazardous substances list volatiles
Hazardous substances list semivolatiles
Hazardous substances list pesticides/PCBs

Radionuclides

Gross alpha
Gross beta
Uranium 233, 234, 238
Americium 241
Plutonium 239
Tritium

Notes:

1. *Temperature, pH and specific conductance are measured in the field. All other parameters are measured in the laboratory.*
2. *Samples from the first sampling event will be analyzed for the complete hazardous substances list. Later samples will be analyzed for only those hazardous substances list compounds detected in the first sampling period.*
3. *Analytical methods are presented in Appendix E-13.*

parameters except that analyses will only be made for the hazardous substances list metals, volatiles, semi-volatiles and pesticides/PCBs that were detected...". This approach does not comply with State regulations [100.42(c)(6)], because for a detection monitoring program, the parameters are to be based on the waste composition, not that of the ground water.

The procedures described in Appendix E-13 of the Part B for sample collection, preservation, shipment, analysis and chain-of-custody are generally acceptable; however, some modifications and additional details are necessary. For example, a footnote on Table 4-1 of Appendix E-13 indicates that all samples with the exception of volatile organics are to be filtered. Filtering of samples for organics is unacceptable because of the potential for organic compounds to become bound to the filter and bias the analytical results. For other parameters, a rationale for filtering needs to be provided along with supporting data. Also, samples should be preserved immediately after collection rather than within the 3 hours specified in the plan. The plan specifies that sample aliquots for several parameters are preserved by base or acid addition until a certain pH is achieved, but does not describe procedures for verifying the pH of the preserved sample.

More details are needed for several sampling procedures included in the plan. Specific procedures for operating a dedicated bladder pump, and pH and conductivity meters are presented; however, the brand name and model number of the equipment are not stated. Calibration procedures are described for the conductivity meter using "standard solutions"; but, the solutions are not described. The plan indicates that a photoionization detector will be used to monitor a well head immediately after opening it, yet no actions are specified in the event that high vapor concentrations are indicated. Finally, disposal of purge water is not addressed. EPA guidance (RCRA Ground-Water Monitoring Technical Enforcement Guidance Document - TEGD) recommends that purge water be captured for proper disposal if it is found to be hazardous.

EVALUATION OF MONITORING DATA FOR INDICATIONS OF WASTE RELEASE

This section presents an analysis of Task Force and Rockwell data regarding indications of waste releases to ground water from various waste disposal areas.* These include the evaporation ponds, west spray field, 881 hillside, active landfill and the original landfill near the southwestern corner of the production area at the Rocky Flats plant. Field and laboratory analytical results from samples collected by Task Force personnel are presented in Appendix C, together with the analytical methods.

Task Force and DOE/Rockwell data indicate releases of hazardous constituents from the evaporation ponds and unspecified sources on the 881 hillside.** The data are inconclusive regarding releases from the west spray field and the two landfills. Two of the wells sampled (8-86 and 62-86) had elevated pH levels that were inconsistent with other data and waste disposal information. These levels may be artifacts from well construction. Details of these findings are presented in the following.

EVAPORATION PONDS

As previously indicated, the evaporation ponds were used primarily for treatment of aqueous wastes containing low-level radioactivity, high nitrates, acids and aluminum hydroxide. Task Force personnel sampled one alluvial well (30-86), four bedrock wells (14-86, 27-86, 32-86 and 34-86), and the wet well for the ground water collection system for indications of waste release. Selected Task Force data for these wells and an upgradient bedrock well (54-86) are presented in Table 8.

Task Force data show that four hazardous constituents (carbon tetrachloride, chloroform, trichloroethane and trichloroethene) were detected at low concentrations in the wet well. Four hazardous constituents (carbon

* Company data reviewed were presented in an "Annual Environmental Monitoring Report" for the 1986 calendar year.

** "Hazardous Constituents" are listed in 40 CFR Part 261, Appendix VIII.

Table 8
GROUND-WATER QUALITY NEAR THE SURFACE IMPOUNDMENTS
(Selected Parameters)

Well No./ Parameter*	Background Well 54-86	Wet Well	14-86	27-86	30-86	32-86	34-86
pH (std. units)	7.5	7.7	7.7	7.9	7.2	8.0	7.2
Conductance (µmho/cm)	755	3,400	1,860	1,420	7,150	960	2,200
TOX (µg/L)	<5.	50	6.		82	<5.	<5.
POC (µg/L)	36	21	44	62			19
TOC (µg/L)	67,000	5,300	2,000		6,600	4,300	3,400
Carbon tetrachloride (µg/L)		8					
Chloroform (µg/L)		2E**					
1,1,1-Trichloroethane (µg/L)		9					
Trichloroethene (µg/L)		6					
Octanoic acid (µg/L)				10E			
Nonanoic acid (µg/L)				50E			
Decanoic acid (µg/L)				10E			
Dodecanoic acid (µg/L)				30E	20E	20E	
Calcium*** (mg/L)	99.1	255	133	48.9	1,470	47.4	268
Magnesium*** (mg/L)	24.4	66.6	39.6	16.1	333	12.1	83
Potassium*** (mg/L)	4.8	66.9	6.9	6.9	71.6	5.1	8.5
Sodium*** (mg/L)	36.7	406	255	236	1,360	145	259
Chloride (mg/L)	19	93	94	160	260	115	52
Nitrate (mg/L)	<0.3	460	<0.3	<0.3	2,100	1	<0.3
Sulfate (mg/L)	50	120	590	250	300	97	910
Gross alpha (pCi/L)	7	64	3		155	12	7
Gross beta (pCi/L)	8	59	8		172	23	16
Gross radium (pCi/L)	<2	<2	2		15	14	3
Radium 228 (pCi/L)	<2	<2	<2		9.5	<2	<2
Uranium 234 (pCi/L)	1.2	14.8	0.8		21.4	1.1	0.8
Uranium 235 (pCi/L)	0.3	3.6	<0.2		1.1	0.2	<0.2
Uranium 238 (pCi/L)	1.5	9.9	0.3		13.5	0.8	1.0
Tritium (pCi/L)	<200	1,931	<200		8,811	-	<200

* Blanks indicate no data.

** E denotes estimated concentration

*** Dissolved metal concentration

tetrachloride, chloroform, trichloroethene and dichloroethene) were previously detected by Rockwell in well 22-86.

Task Force data also indicate elevated nitrate, potassium, TOX and radionuclide concentrations in the wet well and alluvial well 30-86. Company data for 1986 from wells near the evaporation ponds* [Figure 12] also indicate elevated concentrations for these parameters [Appendix D], except for TOX for which no data are presented.** The highest nitrate concentration (9,640 mg/L) was measured by Rockwell in well 30-86. Also, low levels of organics were detected in Task Force samples from the wet well and bedrock well 27-86.

The background bedrock well (54-86) sample, collected by Task Force personnel, had a very high TOC concentration (67,000 µg/L). A review of the raw laboratory data indicates no calculation errors. The high TOC concentration cannot be explained from available information.

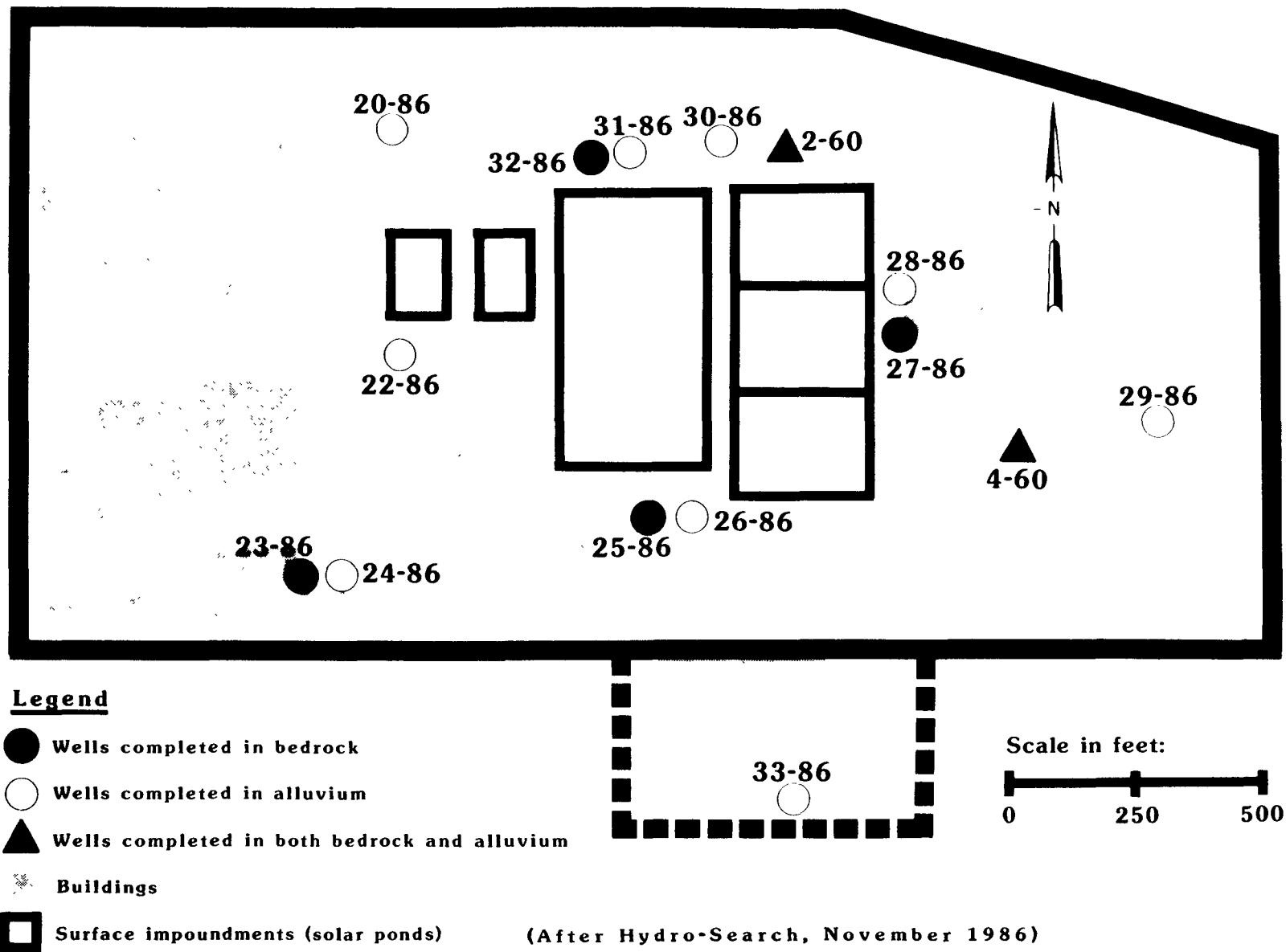
Task Force and Company ground-water monitoring data together with information on the types of waste discharged to the evaporation ponds strongly suggest that waste constituents have been released to the underlying soil and ground water. Past problems with the pond bottoms and related remedial actions, discussed previously, further support the analytical evidence of leakage.

WEST SPRAY FIELD

The west spray field was used for disposal of water from the evaporation ponds. Samples from a bedrock well (48-86) and an alluvial well (49-86) in the eastern end (downgradient side) of the west spray field were collected by Task Force personnel. Selected Task Force and Company data for these wells, alluvial wells 49-86, 50-86 and 51-86, and well 5-82, which is completed in both the alluvium and bedrock, are presented in Table 9.

* These wells include 2-60, 4-60 and 20-86 through 32-86.

** Data were reviewed for wells 2-60, 4-60 and wells 20-86 through 32-86, which are near the evaporation ponds.



Monitoring Wells in the Vicinity of the Surface Impoundments
Figure 12

Table 9
GROUND-WATER QUALITY NEAR THE WEST SPRAY AREA
(Selected Parameters)

Well No./ Parameter*	Task Force		Data 1986 Rockwell Data			
	48-86	49-86	5-82	49-86	50-86	51-86
pH (std. units)	11	6.3				
Conductance ($\mu\text{mho/cm}$)	350	400				
POC ($\mu\text{g/L}$)		26				
TOC ($\mu\text{g/L}$)	1,300	2,500				
Cyclohexanol ($\mu\text{g/L}$)		30E**				
Potassium*** (mg/L)	6.3	0.9	15.5	ND	1.5	1.1
Chloride (mg/L)	11	20	55	30	7.6	7.3
Nitrate (mg/L)	<0.3	15	32.4	14.8	37.4	18.4
Sulfate (mg/L)	18	45	77	29	16	31
Gross alpha (pCi/L)	3	43	2			
Gross beta (pCi/L)	7	80	3			
Gross radium (pCi/L)	<2	7				

* Blank indicates no data.

** E denotes estimated concentration

*** Dissolved concentrations are presented

The data suggest a nitrate enrichment of ground water; however, the data are inconclusive. Well 5-82 appears to have slightly elevated concentrations of potassium, chloride, nitrate and sulfate, none of which are listed hazardous constituents. The gross alpha and beta are slightly elevated in well 49-86. The pH of the sample from well 48-86 is inconsistent with samples collected elsewhere from bedrock wells and may be a construction artifact.

881 HILLSIDE

Samples were collected by Task Force personnel from five wells downgradient from the 881 hillside area. Three of the wells were completed in both the bedrock and alluvium (2-71 and 9-74) and the other two were completed in bedrock (59-86 and 62-86). Another alluvial well (43-86) near the hillside and a former drum storage area was also sampled. Selected Task Force and Company data for these wells are presented in Table 10.

Table 10
GROUND-WATER QUALITY NEAR 881 HILLSIDE
(Selected Parameters)

Well No./ Parameter*	Task Force Data					1986 Rockwell Data	
	2-71	9-74	59-86	62-86	43-86	2-71	9-74
pH (std. units)	8.0	7.4	7.2	11.1	7.7		
Conductance (µmho/cm)	1,200	1,925	1,340	460	600		
POX (µg/L)			<5.	<5.			
TOX (µg/L)	8,720		17	9	15		
POC (µg/L)			36	28	28		
TOC (µg/L)	3,400		2,900	2,200	2,600		
Tetrachloroethene(µg/L)		2,000				15	4,800
Chloroform (µg/L)	210					79	5
1,1,1-Trichloroethane(µg/L)		11,000					14,000
Trichloroethene (µg/L)	14,000	9,400				4,500	11,000
1,2 Dichloroethane (µg/L)		3,500					38
Cyclohexanol (µg/L)			30E**				
Dodecanoic acid (µg/L)				10E	10E		
1,1-Dichloroethene (µg/L)		3,500					7,200
Gross alpha (pCi/L)	8	7	12	4	7	350	28
Gross beta (pCi/L)	9	7	12	12	16	1,000	28
Gross radium (pCi/L)	5	3	<2	<2	9		
Uranium 233, 234 (pCi/L)	1	8.4	11	3.6	<0.3	30	11
Uranium 235 (pCi/L)	<0.2	0.7	0.6	<0.3	<0.3		
Uranium 238 (pCi/L)	0.8	6.6	8.5	2.1	<0.3	33	8
Tritium (pCi/L)	<200	<200	264		308	-20	110

* Blank indicates no data.

** E denotes estimated concentration.

Both Task Force and Company data indicate that organic hazardous constituents are present in ground water, including several chlorinated ethanes and ethenes. Ground-water contamination in this area had been previously identified by DOE. The extent and source(s) of the contamination were being investigated by Rockwell during the Task Force inspection.

A comparison of Task Force and Rockwell data for radionuclides in samples from well 2-71 and 9-74 indicates substantial differences. Errors in Rockwell data are suspected because of analytical problems described in the section on Sample Analysis and Data Quality Evaluation.

ACTIVE LANDFILL

Samples were collected by the Task Force from one bedrock well (8-86) downgradient from the active landfill. Selected Task Force and Company data for this and two other wells adjacent to the active landfill are presented in Table 11. Bedrock well 9-86 and alluvial well 10-86 are upgradient from the landfill. The data indicate low-level contamination in the downgradient well sample, collected by Task Force personnel, by several of the same organic acids detected in bedrock well 27-86 near the evaporation ponds, including octanoic, nonanoic, decanoic and dodecanoic acids. None of these compounds are listed hazardous constituents. Company data for 1986 do not include any results for these compounds and are not consistent with Task Force data for other possible indicator compounds such as potassium and nitrate. Consequently, the evidence for a release of hazardous constituents from the active landfill is inconclusive.

The high pH of the Task Force sample from well 8-86 is inconsistent with data from other alluvial wells and is not expected based on the wastes known to be disposed of in the landfill. The elevated pH may be a well construction artifact.

Table 11
GROUND-WATER QUALITY NEAR THE ACTIVE LANDFILL
(Selected Parameters)

Well No./ Parameter*	Task Force <u>Data</u> 8-86	<u>1986 Rockwell Data</u>		
		8-86	9-86	10-86
pH (std. units)	11			
Conductance (μ mho/cm)	710			
POC (μ g/L)	17			
TOC (μ g/L)	3,400			
Diethylene glycol (μ g/L)	10E**			
Tetraethylene glycol (μ g/L)	8E			
Octanoic acid (μ g/L)	20E			
Nonanoic acid (μ g/L)	70E			
Decanoic acid (μ g/L)	30E			
Dodecanoic acid (μ g/L)	90E			
Tetradecanoic acid (μ g/L)	20E			
Potassium*** (mg/L)	10.8	41.1	3.6	12.9
Nitrate (mg/L)	<0.3	41.0	<5.0	<5.0
Sulfate (mg/L)	190		15	17
Gross alpha (pCi/L)	<2			
Gross beta (pCi/L)	9			
Gross radium (pCi/L)	2			

* Blank indicates no data.

** E denotes estimated concentrations

*** Dissolved concentrations are presented

ORIGINAL LANDFILL

A sample was collected by Task Force personnel from one alluvial well (57-86) downgradient from the original landfill. No previous samples had been collected from the well because it had been dry. During Task Force sampling, the well yield was very low and samples were only collected for organic, general constituent and radionuclide analysis. Vapor readings (HNU meter) from inside the top of the casing were 10 parts per million above background. However, no organic compounds were identified in the sample. No results

were reported for the general constituent sample. The radionuclide results [Table 12] indicate low concentrations of these constituents.

Table 12
GROUND-WATER QUALITY NEAR
OLD LANDFILL
(Selected Parameters)

Well No./ Parameter	57-86
Gross alpha (pCi/L)	9
Gross beta (pCi/L)	15
Gross radium (pCi/L)	4
Uranium 234 (pCi/L)	6.7
Uranium 235 (pCi/L)	0.5
Uranium 238 (pCi/L)	5.1

The Task Force data are inconclusive regarding indications of releases from the old landfill.

APPENDICES

- A MEMORANDUM OF UNDERSTANDING BETWEEN EPA AND
DOE FOR MANAGEMENT OF HAZARDOUS AND RADIOACTIVE
MIXED WASTES
- B SUMMARY OF LEAF vs. HODEL DECISION
- C ANALYTICAL TECHNIQUES AND RESULTS FOR TASK FORCE
SAMPLES
- D DOE GROUND-WATER MONITORING DATA FOR 1986

APPENDIX A

MEMORANDUM OF UNDERSTANDING BETWEEN EPA AND DOE FOR MANAGEMENT OF HAZARDOUS AND RADIOACTIVE MIXED WASTES

ENVIRONMENTAL PROTECTION AGENCY/DEPARTMENT OF ENERGY MEMORANDUM OF UNDERSTANDING ON RESPONSIBILITIES FOR HAZARDOUS AND RADIOACTIVE MIXED WASTE MANAGEMENT

(Signed February 22, 1984)

I. PURPOSE.

A. Responsibilities

This Memorandum of Understanding (MOU) delineates the areas of responsibility of the Department of Energy (DOE) and the Environmental Protection Agency (EPA) concerning ongoing hazardous waste and radioactive mixed waste management at facilities operated by DOE under the authority of the Atomic Energy Act (AEA) of 1954, 42 U.S.C. §2011 *et seq.* This MOU sets forth procedures to assure that hazardous waste and radioactive mixed waste management are conducted in a manner consistent with the national security responsibilities assigned by existing law.

B. Comparable Program Established

This MOU establishes a hazardous waste and radioactive mixed waste management program that is comparable to the design and performance criteria, other technical requirements, and recordkeeping and reporting requirements of the regulations adopted by EPA to implement the Resource Conservation and Recovery Act, 42 U.S.C. §6901 *et seq.* This MOU also addresses coordination with States and community relations concerning hazardous waste and radioactive mixed waste management at AEA facilities.

II. AUTHORITY.

A. Statutes and Executive Orders

The authority for hazardous waste and radioactive mixed waste management at Atomic Energy Act facilities derives from

1. Atomic Energy Act of 1954, 42 U.S.C. §2011 *et seq.*

2. Executive Order (E.O.) 12088, October 13, 1978.

3. E.O. 12146, July 18, 1979, and

4. E.O. 12356, April 2, 1982.

B. Regulations

The regulatory standards for hazardous waste and radioactive mixed waste management referred to in this MOU are set forth in

1. 40 CFR Parts 260 through 266, and 270.

2. DOE Order 5480.2,

3. DOE Order 5632.1,

4. DOE Order 5635.1, and

5. DOE Order 5650.2.

III. DEFINITIONS.

A. Hazardous Waste

Hazardous waste means a solid waste that is determined to be hazardous under 40 CFR Part 261.

B. Hazardous Waste Compliance Plan

Hazardous waste compliance plan (HWCP) means a document issued by EPA that prescribes specific treatment, storage, and disposal practices for hazardous waste and radioactive mixed waste managed at any AEA facility.

C. Radioactive Mixed Waste

Radioactive mixed waste means hazardous waste containing source, special nuclear, or byproduct materials.

IV. SCOPE.

This MOU covers the generation, transportation, treatment, storage, and disposal

of hazardous waste and radioactive mixed waste at DOE facilities operated under the AEA. This MOU does not address responsibilities for implementing the Comprehensive Environmental Response, Compensation and Liability Act (CERCLA).

V. CONFIDENTIAL INFORMATION AND SECURITY.

A. EPA Personnel

DOE agrees to provide security clearances in accordance with DOE procedures for the personnel designated by EPA to perform site inspections and data analysis under this MOU.

B. DOE Documents and Information

1. DOE agrees to give EPA-designated personnel with appropriate security clearances access to any information pertinent to hazardous waste and radioactive mixed waste management that EPA needs to fulfill responsibilities under this MOU. Information includes Restricted Data, National Security Information classified under EO 12356 and its predecessors, and Unclassified Controlled Nuclear Information.

2. EPA agrees to handle and review DOE information in accordance with the AEA and DOE Orders, the EPA Document Security Manual, and EO 12356.

VI. GENERATORS.

A. Standards

For all generators of hazardous wastes or radioactive mixed wastes at AEA facilities, DOE agrees to comply with the requirements of 40 CFR Part 262, Stan-

standards Applicable to Generators of Hazardous Waste, including recordkeeping and reporting.

B. *Modification of Standards*

EPA and DOE can modify these standards by agreement when necessary to ensure protection from radiological hazards to health and safety. Any modification of standards must continue to provide protection of human health and the environment equivalent to the level achieved under 40 CFR Part 262.

VII. TRANSPORTERS.

A. *Standards*

For all DOE transporters of hazardous wastes or radioactive waste mixtures generated at AEA facilities, DOE agrees to comply with the requirements of 40 CFR Part 263, Standards Applicable to Transporters of Hazardous Waste, including recordkeeping, reporting, and cleaning up transporter spills.

B. *Modification of Standards*

EPA and DOE can modify these standards by agreement when necessary to ensure protection from radiological hazards to health and safety. Any modification of standards must continue to provide protection of human health and the environment equivalent to the level achieved under 40 CFR Part 263.

VIII. TREATMENT, STORAGE, AND DISPOSAL FACILITIES (TSDFs).

A. *Standards*

1. DOE agrees to require AEA facilities that treat, store, or dispose of hazardous waste or radioactive mixed waste on site to comply with the requirements of ~~40 CFR Part 265, Interim Status Standards for Owners and Operators of Hazardous Waste TSDFs, until EPA issues an HWCP to the facility.~~

2. DOE agrees to require AEA facilities that treat, store, or dispose of hazardous waste or radioactive waste mixtures on site to comply with the requirements of an HWCP issued by EPA. Any HWCP that EPA issues will conform to the requirements of 40 CFR Part 264, Standards for Owners and Operators of Hazardous Waste TSDFs, and Part 266 (untitled).

B. *Modification of Standards*

EPA and DOE can modify the standards for TSDFs by agreement when necessary to ensure protection from radiological hazards to health and safety. Any modification of standards must continue

to provide protection of human health and the environment equivalent to the level achieved under 40 CFR Parts 264, 265, and 266.

C. *Procedures for Issuing a Hazardous Waste Compliance Plan (HWCP)*

1. Within the time specified in a notice from EPA, DOE agrees to submit a request for an HWCP that provides all of the information described in Subparts B and C of 40 CFR Part 270. The notice will provide at least 180 days for DOE to submit the request.

2. EPA agrees to provide to DOE a draft HWCP that will be available for review in accordance with Part X of this MOU. Before any release of information under Part X of this MOU, DOE agrees to review the draft HWCP to ensure that no classified information is improperly disclosed.

3. EPA agrees to issue a final HWCP to any AEA facility that demonstrates that the facility is complying with the requirements of Part 264 or 266, or will comply with these requirements on a mutually agreed on schedule.

4. If the regulations that establish the standards for HWCPs change, EPA will review the HWCPs for all AEA facilities and issue any needed revisions. DOE agrees to apply these revised standards in accordance with the provisions of this MOU.

5. If DOE program requirements change, EPA will review the HWCPs and, after consulting with DOE, issue any needed revisions.

IX. COMPLIANCE

A. *Inspections*

DOE agrees to allow properly cleared EPA-designated personnel to perform site inspections as provided by 40 CFR §270.30(i).

B. *Self Inspections*

DOE agrees to perform the inspections required by 40 CFR Part 264, Standards for Owners and Operators of Hazardous Waste TSDFs, and submit any required reports to the appropriate EPA office.

C. *Written Compliance Demands*

When EPA determines that an AEA facility is not in compliance with any standard in Parts VI, VII, or VIII of this MOU, EPA will issue to an appropriate official at the AEA facility a written compliance demand that identifies the nature

of the violation. A written compliance demand may be based on a site inspection, reports, or any other information.

D. *Response to Written Compliance Demand*

Within 30 days after DOE receives a written compliance demand, DOE will submit a response to EPA that identifies:

(i) The causes of the noncompliance, or if DOE believes that a facility is in compliance, DOE's explanation of that belief.

(ii) The action that DOE will take to bring the facility into compliance, and

(iii) The date by which DOE proposes to bring the facility into compliance.

E. *Compliance Schedules*

1. After consulting with DOE, EPA will develop a compliance schedule that identifies:

(i) What DOE must do to bring the facility into compliance, and

(ii) The time frame in which DOE must take action.

2. DOE agrees to implement the compliance schedule.

F. *Technical Assistance*

EPA agrees to provide technical advice and assistance to DOE generators and TSD facilities as required by E.O. 12088 to help DOE comply with the hazardous waste and radioactive mixed waste standards set forth in this MOU.

X. COORDINATION.

A. *State Relationships*

1. EPA will consult with affected States in:

(i) Issuing HWCPs under Part VIII of this MOU,

(ii) Considering any proposed modifications to standards under Parts VI, VII, and VIII of this MOU.

2. EPA will consult with affected States concerning violations of applicable standards, appropriate remedies, and compliance schedules.

B. *Community Relations*

1. With the assistance of EPA, DOE will provide notice to any affected community of:

(i) The availability of a draft HWCP or

(ii) Any proposed modifications to standards under Parts VI, VII, or VIII of this MOU.

2. The notice will include:

(i) The proposed treatment, storage, and disposal practices for hazardous waste and radioactive mixed waste management.

(ii) The schedule for implementing the practices, and

(iii) The places where copies of the draft HWCP may be reviewed.

3. After issuing a notice, DOE will provide

(i) At least 45 days for review of a draft HWCP or proposed modifications to standards, and

(ii) An opportunity for a public meeting in the affected community on the draft HWCP or proposed modifications to standards.

4. EPA and DOE agree to consider information and comments received dur-

ing the review period in final decisions concerning the HWCP or proposed modifications to standards.

XI. INCONSISTENT REQUIREMENTS.

DOE agrees to modify any provisions in DOE Order 5480.2 or other Orders that govern DOE's hazardous waste and radioactive mixed waste management that are inconsistent with this MOU. DOE agrees to remove or modify any provisions in these Orders for exemptions or waivers from the standards of 40 CFR Parts 260 through 266, or 270.

XII. DURATION AND MODIFICATION OF MOU.

On signing by the Secretary, DOE, and by the Administrator, EPA, this MOU

will be in effect until terminated by mutual written consent of EPA and DOE. EPA and DOE can modify this MOU by mutual written consent.

XIII. RESOLUTION OF DISAGREEMENTS.

DOE and EPA agree to use the procedures in E.O. 12088 and E.O. 12146 as methods for resolving any disagreements arising under this MOU.

Donald Paul Hodel	William Ruckelshaus
Secretary	Administrator
Department of	Environmental
Energy	Protection Agency

Date: 2/22/84

Date: 2/22/84

APPENDIX B

SUMMARY OF LEAF vs. HODEL DECISION

Legal Environmental Assistance Foundation, Inc. v. Hodel

No. 3-83-562 (E.D. Tenn. Apr. 13, 1984)

The court rules that the Department of Energy's (DOE's) Y-12 nuclear weapons components plant is subject to the provisions of the Resource Conservation and Recovery Act (RCRA) and that DOE has violated the Federal Water Pollution Control Act (FWPCA) by allowing unpermitted discharges of pollutants from the plant. The court first holds that plaintiff environmental groups have standing to bring the suit. The court then rules that RCRA §1006(a), which excludes activities regulated by the Atomic Energy Act (AEA) from RCRA coverage, does not exclude activities at AEA federal facilities from RCRA if such regulation is consistent with the AEA. AEA §161 does not vest DOE with exclusive authority to regulate health and safety at facilities like Y-12. Defendants have presented no evidence that enforcing RCRA would cause disclosure of data protected under the AEA. DOE may apply for presidential exemption from RCRA to protect national security interests under RCRA §6001; absent such an application, the court should not weigh national security considerations. Thus, the court holds that applying RCRA to Y-12 is consistent with the AEA. The court also rules that DOE's discharge of pollutants at locations other than those listed in its national pollutant discharge elimination system permit is in violation of the FWPCA. The court rejects DOE's argument that plaintiffs' challenge could only have been brought within 90 days of the issuance of the permit, ruling that plaintiffs have a cause of action under FWPCA §505 to enforce permit conditions. The court also rejects DOE's argument that the court should defer to the Environmental Protection Agency's expertise in determining whether the permit has been violated. However, the court declines to enjoin the operation of Y-12 or assess civil penalties, but simply orders DOE to comply with RCRA and the FWPCA.

Counsel for Plaintiffs

Garry A. Davis
602 S. Gay St., Knoxville TN 37902
(615) 637-5172

Dean Hill Rivkin
6608 Crystal Lake Dr., Knoxville TN 37919
(615) 974-2331

Counsel for Plaintiff-Intervenor

Frank J. Scanlon, Ass't Attorney General
450 James Robertson Pkwy., Nashville TN 37219
(615) 741-1963

Counsel for Defendants

Dean K. Dunsmore
Land and Natural Resources Division
Department of Justice, Washington DC 20530
(202) 633-2216

Jimmie Baxter, Ass't U.S. Attorney
P.O. Box 872, Knoxville TN 37901
(615) 673-4561

Taylor, J.:

Memorandum

Plaintiffs allege that defendants are in violation of the Resource Conservation and Recovery Act [RCRA], 42 U.S.C. §§6901-6987, and the Clean Water Act [CWA], 33 U.S.C. §§1251-1376. Plaintiffs seek declaratory and injunctive relief plus the imposition of civil penalties. This case is now before the Court on cross motions for summary judgment.

Defendants are the United States Department of Energy [DOE] and the Secretary of DOE. Defendants operate the Y-12 Plant in Oak Ridge, Tennessee, pursuant to the Atomic Energy Act [AEA], 42 U.S.C. §§2011-2284. Plaintiffs, Legal Environmental Assistance Foundation and Natural Resources Defense Council, Inc., are non-profit corporations concerned with envi-

ronmental protection. Several members of these organizations reside in the Oak Ridge, Tennessee, area and the organizations have standing to bring this suit. The State of Tennessee intervened as plaintiff to protect its interest in hazardous waste and water quality regulation.

The Y-12 Plant consists of approximately 260 buildings located on 600 acres. Y-12 is primarily engaged in the fabrication and assembly of nuclear weapons components. It is an essential and unique facility in this country's system of nuclear defense. Y-12 produces a large amount of hazardous wastes containing chromium, mercury, PCBs, cadmium and other pollutants. Some of these wastes are leaked or discharged into ground water and the tributaries of the Clinch River.

The questions before the Court are: 1) Whether the Y-12 Plant is subject to the provisions of the RCRA, and 2) Whether defendants have violated the CWA by allowing unpermitted discharges of pollution at Y-12.

Resource Conservation and Recovery Act

One purpose of the RCRA is "to promote the protection of health and the environment . . . by . . . regulating the treatment, storage, transportation, and disposal of hazardous wastes which have adverse effects on health and the environment." 42 U.S.C. §6902. The RCRA and its accompanying regulations establish a comprehensive program for the handling of hazardous wastes. This comprehensive program is applicable to federal facilities. 42 U.S.C. §6961. Nothing in the RCRA, however, "shall be construed to apply to (or to authorize any State, interstate, or local authority to regulate) any activity or substance which is subject to the . . . Atomic Energy Act of 1954 except to the extent that such application (or regulation) is not inconsistent with the requirements of such [Act]." 42 U.S.C. §6905(a).

Defendants oppose application of the RCRA to Y-12. They argue that application of the RCRA to Y-12 is inconsistent with the AEA for three reasons. First, the AEA precludes state regulation of activities of DOE, 42 U.S.C. §2018, but the RCRA subject[s] federal facilities to state regulation. 42 U.S.C. §6961. Second, the RCRA gives the United States Environmental Protection Agency [EPA], state and local authorities the authority to set standards for waste disposal, 42 U.S.C. §6902, yet the AEA places that authority with DOE. 42 U.S.C. §2201(i)(3). Third, the AEA restricts dissemination of restricted data pertaining to nuclear weapons and materials, 42 U.S.C. §§2014(y), 2274, 2277, but the RCRA would subject this information to public disclosure. 42 U.S.C. §6927.

Section 271 of the AEA, 42 U.S.C. §2018, provides that:

Nothing in this chapter shall be construed to affect the authority or regulations of any Federal, State, or local agency with respect to the generation, sale, or transmission of electric power produced through the use of nuclear facilities licensed by the [Atomic Energy] Commission: *Provided*, That this section shall not be deemed to confer upon any Federal, State, or local agency any authority to regulate, control, or restrict any activities of the Commission.

The parties are in disagreement as to whether this section prohibits any state or local regulation of Y-12 or whether it merely prohibits state and local regulations of electricity. In any event, plaintiffs assert, and defendants do not deny, that Y-12 is currently subject to federal, state and local regulations under several other environmental statutes. See, e.g., National Environmental Policy Act, 42 U.S.C. §§4321-4347; Safe Drinking Water Act, 42 U.S.C. §§300f-300j-10; Clean Air Act, 42 U.S.C. §§7401-7642; Clean Water Act, 33 U.S.C. §§1251-1376; and Toxic Substances Control Act, 15 U.S.C. §§2601-2629. Admittedly, none of these other environmental laws contain a provision limiting its application to consistency with the AEA. But see 33 U.S.C. §1371(a) (Clean Water Act does not limit inconsistent regulations of other agencies). The fact that Y-12 is subject to other state and local environmental regulations, however, precludes the argument that state and local environmental regulation of Y-12 is inconsistent with the AEA.

"Federal installations are subject to state regulations only when and to the extent that congressional authorization is clear and unambiguous." *Environmental Protection Agency v. Cal-*

1. Also known as the Federal Water Pollution Control Act. See Gaba, *Federal Supervision of State Water Quality Standards Under the Clean Water Act*, 36 VAND. L. REV. 1167, 1168 n.3 (1983).

2. DOE is successor to many functions formerly vested with the Atomic Energy Commission. 42 U.S.C. §§5814, 7151.

California ex rel. State Water Resources Control [Board], 426 U.S. 200, 211 [6 ELR 20563] (1976). On the other hand, a court must give full effect to a statute unless it is in "irreconcilable conflict" with another statute. *Radzanou v. Touche Ross & Co.*, 426 U.S. 148, 155 (1976). "[W]hen two statutes are capable of co-existence, it is the duty of the courts . . . to regard each as effective." *Id.*, quoting *Morton v. Mancari*, 417 U.S. 535, 551 (1974). The RCRA and the AEA are certainly not in irreconcilable conflict. Congress must have intended that the RCRA be at least partially applicable to facilities operated pursuant to the AEA. Otherwise 42 U.S.C. §6905(a) would have simply excluded application of the RCRA to AEA federal facilities. Although defendants have taken the position that Y-12 is totally excluded from RCRA regulations, §6905(a) precludes RCRA application only to the extent it is inconsistent with the AEA. Defendants' position would render §6905(a) a nullity.

The RCRA provides a comprehensive program for the handling of most hazardous wastes, but expressly excludes regulation of nuclear wastes. 42 U.S.C. §6903(27). The AEA regulates nuclear material, regardless of whether it is considered waste. 42 U.S.C. §2014(e), (z), (aa). The Court concludes that the most reasonable reconciliation of the RCRA and the AEA is that AEA facilities are subject to the RCRA except as to those wastes which are expressly regulated by the AEA: nuclear and radioactive materials. Although it could be said this interpretation renders §6905(a) redundant with §6903(27), the Court believes that these two sections support one another and firmly evince Congressional intent as to the application of the RCRA.

Section 161 of the AEA, 42 U.S.C. §2201, provides that:

In the performance of its functions the [Atomic Energy] Commission is authorized to—

(i) prescribe such regulations or orders as it may deem necessary

(3) to govern any activity authorized pursuant to this chapter, including standards and restrictions governing the design, location, and operation of facilities used in the conduct of such activity, in order to protect health and to minimize danger to life or property.

It does not appear that 42 U.S.C. §2201(i)(3) vests DOE with exclusive authority to regulate health and safety standards in the operation of Y-12. Accordingly, the RCRA is not inconsistent with the AEA in this respect. *Cf. Blaber v. United States*, 212 F. Supp. 95 (E.D.N.Y. 1962), *aff'd.*, 332 F.2d 629 (2nd Cir. 1964) (DOE's authority to prescribe health and safety regulations is discretionary, not mandatory).

If application of the RCRA to Y-12 would require disclosure of restricted nuclear material data protected by 42 U.S.C. §2014(y), 2274, 2277, this would be inconsistent with the AEA. The burden is upon defendants, however, to show that such an inconsistency would result. Nothing the Court says today should be construed to require disclosure of restricted nuclear material data, however, defendants have not shown that application of the RCRA to Y-12 would result in such disclosures. Defendants' conclusory statement that such disclosures would be required is unsupported. The Court can no more assume that the RCRA would require defendants to disclose restricted nuclear material data than it could assume that the RCRA would require private business to disclose trade secrets. If security of nuclear material data would conflict with the RCRA, defendants should apply for a Presidential exemption from the RCRA for Y-12. 42 U.S.C. §6961. Apparently, defendants have not sought a Presidential exemption. Where DOE has not applied for a Presidential exemption, national security considerations should not be considered by the Court. See *United States v. Puerto Rico*, 721 F.2d 832, 835 n.4 [14 ELR 20003] (1st Cir. 1983) (interpreting the Clean Water Act, which has a similar Presidential exemption. 33 U.S.C. §1333(a)).

The Court concludes that application of the RCRA to Y-12 will not be inconsistent with the AEA. The restriction upon the RCRA found in 42 U.S.C. §6961 merely clarifies the Congressional intent to exclude nuclear wastes from coverage by the RCRA. The AEA still provides exclusive regulation of nuclear wastes. Defendants acknowledge that they have neither an EPA

permit, 42 U.S.C. §6925, nor a state permit, 42 U.S.C. §6926, for the treatment, storage or disposal of hazardous waste. Accordingly, summary judgment for plaintiffs is appropriate for their claim under the RCRA.

Clean Water Act

The goal of the CWA is to eliminate the discharge of pollutants into navigable waters. 33 U.S.C. §1251. Except as permitted under certain exceptions, "the discharge of any pollutant by any person shall be unlawful." 33 U.S.C. §1311(a). One exception is granted for discharges allowed by a National Pollutant Discharge Elimination System [NPDES] permit issued pursuant to 33 U.S.C. §1342. The "discharge of a pollutant" is defined as "any addition of any pollutant to navigable waters from any point source." 33 U.S.C. §1362(12). "The term 'point source' means any discernible, confined and discrete conveyance, including but not limited to any pipe, ditch, channel, tunnel, conduit, well, discrete fissure, container, rolling stock, concentrated animal feeding operation, or vessel or other floating craft, from which pollutants are or may be discharged." 33 U.S.C. §1362(14). Every identifiable point that emits pollution is a point source which must be authorized by a NPDES permit. *United States v. Earth Sciences, Inc.*, 599 F.2d 368 [9 ELR 20542] (10th Cir. 1979); 40 C.F.R. §122.1(b)(1).

The EPA issued a NPDES permit for Y-12 in 1974 which was to expire on February 15, 1980. Since DOE made application for a renewal of this permit more than 180 days before it was to expire, the 1974 permit is still in effect. 40 C.F.R. §122.10(b)(2) (1979) (recodified at 40 C.F.R. §122.21(d)(2) [sic] (1983)). This permit authorizes discharges at four points: Kerr Hollow Quarry, Rogers Quarry, New Hope Pond and Bear Creek. The parties acknowledge that at one time it was EPA policy to designate the facility boundary as the point of discharge, but that this is no longer consistent with the requirements of the CWA. Apparently the 1974 permit conforms with EPA's prior policy.

Plaintiffs claim that defendants are violating the CWA because they do not have a NPDES permit covering Y-12 discharges at four other locations: the Oil Landfarm, the S-3 ponds, the Burial Ground Oil Pond and over 200 discharge pipes into Upper East Fork Poplar Creek. It seems clear to the Court, and defendants have offered no evidence to the contrary, that these four locations are point sources that are discharging pollutants into navigable waters. Since this lawsuit was filed, DOE has submitted NPDES permit applications for many of these point sources.

DOE argues that because it has a NPDES permit for Y-12, any discharge of pollution from Y-12 is not in violation of the CWA. DOE says that judicial review of the permit may only be by the appropriate Court of Appeals within ninety days after the permit was issued. 33 U.S.C. §1369(b)(1). Plaintiffs, on the other hand, claim that they are not challenging the issuance of the 1974 permit. They construe this case as a complaint against the unlawful discharge of pollutants without a permit, which may be challenged in a citizen's suit such as this. 33 U.S.C. §1365. The Court is inclined to agree with plaintiff's characterization of this suit. The 1974 permit does not purport to allow pollutant discharges at the Oil Landfarm, S-3 ponds, Burial Ground Oil Pond or Upper East Fork Poplar Creek. The permit allows pollutant discharges only in accordance with the limitations and conditions of the permit. Defendants have taken the position that a NPDES permit for one point source of pollution, allows many other point sources of pollution unless someone appeals the issuance of the permit. This position is inconsistent with the remedial purpose of the CWA and the requirement that any point source of pollutant discharge be authorized by permit. 40 C.F.R. §122.1(b)(1).

Defendants argue in the alternative that, if the Court determines that Y-12's NPDES permit does not authorize other pollution discharges, this Court should defer to the primary jurisdiction of the EPA and dismiss this action.

Primary jurisdiction is a common-law doctrine that enables a court to determine the appropriate timing of its own exercise of jurisdiction so that an agency sharing concurrent jurisdiction with the court over the subject matter has time to make its own findings with respect to the claims and disputes. *United States v. Western Pacific R.R.*, 352 U.S. 59, 64, 77 S. Ct. 161, 165, 1 L. Ed. 2d 126 (1956). Its

objective is to encourage "proper relationships between courts and administrative agencies charged with particular regulatory duties." *Id.* at 63, 77 S. Ct. at 164. Primary jurisdiction is appropriately invoked "when a claim is cognizable in a court but adjudication of the claim" requires the special competence of administrative bodies created by Congress to regulate the subject matter. *Hansen v. Norfolk & Western Ry.*, 689 F.2d 707, 710 (7th Cir. 1982).

Illinois Hospital Association v. Illinois Department of Public Aid, 576 F. Supp. 360 (N.D. Ill. 1983). Whether several locations at Y-12 are point sources for pollution is a question within the competence of courts. See e.g., *United States v. Earth Sciences, Inc.*, 599 F.2d 368 [9 ELR 20542] (10th Cir. 1979). Accordingly, deferral to the EPA would not be appropriate in this case.

Remedy

The Court concludes that defendants are in violation of the RCRA and the CWA. At this time, however, the Court will impose neither an injunction nor civil penalties upon defendants for the following reasons:

1. The Y-12 Plant is a unique and essential element of this nation's system of nuclear defense. See *Weinberger v. Romero-Barcelo*, 456 U.S. 305, 310 [12 ELR 20538] (1982).

2. Defendants have already taken and have agreed to take steps that will reduce environmental harm caused by violations of the RCRA and the CWA.

It is therefore ORDERED that plaintiffs' motion for summary judgment be and the same hereby is granted. It is further ORDERED that defendants' motion for summary judgment be, and the same hereby is, denied. It is further ORDERED that defendants, with all deliberate speed, file for and seek a permit for the treatment, storage and disposal of hazardous waste at Y-12. 42 U.S.C. §§6925, 6926. It is further ORDERED that defendants, with all deliberate speed, file for and seek a NPDES permit for any discharge of pollutants into Upper East Fork Poplar Creek, and into Bear Creek from the Burial Ground Oil Pond, the Oil Landfarm and the S-3 ponds. See *Barcelo v. Brown*, 478 F. Supp. 646, 798 (D.P.R. 1979), *aff'd sub nom*, 456 U.S. 395.

Order

For the reasons stated in a memorandum opinion this day passed to the Clerk for filing, it is ORDERED that plaintiffs' motion for summary judgment be, and the same hereby is, GRANTED. It is further ORDERED that defendants' motion for summary judgment be, and the same hereby is, DENIED. It is further ORDERED that defendants, with all deliberate speed, file for and seek a permit for the treatment, storage or disposal of hazardous waste at Y-12 pursuant to 42 U.S.C. §§6925 or 6926. It is further ORDERED that defendants, with all deliberate speed, file for and seek a NPDES permit for any discharge of pollutants into Upper East Fork Poplar Creek, and into Bear Creek from the Burial Ground Oil Pond, the Oil Landfarm and the S-3 ponds.

Kean v. Clark

Nos. 82-5679, -5752 (3d Cir. Mar. 21, 1984)

In light of the Supreme Court ruling in *Secretary of the Interior v. California*, 14 ELR 20129, the circuit court reverses and remands the district court's ruling requiring consistency determinations under the Coastal Zone Management Act for outer continental shelf oil and gas lease sales, 13 ELR 20618.

Counsel for Appellants (Cross-Appellees)

Irvin I. Kimmelman, Attorney General; John M. Van Dalen,
Deborah T. Poritz, James J. Ciancia
Richard J. Hughes Justice Complex, CN112, Trenton NJ
08625
(609) 984-6500

Counsel for Appellees (Cross-Appellants)

Nancy B. Firestone, Arthur E. Gowran, Peter R.
Steenland Jr.
Land and Natural Resources Division
Department of Justice, Washington DC 20530
(202) 633-2757

Counsel for Amici Curiae

Sarah Chasis, David Keto, David Wirth
Natural Resources Defense Council, Inc.
122 E. 42d St., New York NY 10017
(212) 949-0049

Norman C. Gorsuch, Attorney General; Lauri J. Adams
Pouch K, Capitol Bldg., Juneau AK 99811
(907) 465-3600

E. Edward Bruce, David K. Flynn, Bobby R. Burchfield
Covington & Burling
P.O. Box 7566, Washington DC 20044
(202) 662-6000

Per curiam (before Gibbons, Garth, and Sloviter, JJ.):

This appeal and cross-appeal raised two issues with regard to the Coastal Zone Management Act ("CZMA"), 16 U.S.C. §§1451-1464 (1980). The Secretary of the Interior questioned whether outer continental shelf oil and gas leasing directly affects an adjacent state's coastal zone within the meaning of section 307(c)(1) of the CZMA. The district court ruled against the Secretary of the Interior and held that the lease sale in question did directly affect New Jersey's coastal zone, thereby triggering the CZMA's consistency requirements.

The State of New Jersey challenged whether the CZMA, assuming it applies to a lease sale, protects the coastal zone of a directly affected state from economic or social impacts inconsistent with the state's approved coastal management program. Contrary to New Jersey's position, the district court ruled that the CZMA only protects against inconsistent physical impacts to the coastal zone, and not against inconsistent socio-economic impacts. Prior to disposition on the merits, all parties agreed that we should withhold disposition until after the Supreme Court decided *California v. Watt*, 683 F.2d 1253 [12 ELR 21084] (9th Cir. 1982), *cert. granted*, 51 USLW 3818 (1983), which presented the precise issue raised by the Secretary of the Interior in the instant appeal.

On January 11, 1984, the Supreme Court decided *Clark v. California*, Nos. 82-1326, 82-1327, 82-1511 [14 ELR 20129], and held, in accordance with the position taken by the Secretary of the Interior, that the Department of the Interior's sale of oil and gas leases on the outer continental shelf off the coast of California was not an activity "directly affecting" the coastal zone under section 307(c)(1) of the CZMA. Thereafter, counsel in the instant matter, in response to this court's instruction, filed supplemental memoranda commenting on the application of the Supreme Court decision to the issues in *Kean v. Clark*.

As a result of the responses to the court's inquiry and the consistent position taken by all counsel which the court hereby approves, we will reverse that part of the district court's judgment which the Secretary of the Interior challenged by cross-appeal, (No. 82-5752) and remand to the district court with instructions to dismiss as moot that aspect of the judgment appealed by the State of New Jersey (No. 82-5679).

Conant v. United States

No. 83-3325 (11th Cir. Feb. 27, 1984)

The court rules that a claim for damages caused by an allegedly wrongfully issued Army Corps of Engineers dredge and fill cease and desist order must meet the requirements of the Federal Tort Claims Act (FTCA), but that a claim for equitable relief may lie under the Administrative Procedure Act (APA). The court holds that the district court lacked evidence to support its ruling that appellant's damage claim was untimely under the FTCA. Further, it holds that injunctive relief from Corps' action under §404 of the Federal Water Pollution Control Act is not barred by sovereign immunity, since the APA waives that immunity.

Counsel for Appellant (Pro Se)

Marcus Conant
P.O. Box 30, Gainesville FL 32602
(904) 372-4813

1. "Each Federal agency conducting or supporting activities directly affecting the coastal zone shall conduct or support those activities in a manner which is, to the maximum extent practicable, consistent with approved state management programs." 16 U.S.C. §1456(c)(1).

Counsel for Appellee

Kenneth Sukhia, Ass't U.S. Attorney
110 E. Park Ave., Rm. 100, Tallahassee FL 32301
(904) 224-3186

Per curiam (before Hill, Johnson, and Henderson, JJ.):

This lawsuit stems from a June 1981 cease and desist order issued by the United States Army Corps of Engineers prohibiting further discharges by Marcus Conant of dredge or fill materials in the water of the United States at or near the Santa Fe River in Alachua County, Florida. Upon receipt of the cease and desist order, Conant filed a claim with the Army Corps of Engineers seeking \$300,000 in damages resulting from the issuance of the order. Notice of final denial of his administrative claim was dated July 13, 1982. The basis for the denial according to the July 13, 1982, letter was that the claim was "not payable because the applicable statute (28 U.S.C. 2680(a)) excludes liability for inspection and enforcement of the Clean Water Act." On January 19, 1983, Conant filed in the United States District Court for the Northern District of Florida his pro se complaint seeking monetary damages and injunctive relief. His complaint alleges that the United States District Court had jurisdiction over the case pursuant to 28 U.S.C.A. §1331 and that the Corps of Engineers had misapplied the Clean Water Act of 1977 by issuing the cease and desist order. He requests that the district court award him \$300,000 in compensatory damages, plus an amount in punitive damages to be determined by the court. He further asked the district court to nullify the cease and desist order and enjoin the Corps from taking additional action against him. The government moved to dismiss his complaint on the ground that the court lacked subject matter jurisdiction in that Conant's claim was barred under 28 U.S.C.A. §2401 because he did not commence his action within six months of the date on which the notice of final denial of his administrative claim was mailed.

Finding that Conant had failed to bring his suit within the six-month period required by Section 2401, the district court dismissed his monetary damage claim for lack of jurisdiction. The district court in a separate order determined that Conant's claim for injunctive relief was barred by the doctrine of sovereign immunity. Accordingly, the court dismissed his entire action with prejudice.

According to 28 U.S.C.A. §2401, a tort claim against the United States shall be forever barred unless the action is commenced "within six months after the date of mailing, by certified or registered mail, of notice of final denial of the claim by the agency to which it was presented." See *Carr v. Veterans Administration*, 522 F.2d 1355, 1357 (5th Cir. 1975).¹ This court cannot set aside the district court's finding as to the mailing date of the final notice unless that finding is clearly erroneous. FED. R. Civ. P. 52(a). In determining that Conant had failed to file his action timely, the district court found that the Corps' final notice was mailed to him on July 13, 1982, and that he filed his claim on January 19, 1983, more than six months later. The record does reflect that the letter of the Corps is dated July 13, 1982; however, there is nothing in the record showing that it was mailed on that date. Consequently, in the absence of any evidence establishing the mailing date of the final notice, the district court erred in finding that Conant failed to file his claim for monetary damages within the six-month period required by Section 2401. This part of Conant's claim will be remanded to the district court for the purpose of allowing the parties to present evidence as to the "date of mailing" of the July 13, 1982, letter of the Corps of Engineers.

In considering the disposition by the district court of Conant's claim for injunctive relief against the Corps of Engineers pursuant to 28 U.S.C.A. §1331, we start with the premise that a suit for injunctive relief against a federal agency is barred by sovereign immunity unless specifically and explicitly waived. See *Larson v. Domestic & Foreign Commerce Corporation*, 337 U.S. 682, 686-90 (1949); *Petterway v. Veterans Administration Hospital*, 495 F.2d 1223, 1225 (5th Cir. 1974). Although Conant characterizes his claim as one under Section 1331, that section cannot be construed as a waiver of sovereign immunity. *Beale v. Blount*, 461

F.2d 1133, 1138 (5th Cir. 1972). However, this does not end the matter since 5 U.S.C.A. §702 provides that a party suffering a legal wrong or adversely affected or aggrieved because of agency action is entitled to judicial review of that action and the party's claim shall not be dismissed on the ground that it is against the United States. It is clear, therefore, that Section 702 "waives sovereign immunity for actions against federal government agencies, seeking nonmonetary relief, if the agency conduct is otherwise subject to judicial review." *Sheehan v. Army & Air Force Exchange Service*, 619 F.2d 1132, 1139 (5th Cir. 1980), *rev'd on other grounds*, 456 U.S. 728 (1982).

Title 33 U.S.C.A. §1311 prohibits the discharge of fill material into navigable waters unless authorized by 33 U.S.C.A. §1344. Under Section 1344 the Secretary of the Army is authorized to issue permits for the discharge of fill material into navigable waters. Conant alleges in his complaint, however, that he was not required to obtain a permit because normal fish farming on a scale where the fish farming facilities produce less than a 100,000 harvest weight pounds per year are exempted from the statutory provisions and therefore, since his operation was not that large, the Corps of Engineers improperly issued him a cease and desist order. There is no question but that the United States Army Corps of Engineers is an "agency" within the meaning of the Administrative Procedure Act, *Jaffee v. United States*, 592 F.2d 712, 719 (3rd Cir.), *cert. denied*, 441 U.S. 961 (1979). Therefore, construing Conant's allegations liberally, which we must under *Haines v. Kerner*, 404 U.S. 519 (1972), it is clear that he states a claim that he suffered a legal wrong because of the Corps of Engineers' action. Consequently, the district court erred in dismissing his claim for injunctive relief as barred by sovereign immunity.

For the foregoing reasons, the judgments entered in this case by the district court are REVERSED and the case is REMANDED for further proceedings.

Massachusetts v. Pace

No 83-3883-G (D. Mass. Mar. 22, 1984)

The Commonwealth of Massachusetts signs a consent agreement to recover over \$1.9 million expended for cleanup of the Silresim Chemical Corp. site in Lowell. In the agreement, 231 corporations agree to pay sums ranging from \$16.41 to \$287,190.31 in return for release from civil liability for cleanup of the site. The agreement also attempts to protect the defendants from suits for contribution from non-settling joint tortfeasors, and allows defendants credit for sums paid to third parties in independent suits to recover cleanup costs. The parties do not acknowledge liability for disposal of materials at the site. An appendix listing settling parties and amounts is available from ELR (11 pp. \$2.00, ELR Order No. C-1321a).

In a separate but identical agreement, the state settles with four additional corporate defendants. (Full text available from ELR, 9 pp. \$1.75, ELR Order No. C-1321b).

In a similar agreement, the state settles with the Departments of the Navy and Air Force. The agreement expressly preserves the rights of recovery of the United States. (Full text available from ELR, 7 pp. \$1.50, ELR Order No. C-1321c).

Counsel for Plaintiff

Lee P. Breckenridge, Ass't Attorney General
Environmental Protection Division
One Ashburton Pl., Boston MA 02108
(617) 727-2265

Counsel for Defendants

John R. Cromer
Hammond, Cromer & Jackson
431 E. Hanna Ave., Indianapolis IN 46227
(317) 786-0487

James I. Wyer, General Counsel
American Cyanamide Co., Wayne NJ 07470
(201) 831-2000

Edward Arthur Schwartz, General Counsel
Digital Equipment Corp., 111 Powdermill Rd., Maynard
MA 01754
(617) 493-5500

1. The Eleventh Circuit has adopted the case law of the former Fifth Circuit handed down as of September 30, 1981, which is binding unless and until overruled or modified by this Court en banc. See *Bonner v. City of Prichard*, 661 F.2d 1206, 1209 (11th Cir. 1981) (en banc).

APPENDIX C

ANALYTICAL TECHNIQUES AND RESULTS FOR TASK FORCE SAMPLES

CDM Federal Programs Corporation

8-11-87
C-1

September 2, 1987

Hans Waetjen
Project Officer
U.S. Environmental Protection Agency
401 M Street, Room 2834
Washington, D.C. 20460

PROJECT: EPA CONTRACT NO.: 68-01-7331
DOCUMENT NO.: T014-R00-EP-BAFX-1
SUBJECT: Final Memorandums for Work Assignment 14
Document Nos. T014-R00-FR-AXBB-4
T014-R00-FR-AYGR-2

Dear Mr. Waetjen:

Please find enclosed the Final Memorandums entitled, "Evaluation of Quality Control Attendant to the Analysis of Samples from the Rocky Flats Arsenal, Colorado Facility" and "Evaluation of Quality Control Attendant to the Analysis of Samples from the Mineral Research, Inc., North Carolina Facility" as partial fulfillment of the reporting requirements for this work assignment.

If you have any comments regarding this submittal, please contact Ken Partymiller of PRC Environmental Management, Inc. at (713) 292-7568 by September 15, 1987.

Sincerely,

CDM Federal Programs Corporation


Harry P. Butler
Deputy Program Manager

TEM:mhf

Enclosure

cc: Richard Steimle, EPA Primary Contact, HW Ground-Water Task Force, HQ
Paul Friedman, EPA HQ
Ann Whitney, CDM Federal Programs Corporation (letter only)
Bruce Bakaysa (letter only)
Daniel Chow, PRC Environmental Management, Inc., Project Manager
(letter only)
Ken Partymiller, PRC Environmental Management, Inc., Houston

TAH6-67

FINAL MEMORANDUM
EVALUATION OF QUALITY CONTROL ATTENDANT
TO THE ANALYSIS OF SAMPLES FROM
THE ROCKY FLATS ARSENAL,
COLORADO FACILITY

Prepared for

U.S. ENVIRONMENTAL PROTECTION AGENCY
Office of Waste Programs Enforcement
Washington, D.C. 20460

Work Assignment No.	:	14
EPA Region	:	Headquarters
Facility I.D. No.	:	C07890010526
Contract No.	:	68-01-7331
CDM Federal Programs		
Corporation Document No.	:	T014-R00-FR-AXBB-4
Prepared By	:	PRC Environmental Management, Inc.
Work Assignment Project Manager	:	Daniel Chow
Telephone Number	:	(312) 856-8700
Primary Contact	:	Rich Steimle
Telephone Number	:	(202) 382-7912
Date Prepared	:	September 2, 1987

TAH6-67

MEMORANDUM

DATE: August 4, 1987

SUBJECT: Evaluation of Quality Control Attendant to the Analysis of Samples from the Rocky Flats Arsenal, Colorado. Facility

FROM: Ken Partymiller, Chemist
PRC Environmental Management, Inc.

TO: HWGWTF: Richard Steimle, HWGWTF*
Paul H. Friedman, Chemist*
Gareth Pearson (EPA 8231)*
Steve Sisk, NEIC
Steve Mangion, Region-I

This memo summarizes the evaluation of the quality control data generated by the Hazardous Waste Ground-Water Task Force (HWGWTF) contract analytical laboratories (1). This evaluation and subsequent conclusions pertain to the data from the Rocky Flats Arsenal, Colorado sampling effort by the Hazardous Waste Ground-Water Task Force.

The objective of this evaluation is to give users of the analytical data a more precise understanding of the limitations of the data as well as their appropriate use. A second objective is to identify weaknesses in the data generation process for correction. This correction may act on future analyses at this or other sites.

The evaluation was carried out on information provided in the accompanying quality control reports (2-4) which contain raw data, statistically transformed data, and graphically transformed data.

The evaluation process consisted of three steps. Step one consisted of generation of a package which presented the results of quality control procedures, including the generation of data quality indicators, synopses of statistical indicators, and the results of technical qualifier inspections. A report on the results of the performance evaluation standards analyzed by the laboratory was also generated. Step two was an independent examination of the quality control package and the performance evaluation sample results by members of the Data Evaluation Committee. This was followed by a meeting (teleconference) of the Data Evaluation Committee to discuss the foregoing data and data presentations. These discussions were to come to a consensus, if possible, concerning the appropriate use of the data within the context of the HWGWTF objectives. The discussions were also to detect and discuss specific or general inadequacies of the data and to determine if these are correctable or inherent in the analytical process.

Preface

The data user should review the pertinent materials contained in the accompanying reports (2-4). Questions generated in the interpretation of these data relative to sampling and analysis should be referred to Rich Steimle of the Hazardous Waste Ground-Water Task Force.

* HWGWTF Data Evaluation Committee Member

I. Site Overview

No background information concerning the Rocky Flats facility was made available to the HWGWTF Data Evaluation Committee teleconference.

Twenty-three field samples were collected at this facility. The samples included two field blanks (MQA754 and 790), two equipment blanks (MQA753 and 761), a trip blank (MQA763), and a set of triplicate samples (MQA760, 830, and 831) as well as 15 other field samples. All samples were designated as low concentration ground-water samples. All samples were analyzed for all HWGWTF Phase 3 analytes with several exceptions. Samples MQA765 and 793 were not analyzed for pesticides or herbicides and no samples were analyzed for dioxins and dibenzofurans.

II. Evaluation of Quality Control Data and Analytical Data

1.0 Metals

1.1 Metals QC Evaluation

Total metal spike recoveries were calculated for twenty-four metals spiked into two samples (MQA755 and 791). Twenty-one total metal average spike recoveries from these samples were within the data quality objectives (DQOs) for this Program. The total aluminum, iron, and selenium average spike recoveries were outside the DQO with values of 149, 140, and 338 percent, respectively. Seven individual total metal spike recoveries were also outside DQO. This information is listed in Tables 3-1a and 3-2a of Reference 2 as well as in the following Sections.

Twenty-four dissolved metals were also spiked into two samples (MQA755 and 791). Twenty-two of the twenty-four dissolved metal average spike recoveries were within the data quality objectives (DQOs) for this Program. Dissolved chromium and thallium average spike recoveries were outside DQO with values of 132 and 18 percent. Eight individual dissolved metal spike recoveries from these samples were also outside DQO. This information is listed in Tables 3-1b and 3-2b of Reference 2 as well as in the following Sections.

The calculable average relative percent differences (RPDs) for all metallic analytes, with the exception of total chromium, were within Program DQOs. RPDs were not calculated for about two-thirds of the metal analytes because the concentrations of many of the metals in the field samples used for the RPD determination were less than the CRDL and thus were not required, or in some cases, not possible to be calculated.

Required metal analyte analyses were performed on all samples submitted to the laboratory.

No sample contamination involving the metallic analytes was reported in the laboratory blanks. Sampling blank contamination was reported and will be discussed in the following Sections.

1.2 Furnace Metals

The quality control results for the graphite furnace metals (antimony, arsenic, cadmium, lead, selenium, and thallium) were generally acceptable.

The total lead and selenium matrix spike recoveries for spiked sample MQA755 were outside DQO with values of 26 and 675 percent, respectively. The dissolved cadmium and thallium matrix spike recoveries for spiked sample MQA755 were also outside DQO with values of 128 and 36 percent, respectively. The total antimony, lead, and selenium matrix spike recoveries for spiked sample MQA791 were outside DQO with values of 66, 127, and 0 (no recovery) percent, respectively. The dissolved selenium and thallium matrix spike recoveries for spiked sample MQA791 were also outside DQO with values of 72 and 0 percent, respectively. All total antimony and the dissolved cadmium and selenium results should be considered semi-quantitative. All total selenium and dissolved thallium results should not be used. All total lead results greater than 6 ug/L qualitative (samples MQA755, 757, 758, 792, 793, and 829) should be considered qualitative and all other total lead results should not be used.

The correlation coefficient for the method of standard addition (MSA) determination of dissolved selenium in sample MQA755D (duplicate sample) was below DQO. This was considered to have no impact on data usability as the value was very close to the DQO and the value for sample MQA755 was acceptable and above DQO.

MSA analyses should have been performed on total antimony in laboratory control standard #1. This was considered to have no impact on data usability as no total antimony was detected in any field samples.

The precision for the duplicate injections of total antimony in spiked sample MQA791 was above DQO. This was considered to have no impact on data usability.

Several continuing calibration verifications (CCVs) for total and dissolved thallium were above DQO. The affected samples were rerun but the CCV was not reanalyzed prior to resuming sample analysis. Total thallium results for samples MQA755, 756, 758, 759, and 790 and dissolved thallium results for samples MQA754, 761, 762, 764, 792, and 863 were affected and should be considered semi-quantitative unless further qualified for other reasons.

The dissolved selenium result for sample MQA755 was 49 ug/L while the total selenium result for the same sample was reported as less than 4 ug/L. Due to this poor agreement, both of these results should not be used.

All total arsenic and cadmium and dissolved antimony, arsenic, and lead results should be considered quantitative. Total thallium results should be considered quantitative with exceptions listed below. All total antimony and dissolved cadmium results and dissolved selenium results with an exception should be considered semi-quantitative. Also, total thallium results for samples MQA755, 756, 758, 759, and 790 should also be considered semi-quantitative. Total lead results for samples MQA755, 757, 758, 792, 793, and 829 should be considered qualitative. All total selenium and dissolved thallium results, total lead results with exceptions, and the dissolved selenium result for sample MQA755 should not be used. The usability of all graphite furnace analytes is summarized in Section 4.0 and 4.1 at the end of this Report.

1.3 ICP Metals

The matrix spike recoveries for total aluminum and iron and dissolved calcium, chromium, magnesium, and sodium in sample MQA791 were outside DQO with recoveries of 191, 160, 72, 166, 74, and 57 percent, respectively. As a rule, the trend of high spike recoveries indicate a high bias in the data and low recoveries

indicate a low bias. Chromium results were not affected. Dissolved calcium, magnesium, and sodium results should be considered semi-quantitative. Total aluminum and iron results should be considered semi-quantitative with exceptions. Total aluminum and iron results less than the CRDL should be considered quantitative and the total aluminum result for sample MQA830 should not be used.

The low level (twice CRDL) linear range checks for all total beryllium, chromium, cobalt, copper, nickel, vanadium, and zinc results and most of the results for dissolved beryllium, chromium, cobalt, copper, manganese, nickel, silver, tin, vanadium, and zinc exhibited low recoveries. See Section B7 of Reference 3 for a detailed listing of analysis dates, samples affected, and biases. The low level linear range check is an analysis of a solution with elemental concentrations near the detection limit. The range check analysis shows the accuracy which can be expected by the method for results near the detection limits. The accuracy reported for these metals at these concentrations is not unexpected.

Total and dissolved zinc contamination were reported in field blank MQA754, both at concentrations of 26 ug/L. Dissolved zinc contamination was reported in equipment blank MQA753 and in field blank MQA790 at concentrations of 42 and 28 ug/L. The zinc CRDL is 20 ug/L. As a result of this contamination, total zinc results for samples MQA753, 754, 755, 757, 761, 790, and 863 and dissolved zinc results MQA753, 754, 755, 761, 763, and 790 should be considered quantitative. The total zinc result for sample MQA793 should be considered qualitative. All other total and dissolved zinc results should not be used.

The duplicate injection RPDs for total chromium and iron in sample MQA755 were greater than DQO. All total chromium and iron results should be considered semi-quantitative.

The serial dilution RPD results for total magnesium, manganese, and sodium and dissolved manganese in sample MQA791 were outside DQO. All results for these analytes should be considered semi-quantitative.

In several of the samples the dissolved results for an analyte were greater than the total results for the same analyte. This was true for zinc in samples MQA756, 759, 764, 791, 828, and 829 and for calcium in sample MQA863. Total and dissolved zinc results for the above samples should not be used while the total and dissolved calcium results for sample MQA863 should be considered qualitative. The HWGWTF does not normally require dissolved metal sample determination because EPA does not have a standardized protocol for subtracting dissolved metals from total metals.

The analytical laboratory failed to report the mean and the standard deviations for the interference check sample. This did not impact the data usability.

One of the analytical batches for the dissolved metal analytes included an initial calibration blank (ICB) and several continuing calibration blanks (CCBs) for chromium which were outside DQO. Dissolved chromium results for samples MQA754, 756 through 762, 764, 792, 828 through 831, and 863 should be considered semi-quantitative with the detection limits increased by a factor of two.

All total barium, beryllium, cobalt, copper, nickel, potassium, silver, tin, and vanadium results should be considered quantitative. Dissolved aluminum, barium, beryllium, cobalt, copper, iron, nickel, potassium, silver, tin, and vanadium results should be considered quantitative. Total calcium results with an exception, dissolved chromium results for samples MQA753, 755, 763, 790, 791, and 793, total

aluminum results for samples MQA753, 754, 761, and 763, dissolved zinc results for samples MQA753 through 755, 761, 763, and 790, and total zinc results for samples MQA753 through 755, 757, 761, 790, and 863 should also be considered quantitative. All total chromium and iron and total and dissolved magnesium, manganese, and sodium results should be considered semi-quantitative. Dissolved calcium and chromium and total aluminum results, all with exceptions, should also be considered semi-quantitative. All calcium results for sample MQA863 and total zinc results for sample MQA793 should be considered qualitative. All zinc results with exceptions and total aluminum results for sample MQA830 should not be used. The usability of all total and dissolved ICP metal analytes is summarized in Section 4.2 and 4.3 at the end of this Report.

1.4 Mercury

All mercury results should be considered quantitative with an acceptable probability of false negatives.

2.0 Inorganic and Indicator Analytes

2.1 Inorganic and Indicator Analyte QC Evaluation

The average spike recoveries of all of the inorganic and indicator analytes were within the accuracy DQOs. Accuracy DQOs have not been established for the bromide, fluoride, nitrite nitrogen, and sulfide matrix spikes.

The calculable average RPDs for all inorganic and indicator analytes were within Program DQOs. RPDs were not calculated if either one or both of the duplicate values were less than the CRDL. Precision DQOs have not been established for bromide, fluoride, nitrite nitrogen, and sulfide.

Requested analyses were performed on all samples for the inorganic and indicator analytes.

No laboratory blank contamination was reported for any inorganic or indicator analyte. POX and/or POC contamination were reported in all of the sampling blanks and will be discussed below.

2.2 Inorganic and Indicator Analyte Data

All results for cyanide, bromide, chloride, fluoride, sulfate, sulfide, total phenols, TOC, and TOX should be considered quantitative with an acceptable probability of false negatives.

The matrix spike recovery of bromide from sample MQA791 was poor with a value of 56 percent. This sample was diluted by a factor of 50 due to high chloride suppression. It was not known whether this poor recovery was a dilution error or a negative interference which was representative of the field samples. As there are no HWGWTF DQOs for bromide, there was no impact on the usability of the bromide results although they may be biased low.

The matrix spike result for fluoride from sample MQA791 was not identified in the raw data. This sample was diluted by a factor of 50 due to high chloride suppression. There was no impact on the usability of the fluoride results.

The holding times for the nitrate and nitrite nitrogen determinations ranged from 4 to 14 days from receipt of the samples which is longer than the recommended 48 hour holding time for unpreserved samples. All nitrate and nitrite nitrogen results should be considered semi-quantitative.

Calibration verification standards for POC were not analyzed. A POC spike solution was run during the analytical batch but the "true" value of the spike was not provided by the laboratory. EPA needs to supply the inorganic laboratory with a POC calibration verification solution. Until then, the instrument calibration can not be assessed. Headspace was noticed in the sample vials for samples MQA753, 761, and 791. POC contamination was found in all sampling blanks at concentrations ranging from 22 to 94 ug/L. The POC CRDL is 10 ug/L. The POC results for samples MQA758, 765, 792, 828, 829, and 864 should be considered qualitative. All other POC results should not be used due to blank contamination.

POX contamination was found in equipment blank MQA761 and field blank MQA754 at concentrations of 42 and 17 ug/L. The POX CRDL is 5 ug/L. Due to this contamination, all positive POX results five times the higher concentration or less should not be used, all POX results between five and ten times the higher of the concentrations should be considered qualitative, and all results ten times the level of contamination or greater, as well as all negative results, should be considered quantitative. Therefore, POX results for sample MQA760 should not be used while all other results should be considered quantitative with the following exceptions. Headspace was reported in the sample vials for samples MQA753, 763, 790, and 791. Results for these four samples should be considered semi-quantitative.

3.0 Organics and Pesticides

3.1 Organic OC Evaluation

All matrix spike average recoveries were within established Program DQOs for accuracy. Individual matrix spike recoveries which were outside the accuracy DQO will be discussed in the appropriate Sections below.

All surrogate spike average recoveries, with the exception of the organo-phosphorous herbicide surrogates which were neither required nor analyzed, were within DQOs for accuracy. Individual surrogate spike recoveries which were outside the accuracy DQO will be discussed in the appropriate Sections below.

All reported matrix spike/matrix spike duplicate average RPDs were within Program DQOs for precision. Individual matrix spike RPDs which were outside the precision DQO will be discussed in the appropriate Sections below.

All average surrogate spike RPDs were within DQOs for precision. No surrogate standard was used or required for the organo-phosphorous herbicide analysis.

Requested analyses were performed on all samples submitted to the laboratory.

Laboratory (method) and sampling blank contamination was reported for organics and is discussed in Reference 4 as well as the appropriate Sections below.

Detection limits for the organic fractions are summarized in Reference 4 as well as the appropriate Sections below.

3.2 Volatiles

The analytical laboratory exceeded the volatile holding time of seven days for twenty of the twenty-three volatile samples. Holding times ranged from 5 to 63 days in excess of the maximum permissible seven day holding time. Volatile results for all samples except MQA756, 758, and 759 should be considered unreliable. Volatile results for samples MQA756, 758, and 759 should be considered quantitative.

Acetone contamination was found in laboratory (method) blanks MB-2, MB-4, MB-5, and MB-6 at concentrations of 2 to 4 ug/L. Acetone contamination was also found in sampling blanks MQA753 (equipment blank), 761 (equipment blank), 754 (field blank), and 763 (trip blank) at concentrations ranging from 2 to 6 ug/L. The acetone CRDL is 10 ug/L. The source of this contamination is presumed to be the analytical laboratory. All positive acetone results should not be used due to this blank contamination.

Laboratory (method) blanks MB-1, MB-4, and MB-6 contained methylene chloride contamination at concentrations of 1 to 2 ug/L. Methylene chloride contamination was also found in sampling blanks MQA754 (field blank), 761 (equipment blank), 763 (trip blank), and 790 (field blank) at concentrations ranging from 2 to 3 ug/L. The methylene chloride CRDL is 5 ug/L. The source of this contamination is presumed to be the analytical laboratory. All positive methylene chloride results should not be used due to this blank contamination.

2-Butanone was found both in laboratory (method) blank MB-5 and sampling blank MQA754 at concentrations of 2 ug/L. The 2-butanone CRDL is 10 ug/L. All positive 2-butanone results should not be used due to this blank contamination.

Estimated method detection limits were CRDL for all samples except MQA792 and 864 which were both 100 times CRDL, respectively. A one hundred fold dilution of these samples was required due to the high concentration of trichloroethene. The volatile results, with exceptions listed below, should be considered unreliable due to excessive holding times. Volatile results for samples MQA756, 758, and 759 should be considered quantitative. All positive acetone, methylene chloride, and 2-butanone results should not be used due to laboratory (method) blank contamination. The probability of false negative and positive results is unknown due to the lengthy holding times of the samples.

3.3 Semivolatiles

The analytical laboratory exceeded the semivolatile 40 day holding time between extraction and analysis for nine of the semivolatile samples. Holding times ranged from 4 to 20 days in excess of the permitted 40 day holding time from extraction to analysis. Semivolatile results for these samples should be considered semi-quantitative.

The surrogate spike recovery of 2-fluorobiphenyl from samples MQA758, 761, and MB-2 was below DQO. This had no affect on data usability.

Three of the semivolatile laboratory (method) blanks, MB-1, MB-2, and MB-3, contained contamination including several unknown compounds, an unknown alkylamide, and an unknown alkane at concentrations of 6 and 100 ug/L.

The relative standard deviation of response factors for the initial calibration and the percent differences between the initial and continuing calibration response factors showed significant variation. These values should be individually considered and may affect data usability.

An unknown semivolatile compound was detected but not reported or confirmed as a tentatively identified compound in samples MQA753, 754, 755, 756, 757, 758, 759, 761, 762, 763, 764, 765, 790, 791, 792, 793, 830, 831, 863, 864, and MB-1. This is approximately the retention time of 2-hexanone but the compound is not 2-hexanone. According to the laboratory it is an unknown artifact. The presence of this compound should be addressed by the laboratory.

The presence of a large general ion current from retention index 1200 to 2100 in the chromatogram of sample MQA864 may have hindered the detection of target analytes.

Due to a dilution factor of two for all samples, the estimated detection limits for the semivolatiles were approximately twice the CRDL. The semivolatile data are acceptable and the results should be considered semi-quantitative for all samples.

3.4 Pesticides

No laboratory (method) blank contamination was detected. However, on Form VIII, dated 5/10/87, MB-3 is denoted as MB-4. This error was corrected on the method blank sample data sheet.

Heptachlor and aldrin may be present in samples MQA753 and 828 at concentrations below the CRDL but above the actual laboratory detection limit. Their presence was not reported due to retention time shifts.

Pesticide analyses were not performed on samples MQA765 and 793.

The dibutylchlorodate retention time shift was outside DQO for aroclor standard 1016/1260 on the DB-17 column.

An unknown, non-HSL (Hazardous Substance List) compound was present in all chromatograms run on the DB-17 column at a retention time of about 19.23 minutes. The corresponding peak was not seen in the chromatograms run on the primary column.

The estimated method detection limits for all pesticides analyses is the CRDL. The pesticides results should be considered quantitative.

3.5 Herbicides

The herbicides for which the laboratory analyzed include only 2,4-D, 2,4,5-T, 2,4,5-TP, chlorobenzilate, phorate, disulfoton, parathion, and famphur. Herbicide analyses were not performed on samples MQA765 and 793.

2,4-DB was used as a surrogate for the chloro-herbicide fraction. No surrogates were included for the organo-phosphorous herbicides.

The quality of the chloro-herbicides chromatograms was not sufficient to allow the tentative identification and confirmation of these compounds. Several field samples were reported to contain chloro-herbicides. However, numerous chloro-herbicide peaks were observed in the method, field, and trip blank chromatograms.

The tentative identification and quantification of chloro-herbicides in all samples should be considered unreliable due to this blank contamination.

Poor chromatographic quality was observed on the OV-101 column. Peak tailing and apparent column bleed was observed in both the samples and standards run on this column.

The organo-phosphorous herbicide results should be considered qualitative due to the lack of surrogates. The estimated method detection limits were the CRDL for the organo-phosphorous herbicide analyses with the exception of sample MQA828. This sample was diluted by a factor of 10 and thus had its detection limits raised by this same factor.

The chloro-herbicide results should be considered unreliable due to blank contamination.

III. Data Usability Summary

4.0 Graphite Furnace Metals, Total (Section 1.2)

Quantitative:	all arsenic and cadmium results; thallium results with exceptions
Semi-quantitative:	all antimony results; thallium results for samples MQA755, 756, 758, 759, and 790
Qualitative:	lead results for sample MQA755, 757, 758, 792, 793, and 829
Unusable:	all selenium results; lead results with exceptions

4.1 Graphite Furnace Metals, Dissolved (Section 1.2)

Quantitative:	all antimony, arsenic, and lead results
Semi-quantitative:	all cadmium results; selenium results with an exception
Unusable:	all thallium results; selenium results for sample MQA755

4.2 ICP Metals, Total (Section 1.3)

Quantitative:	all barium, beryllium, cobalt, copper, nickel, potassium, silver, tin, and vanadium results; calcium results with an exception; aluminum results for samples MQA753, 754, 761, and 763; zinc results for samples MQA753, 754, 755, 757, 761, 790, and 863
Semi-quantitative:	all chromium, iron, magnesium, manganese, and sodium results; aluminum results with exceptions
Qualitative:	the calcium result for sample MQA863; the zinc result for sample MQA793
Unusable:	zinc results with exceptions; the aluminum result for sample MQA830

4.3 ICP Metals, Dissolved (Section 1.3)

Quantitative:	all aluminum, barium, beryllium, cobalt, copper, iron, nickel, potassium, silver, tin, and vanadium results; chromium results for samples MQA753, 755, 763, 790, 791, and 793; zinc results for samples MQA753, 754, 755, 761, 763, and 790
Semi-quantitative:	all magnesium, manganese, and sodium results; calcium and chromium results with exceptions
Qualitative:	the calcium result for sample MQA863
Unusable:	zinc results with exceptions

4.4 Mercury (Section 1.4)

Quantitative: all mercury results

4.5 Inorganic and Indicator Analytes (Section 2.2)

Quantitative: all cyanide, bromide, chloride, fluoride, sulfate, sulfide, total phenols, TOC, and TOX; POX results with exceptions
 Semi-quantitative: all nitrate and nitrite nitrogen results; POX results for samples MQA753, 763, 790, and 791
 Qualitative: POC results for samples MQA758, 765, 792, 828, 829, and 864
 Unusable: POC results with exceptions, the POX result for sample MQA760

4.6 Organics (Sections 3.2 through 3.5)

Quantitative: volatile results for samples MQA756, 758, and 759 with exceptions listed below; all pesticides results
 Semi-quantitative: all semivolatile results
 Qualitative: organo-phosphorous herbicide results
 Unreliable: volatile results with exceptions; chloro-herbicide results
 Unusable: all positive acetone, methylene chloride, and 2-butanone results

IV. References

1. Organic Analyses: EMSI
 4765 Calle Quetzal
 Camarillo, CA 93010

 Inorganic and Indicator Analyses:
 Centec Laboratories
 P.O. Box 956
 2160 Industrial Drive
 Salem, VA 24153
 (703) 387-3995
2. Draft Quality Control Data Evaluation Report (Assessment of the Usability of the Data Generated) for Case K-2363HQ, Site 50, Rocky Flats, CO, 6/30/87, Prepared by Lockheed Engineering and Management Services Company, Inc., for the US EPA Hazardous Waste Ground-Water Task Force.
3. Draft Inorganic Data Usability Audit Report, for Case K-2363HQ, Rocky Flats, CO, Prepared by Laboratory Performance Monitoring Group, Lockheed Engineering and Management Services Co., Las Vegas, Nevada, for US EPA, EMSL/Las Vegas, 7/1/87.
4. Draft Organic Data Usability Audit Report, for Case K-2363HQ, Rocky Flats, CO, Prepared by Laboratory Performance Monitoring Group, Lockheed Engineering and Management Services Co., Las Vegas, Nevada, for US EPA, EMSL/Las Vegas, 7/1/87.

V. Addressees

Gareth Pearson
Quality Assurance Division
US EPA Environmental Monitoring Systems Laboratory - Las Vegas
P.O. Box 1198
Las Vegas, Nevada 89114

Richard Steimle
Hazardous Waste Ground-Water Task Force, OSWER (WH-562A)
US Environmental Protection Agency
401 M Street S.W.
Washington, DC 20460

Steve Mangion
US Environmental Protection Agency
JFK Federal Building
Room 2203
Boston, MA 02203

Steve Sisk
US Environmental Protection Agency
NEIC/OECM
Building 53, Box 25227
Denver, CO 80225

Paul Friedman
Room 413-W
Science Policy Branch (PM-220)
US Environmental Protection Agency
401 M Street S.W.
Washington, DC 20460

Sujith Kumar
Laboratory Performance Monitoring Group
Lockheed Engineering and Management Services Company
1051 East Flamingo Drive, Suite 257
Las Vegas, Nevada 89119

Ken Partymiller
PRC EMI/Houston
10716 Whisper Willow Place
The Woodlands, TX 77380

Appendix C
Specific Analytical Results
Rocky Flats
Golden, Colorado

Table C-1	Sample Preparation, Analytical Techniques, and Methods
Table C-2	Organic Results
Table C-3	Organic Limits of Quantitation
Table C-4	Dissolved and Total Metal Results
Table C-5	Field Measurements and General Analytical Parameters
Table C-6	Radionuclide Results
Table C-7	Radionuclide Limits of Detection

Table C-1

Sample Preparation and Analysis Techniques and Methods
Rocky Flats Facility, Golden, Colorado
Samples Collected, April 1987

Parameter	Preparation Technique	Analysis Technique	Method Reference
=====	=====	=====	=====
Specific Organic Constituents			
Volatiles	Purge and trap	Gas Chromatography - Mass Spectroscopy	CLP Method (a)
Semi-volatiles	Methylene chloride extraction	Gas Chromatography - Mass Spectroscopy	CLP Method
Pesticides/PCB	Methylene chloride/hexane extraction	Gas Chromatography with Electron Capture Detection	CLP Method
Herbicides	Diethyl ether extraction/methylation	Gas Chromatography with Electron Capture Detection	Method 8150 (b)
Dioxins and Dibenzofurans	Methylene chloride/hexane extraction	Gas Chromatography - Mass Spectroscopy	Method 8280 (b)
Non-specific Organic Parameters			
POX	None	Purgable combusted, Microcoulometry	EPA 600/4-84-008
TOX	Carbon absorption	Carbon combusted, Microcoulometry	Method 9020 (b)
POC	None	Purgable combusted, Non-dispersive Infrared	No reference
NPOC	Acidify and purge	UV Persulfate, Non-dispersive Infrared	Method 415.1 (c)
Elemental Constituents			
Mercury	Wet digestion for dissolved and total	Cold Vapor Atomic Absorption Spectroscopy	CLP Method
As, Pb, Se and Tl	Acid digestion for total	Furnace Atomic Absorption Spectroscopy	CLP Method
Other Elements	Acid digestion for total	Inductively Coupled Plasma Emission Spectroscopy	CLP Method
Field Measurements			
Conductance	None	Electrometric, Wheatstone Bridge	Method 120.1 (c)
pH	None	Potentiometry	Method 150.1 (c)
Turbidity	None	Nephelometric	No reference
General Constituents			
Nitrate	None	Ion Chromatography	EPA Method 300.0
Sulfate	None	Ion Chromatography	EPA Method 300.0
Chloride	None	Ion Chromatography	EPA Method 300.0
Nitrite	None	Ion Chromatography	EPA Method 300.0
Bromide	None	Ion Chromatography	EPA Method 300.0
Fluoride	None	Ion Chromatography	EPA Method 300.0
Sulfide	None	Iodometric, Titration	Method 9030 (b)
Phenol	Automated distillation	Colorimetric, Distillation, Automated 4-AAP	Method 9066 (b)
Cyanide	Manual distillation	Pyridine Pyrazolone Colorimetry	Method 9010 (b)
=====	=====	=====	=====

a) Contract Laboratory Program, IFB methods

b) Test Methods for Evaluating Solid Wastes, SW-846.

c) Methods for Chemical Analysis of Water and Wastes, EPA-600/4-79-020

Table C-1 (cont'd.)

Sample Preparation and Analysis Techniques and Methods
Rocky Flats Facility, Golden, Colorado
Samples Collected, April 1987

Parameter =====	Preparation Technique =====	Analysis Technique =====	Method Reference =====
Gross Alpha	Nitric acid digestion	Scintillation Detector	EPA Method 900.0
Gross Beta	Nitric acid digestion	Scintillation Detector	EPA Method 900.0
Gross Radium	Precipitation with barium sulfate	Scintillation Detector	EPA Method 900.1
Radium-228	Coprecipitation separation	Proportional Counter	USGS Gamma Method
Cesium-137	None	Gamma-ray Spectrometer with Analyzer	EPA 901.0
Ruthenium-106	None	Gamma-ray Spectrometer with Analyzer	EPA 901.1
Strontium 90	None	Gamma-ray Spectrometer with Analyzer	ASTM Proposed Method
Americium 241	Multiple Anion separation	Alpha Spectroscopy	RSL 304
Plutonium 238	Multiple Anion separation	Alpha Spectroscopy	RSL 304
Plutonium 239, 240	Multiple Anion separation	Alpha Spectroscopy	RSL 304
Uranium-234	Multiple Anion separation	Alpha Spectroscopy	RSL 304
Uranium-235	Multiple Anion separation	Alpha Spectroscopy	RSL 304
Uranium-238	Multiple Anion separation	Alpha Spectroscopy	RSL 304
Tritium	Distillation	Liquid Scintillation Spectrometer	RSL 302
=====	=====	=====	Based on EPA 906 =====

TABLE C-2
ORGANIC ANALYSIS RESULTS
ROCKY FLATS FACILITY, GOLDEN, COLORADO
SAMPLES COLLECTED APRIL 1987

WELL NUMBER:	02-71	09-74	08-86	14-86	27-86	30-86	32-86
SMO NUMBER:	MQA792	MQA864	MQA764	MQA791	MQA793	MQA828	MQA829
PARAMETER -----	ug/L -----	ug/L -----	ug/L -----	ug/L -----	ug/L -----	ug/L -----	ug/L -----
Tetrachloroethane	ND a	2000	ND	ND	ND	1 b	ND
Trichlorofluoromethane	ND	ND	1 b	ND	ND	ND	ND
Chloroform	210 b	ND	ND	ND	ND	ND	ND
1,1,1-Trichloroethane	ND	11,000	ND	ND	ND	ND	ND
Trichlorethene	14,000	9,400	ND	ND	ND	ND	ND
1,1-dichloroethene	ND	3,500	ND	ND	ND	ND	ND
bis(2-Ethylhexyl) phthalate	ND	ND	ND	3 b	ND	3 b	ND
Diethylene glycol	ND	ND	10 b	ND	ND	ND	ND
Tetraethylene glycol	ND	ND	8 b	ND	ND	ND	ND
Octanoic acid	ND	ND	20 b	ND	10 b	ND	ND
Nonanoic acid	ND	ND	70 b	ND	50 b	7 b	ND
Decanoic acid	ND	ND	30 b	ND	10 b	ND	ND
Dodecanoic acid	ND	ND	90 b	ND	30 b	20 b	20 b
Tetradecanoic acid	ND	ND	20 b	ND	ND	ND	ND
Palmitic acid	ND	10 b	ND	ND	ND	ND	ND
LOQ FACTORS (c)							
VOLATILES	100X	100X	1X	1X	1X	1X	1X
SEMIVOLATILES	2X	2X	2X	2X	2X	2X	2X
PEST/PCBs	1X	1X	1X	1X	NR d	1X	1X

a) Compound was not detected.

b) Estimated concentration. Compound was detected, but the concentration was below the Limit of Quantitation (LOQ)

c) LOQ Factor is the factor to account for dilutions.

d) Not requested

TABLE C-2
ORGANICS ANALYSIS RESULTS
ROCKY FLATS FACILITY, GOLDEN, COLORADO
SAMPLES COLLECTED. APRIL 1987

WELL NUMBER	34-86	43-86	48-86	49-86	54-86	57-86	59-86	62-86	WET WELL (e)
SMO NUMBER.	MQA756	MQA759	MQA758	MQA757	MQA762	MQA765	MQA755	MQA863	MQA760, 830, 831
PARAMETER	ug/L	ug/L	ug/L	ug/L	ug/L	ug/L	ug/L	ug/L	ug/L
Trichlorofluoromethane	ND a	ND	ND	ND	1 b	ND	ND	ND	ND
Carbon tetrachloride	ND	4 b	ND	ND	ND	ND	ND a	ND	8
Chloroform	ND	ND	ND	ND	ND	ND	ND	ND	2 b
1,1,1-Trichloroethene	ND	ND	ND	ND	ND	ND	ND	ND	9
Trichloroethene	ND	ND	ND	ND	ND	ND	ND	ND	6
Chrysene	3 b	ND	ND	ND	ND	ND	ND	ND	ND
bis(2-Ethylhexyl) phthalate	ND	1 b	12	ND	3 b	3 b	ND	ND	ND
Cyclohexanol	ND	ND	ND	30 b	ND	ND	30 b	ND	ND
Dodecanoic acid	ND	10 b	ND	ND	ND	ND	ND	10 b	ND
LOQ FACTOR (c)									
VOLATILES	1X	1X	1X	1X	1X	1X	1X	1X	1X
SEMIVOLATILES	2X	2X	2X	2X	2X	2X	2X	2X	2X
PEST/PCB'S	1X	1X	1X	1X	1X	NR d	1X	1X	1X

a) Compound was not detected.

b) Estimated concentration. Compound was detected, but the concentration was below the Limit of Quantitation (LOQ)

c) LOQ Factor is the factor to account for dilutions

d) Not requested.

e) Wet well was sampled and analyzed in triplicate results were averaged for report

EPA/NEIC/DENVER

Table C-3
Limits of Quantitation for Organic Compounds
Rocky Flats Facility, Golden, Colorado
Samples Collected: April 1987

Volatile Compounds	ug/L	Semi-Volatile Compounds	ug/L	Semi-Volatile Compounds	ug/L
Bromomethane	10.	Pentachloroethane	10.	bis(2-Ethylhexyl) phthalate	20
Dibromomethane	5.	Hexachloroethane	10.	Butyl benzyl phthalate	10.
Chloromethane	10.	1,2-Dibromo-3-chloropropane	10.	di-n-Butyl phthalate	10.
Iodomethane	5.	Hexachloropropene	10.	di-n-Octyl phthalate	10.
Bromodichloromethane	5.	trans-4-dichloro-2-butene	10.	Diethyl phthalate	10.
Dibromochloromethane	5.	2-Hexanone	10.	Dimethyl phthalate	10.
Dichlorodifluoromethane	5.	Acetophenone	10.	Acenaphthene	10.
Trichlorofluoromethane	5.	4-Methyl-2-pentanone	10.	Acenaphthylene	10.
Bromoform	5.	Aniline	10.	Anthracene	10.
Chloroform	5.	4-Chloroaniline	10.	Benzo(a)anthracene	10.
Carbon tetrachloride	5.	2-Nitroaniline	50.	7,12-Dimethylbenz(a)anthracene	10.
Carbon disulfide	5.	3-Nitroaniline	50.	Benzo(b)fluoranthene and/or	
Chloroethane	10.	4-Nitroaniline	50.	Benzo(k)fluoranthene	10.
1,2-Dibromoethane	5.	4-Methyl-2-nitroaniline	10.	Benzo(g,h,i)perylene	10.
1,1-Dichloroethane	5.	3,3'-Dichlorobenzidine	20.	Benzo(a)pyrene	10.
1,2-Dichloroethane	5.	3,3'-Dimethylbenzidine	100. a	Dibenzo(a,e)pyrene	10. a
1,1,1-Trichloroethane	5.	3,3'-Dimethoxybenzidine	10.	Dibenzo(a,h)pyrene	10. a
1,1,2-Trichloroethane	5.	Benzyl alcohol	10.	Dibenzo(a,j)pyrene	10. a
1,1,1,2-Tetrachloroethane	5.	1,2-Dichlorobenzene	10.	Chrysene	10.
1,1,2,2-Tetrachloroethane	5.	1,3-Dichlorobenzene	10.	Dibenzo(a,h)anthracene	10.
1,1-Dichloroethene	5.	1,4-Dichlorobenzene	10.	Dibenzofuran	10.
trans-1,2-Dichloroethene	5.	1,2,4-Trichlorobenzene	10.	Fluoranthene	10.
Trichloroethene	5.	1,2,4,5-Trichlorobenzene	10.	Pyrene	10.
Tetrachloroethene	5.	Pentachlorobenzene	10.	Indeno(1,2,3-c,d)pyrene	10.
Methylene chloride	5.	Hexachlorobenzene	10.	Isophorone	10.
Vinyl chloride	10.	Pentachloronitrobenzene	10.	Naphthalene	10.
1,2-Dichloropropane	5.	Nitrobenzene	10.	2-Chloronaphthalene	10.
1,2,3-Trichloropropane	5.	Dinitrobenzene	10.	2-Methylnaphthalene	10.
1,2-Dibromo-3-chloropropane	5.	2,4-Dinitrotoluene	10.	Phenanthrene	10.
3-Chloropropene	5.	2,6-Dinitrotoluene	10.	3-Methylcholanthrene	10.
trans-1,3-dichloropropene	5.	N-Nitrosodimethylamine	10.	Methapyrilene	50. a
1,4-Dichloro-2-butene	50.	N-Nitrosodiethylamine	10.	5-Nitro-o-toluidine	10.
Benzene	5.	N-Nitrosomethylethylamine	10.	o-Toluidine	10.
Chlorobenzene	5.	N-Nitrosodiphenylamine and/or		2-Picoline	10.
Toluene	5.	Diphenylamine	10.	N-Nitrosopiperidine	10.
Xylenes	5.	N-Nitroso-di-n-butylamine	10.	Safrole	10.
Ethylbenzene	5.	alpha, alpha-		1,4-Naphoquinone	10.
2-Methyl-1-propanol	50.	Dimethylphenethylamine	50.	Pyridine	10.
Acetone	10.	1-Naphthylamine	10.	Methyl Methacrylate	10.
2-Butanone	10.	2-Naphthylamine	10.	Ethyl Methacrylate	10.
2-Hexanone	10.	bis(2-Chloroethyl) ether	10.	p-Dimethylaminoazobenzene	10.
4-Methyl-2-pentanone	10.	4-Chlorophenyl phenyl ether	10.	4-Aminobiphenyl	10.
2-Chloroethyl vinyl ether	10.	4-Bromophenyl phenyl ether	10.	Pronamide	10.
Ethyl cyanide	50.	bis(2-Chloroisopropyl) ether	10.	Isosafrole	10.
1,4-Dioxane	5000.	bis(2-Chlorethoxy)methane	10.	N-Nitrosopyrrolidine	10.
Styrene	5.	Hexachloroethane	10.	Cyclophosamide	10.
Vinyl Acetate	10.	Hexachlorobutadiene	10.	Phenacetin	10.
Crotonaldehyde	50.	Hexachlorocyclopentadiene	10.	Methyl methane sulfonate	10.

Table C-3 (cont.)
 Limits of Quantitation for Organic Compounds
 Rocky Flats Facility, Golden, Colorado
 Samples Collected: April 1987

Semi-Volatile Compounds	ug/L	Chlorinated Pesticides/PCBs	ug/L	Organo-phosphate Pesticides	ug/L
4,4'-Methylene-bis (2-chloroaniline)	10.	Aldrin	0.05	Phorate	5.
N-Nitrosomorpholine	10.	alpha-BHC	0.05	Disulfoton	5
Benzoic Acid	50.	beta-BHC	0.05	Parathion	5
Phenol	10.	gamma-BHC (Lindane)	0.05	Famphur	20.
2-Chlorophenol	10.	delta-BHC	0.05		
2,4-Dichlorophenol	10.	Chlordane	0.5	Herbicides	ug/L
2,6-Dichlorophenol	10.	4,4'-DDD	0.1		----
2,4,5-Trichlorophenol	50.	4,4'-DDE	0.1	2,4-Dichlorophenoxy	
2,4,6-Trichlorophenol	10.	4,4'-DDT	0.1	acetic acid	1.
2,3,4,6-Tetrachlorophenol	10.	Dieldrin	0.1	2,4,5-T	0.1
Pentachlorophenol	50.	Endosulfan I	0.05	2,4,5-TP (Silvex)	0.1
4-Chloro-3-methylphenol	10.	Endosulfan II	0.1	Chlorobenzilate	1.
2-Methylphenol	10.	Endosulfan sulfate	0.2		
4-Methylphenol	10.	Endrin	0.1	Dioxins/Dibenzofurans	ng/L
2,4-Dimethylphenol	10.	Endrin aldehyde	0.1		----
4,6-Dinitro-2-methylphenol	50.	Heptachlor	0.05	TCDD (Tetra)	10. b
2-Nitrophenol	10.	Heptachlor epoxide	0.05	PeCDD (Penta)	10. b
4-Nitrophenol	50.	Toxaphene	1.	HxCDD (Hexa)	10. b
2,4-Dinitrophenol	50.	Methoxychlor	0.5	HpCDD (Hepta)	20. b
Cyclohexanol	50.	Endrin ketone	0.2	OCDD (Octa)	20. b
Diethylene glycol	100.	PCB-1016	0.5	PeCDF (Penta)	10. b
Tetraethylene glycol	100.	PCB-1221	0.5	HxCDF (Hexa)	10. b
Octanoic acid	100.	PCB-1232	0.5	HpCDF (Hepta)	20. b
Nonanoic acid	100.	PCB-1242	0.5	OCDF (Octa)	20. b
Decanoic acid	100.	PCB-1248	0.5		
Dodecanoic acid	100.	PCB-1254	1.		
Tetradecanoic acid	100.	PCB-1260	1.		
Palmitic acid	100.	Kepone	1.		
Chrysene	10.	Chlorobenzilate	1.		
		Isodrin	0.05		

a) Estimated value; standard not available at the time of analysis.

b) Estimated value for an individual isomer of the compound class; calculated by NEIC using the lowest standard concentration analyzed by CL.

TABLE C-4
DISSOLVED AND TOTAL METALS ANALYSIS RESULTS
ROCKY FLATS FACILITY, GOLDEN, COLORADO

Element	Well 02-71 SMO NO: MQA792		Well 08-86 SMO NO: MQA764		Well 14-86 SMO NO MQA791	
	Dissolved Value,ug/L	Total Value,ug/L	Dissolved Value,ug/L	Total Value,ug/L	Dissolved Value,ug/L	Total Value,ug/L
Al	< 44. a	4,380. b	113.	84 b	79.	1,680 b
Sb	< 60.	< 60. b	< 60.	< 60. b	< 60.	< 60. b
As	< 10.	< 6.	< 10.	< 6.	< 10.	< 10.
Ba	71.	104.	33.	17.	60.	59.
Be	< 2.	< 2.	< 2.	< 2.	< 2.	< 2.
Cd	< 5. b	< 5.	< 5. b	.5	< .6 b	< 5.
Ca	63,700. b	61,700.	29,000. b	26,100.	133,000. b	123,000
Cr	< 10.	< 10. d	< 10.	< 10. d	< 10.	26 d
Co	< 20.	< 20.	< 20.	< 20.	< 20.	< 20.
Cu	< 8.	15.	< 8.	9.	< 8.	12
Fe	< 20.	21,100 bd	< 20.	68. bd	< 20.	2,540 bd
Pb	< 2.	6.2 b	< 5.	< 5 b	< 5.	< 5. b
Mg	18,600 b	19,000. b	1,280. b	890. c	39,600. b	36,300 c
Mn	35. c	123 b	< 5. c	< 5. c	164. c	174 c
Hg	< .2	< .2	< .2	< .2	< .2	< .2
Ni	< 24.	< 24.	< 24.	< 24.	< 24.	32.
K	1,560	2,060.	10,800.	9,300.	6,870.	6,210.
Se	26. b	30. b	5 b	4 3 b	< 5 b	< 5 b
Ag	< 5.	9.		8.	< 5.	15
Na	184,000. b	178,000. b	98,900. b	86,200 c	255,000. b	213,000. c
Tl	< 100. b	< 7	< 10. b	< 7	< 100. b	< 10
Sn	< 38	< 38	< 38.	< 38.	< 38.	< 38.
V	< 14.	< 14.	29.	25	< 14.	15
Zn	21	83	37.	< 14.	102.	24

a = Sample concentration is less than the number listed at the 99% confidence level
b = Batch spike sample recovery was not within control limits indicating possible bias
c = Estimated value; interference present causing possible bias.
d = Duplicate analysis not within control limits

TABLE C-4
DISSOLVED AND TOTAL METALS ANALYSIS RESULTS
ROCKY FLATS FACILITY, GOLDEN, COLORADO

Element	Well 27-86 SMO NO: MQA793		Well 30-86 SMO NO: MQA828		Well 32-86 SMO NO: MQA829	
	Dissolved Value,ug/L	Total Value,ug/L	Dissolved Value,ug/L	Total Value,ug/L	Dissolved Value,ug/L	Total Value,ug/L
Al	78.	4,480. b	402.	5,490 b	252.	8,090. b
Sb	< 3. a	< 3 b	< 60	< 60. b	< 60	< 60 b
As	< 10.	< 6.	< 10.	< 10.	< 10.	< 10
Ba	57.	67.	292.	375	110.	159
Be	< 2.	3	2.	3.	< 2.	< 2
Cd	< 5. b	.6	< 5. b	.8	< 5 b	< 5
Ca	48,900. b	44,700	1,470,000. b	1,280,000.	47,400. b	44,400
Cr	< 10.	136 d	< 10.	50. d	< 10	118 d
Co	< 20.	27.	< 20	< 20.	< 20.	< 20
Cu	47.	914.	17	21	< 8	61.
Fe	69.	8,120. bd	< 20.	5,310. bd	< 20.	9,450 bd
Pb	< 5.	17. b	< 2.	< 2. b	< 2.	50. b
Mg	16,100. b	14,600. c	333,000. b	296,000. c	12,100 b	11,800. c
Mn	107. c	154 c	77 c	157. c	53 c	143 c
Hg	< .2	< .2	< .2	< .2	< .2	< .2
Ni	216.	490.	< 24.	29.	< 24.	70
K	6,910.	5,600.	71,600.	87,600	5,120	5,440
Se	< 4 b	< 5. b	< 5. b	< 5. b	< 5 b	< 5. b
Ag	< 5.	10	< 5.	11	< 5.	10
Na	236,000 b	204,000. c	1,360,000. b	1,310,000. c	145,000. b	127,000 c
Tl	< 100. b	< 7	< 100. b	< 10.	< 100. b	< 7
Sn	< 38.	87	< 38.	55	< 38	< 38
V	< 14	22.	14.	22.	< 14.	26.
Zn	180	204	414	24.	305	1

a = Sample concentration is less than the number listed at the 99% confidence level

b = Batch spike sample recovery was not within control limits indicating possible bias.

c = Estimated value, interference present causing possible bias

d = Duplicate analysis not within control limits.

TABLE C-4
DISSOLVED AND TOTAL METALS ANALYSIS RESULTS
ROCKY FLATS FACILITY, GOLDEN, COLORADO

Element	Well 34-86 SMO NO: MQA756		Well 43-86 SMO NO MQA759		Well 48-86 SMO NO MQA758	
	Dissolved Value,ug/L	Total Value,ug/L	Dissolved Value,ug/L	Total Value,ug/L	Dissolved Value,ug/L	Total Value,ug/L
Al	74.	2,820 b	< 44.	3,910. b	83	7,440. b
Sb	< 60. a	< 60. b	< 60	< 3 b	< 60	< 3. b
As	< 10.	< 10.	< 6.	< 6.	< 6.	< 6
Ba	130.	66.	151	129.	41	155
Be	< 2.	< 2.	< 2.	< 2.	2.	< 2
Cd	< 5. b	< 5.	< 5. b	< 5	< 5. b	< 5.
Ca	268,000. b	244,000	99,400. b	99,600.	8,930. b	45,100
Cr	< 10.	22. d	< 10.	62. d	< 10.	< 10 d
Co	< 20.	20.	< 20.	< 20.	< 20.	< 20
Cu	< 8	33.	< 8.	< 8.	< 8.	65
Fe	315.	4,730 bd	< 20	6,250. bd	< 20.	5,430 bd
Pb	< 5.	< 5. b	< 2.	4 7 b	< 2.	10 b
Mg	83,000. b	70,900. c	9,090 b	9,590 c	1,530 b	7,270 c
Mn	117. c	183. c	< 5. c	68. c	< 5. c	123 c
Hg	< .2	< .2	< .2	< .2	< .2	< 2
Ni	< 24.	< 24	< 24.	< 24.	< 24.	< 24
K	8,550.	7,380.	1,140.	1,800	6,330.	6,390
Se	< 5. b	< 5 b	< 4 b	< 40. b	< 4 b	< 50 b
Ag	< 5.	8.	< 5.	10.	6.	< 5
Na	259,000. b	214,000 c	11,200. b	10,700. c	45,400. b	49,400 c
Tl	< 100 b	< 7.	< 10 b	< 7.	< 10 b	< 7
Sn	< 38.	< 38.	< 38	< 38.	< 38	< 38
V	< 14	< 14.	< 14.	16	< 14.	24.
Zn	301	34	62.	24.	71	103

a = Sample concentration is less than the number listed at the 99% confidence level
b = Batch spike sample recovery was not within control limits indicating possible bias
c = Estimated value; interference present causing possible bias
d = Duplicate analysis not within control limits

TABLE C-4
DISSOLVED AND TOTAL METALS ANALYSIS RESULTS
ROCKY FLATS FACILITY, GOLDEN, COLORADO

Element	Well 49-86 SMO NO: MQA757		Well 54-86 SMO NO: MQA762		Well 59-86 SMO NO: MQA755	
	Dissolved Value,ug/L	Total Value,ug/L	Dissolved Value,ug/L	Total Value,ug/L	Dissolved Value,ug/L	Total Value,ug/L
Al	318.	195,000. b	< 44.	1,810. b	138	610 b
Sb	< 60. a	< 3 b	< 60.	< 3 b	< 60.	< 60. b
As	< 6	< 6.	< 6.	< 6	< 10.	< 10
Ba	116.	938.	98	144.	93.	99.
Be	< 2.	12.	< 2.	< 2	< 2.	< 2.
Cd	< 5. b	< 5.	< 5. b	.6	< 5. b	1 0
Ca	31,400 b	55,700.	99,100. b	97,100.	129,000 b	130,000
Cr	< 10.	199. d	< 10.	27. d	< 10.	26. d
Co	< 20.	62.	< 20.	< 20	< 20	21
Cu	< 8.	213.	< 8.	39.	< 8.	< 8.
Fe	50	196,000. bd	< 20	3,650. bd	< 20	578. bd
Pb	< 2.	55. b	< 2.	< 5 b	5.	18. b
Mg	6,990. b	35,300. c	24,400 b	24,400 c	44,200. b	44,800 c
Mn	222 c	2,990. c	214. c	416. c	42 c	54 c
Hg	< .2	.5	< 2	< .2	< 2	< .2
Ni	< 24.	139.	< 24.	< 24.	33	86
K	918.	21,300.	4,760.	4,740.	2,400	2,130.
Se	< 4. b	< 50. b	< 4. b	< 5. b	49. b	< 4. b
Ag	< 5	6.	< 5.	8.	< 5	< 5
Na	31,800. b	36,200. c	36,700. b	37,600. c	145,000. b	147,000 c
Tl	< 10. b	< 7.	< 10. b	< 7.	< 100. b	< 7.
Sn	< 38	98.	< 38.	< 38.	< 38.	< 38
V	< 14	305.	< 14	< 14	< 14	< 14
Zn	102.	329.	42.	46.	< 14.	< 14

a = Sample concentration is less than the number listed at the 99% confidence level.
b = Batch spike sample recovery was not within control limits indicating possible bias
c = Estimated value, interference present causing possible bias.
d = Duplicate analysis not within control limits

TABLE C-4
DISSOLVED AND TOTAL METALS ANALYSIS RESULTS
ROCKY FLATS FACILITY, GOLDEN, COLORADO

Element	WELL 62-86 SMO NO: MQA863		WET WELL SMO NO. MQA760, 830, 831	
	Dissolved Value,ug/L	Total Value,ug/L	Dissolved Value,ug/L	Total Value,ug/L
Al	112.	603. b	< 44	87. b
Sb	< 60. a	< 3 b	< 60.	< 60. b
As	< 6.	< 10	< 10.	< 10.
Ba	27.	30.	176.	171.
Be	< 2.	< 2.	< 2.	< 4.
Cd	< 5. b	< 5.	< 5. b	.7
Ca	42,300. b	32,800.	255,000. b	242,000
Cr	< 10.	< 10 d	< 10.	< 10. d
Co	< 20	< 20.	< 20.	< 20
Cu	< 8.	< 8	< 8	< 8.
Fe	< 20.	477. bd	< 20.	101. bd
Pb	< 2.	< 2. b	< 5.	< 5 b
Mg	4,750. b	3,100. c	66,600 b	64,200. c
Mn	< 5. c	6. c	< 5. c	6 c
Hg	< .2	< .2	< .2	< .2
Ni	< 24.	< 24.	< 24.	< 24.
K	12,300.	12,200.	66,900.	64,900
Se	35. b	29 b	< 45. b	5.1 b
Ag	< 5	5.	< 14.	8.
Na	55,500. b	54,600. c	406,000. b	397,000. c
Tl	< 10. b	< 7.	< 100. b	< 10
Sn	< 38	< 38.	< 38.	< 38.
V	< 14.	< 14.	< 14	< 15
Zn	28.	< 14.	45.	32.

a = Sample concentration is less than the number listed at the 99% confidence level
b = Batch spike sample recovery was not within control limits indicating possible bias
c = Estimated value; interference present causing possible bias
d = Duplicate analysis not within control limits.

NOTE Results for samples MQA765, (MW57-86) and MQA864, (MW 9-74) were not reported

TABLE C-5

FIELD MEASUREMENTS and
GENERAL CONSTITUENT ANALYSIS
ROCKY FLATS FACILITY, GOLDEN, COLORADO
SAMPLES COLLECTED APRIL 1987

STATION.		WELL 02-71	WELL 09-74	WELL 08-86	WELL 14-86	WELL 27-86	WELL 30-86	WELL 32-86	WELL 34-86
SMO NO.		MQA792	MQA864	MQA764	MQA791	MQA793	MQA828	MQA829	MQA756
PARAMETER	UNITS	VALUE	VALUE	VALUE	VALUE	VALUE	VALUE	VALUE	VALUE
pH	UNITS	8.	7.4	11.	7.7	7.9	7.2	8.	7.2
Conductance	umhos/cm	1200.	1925.	710.	1860.	1420	7150.	960	2200.
Temperature	'C	9.	10.	10.	12.	16.	10	14.	NA
POX	ug/L Cl	12100.	NR	< 5	< 5.	< 5	< 5.	< 5	< 5
TOX	ug/L Cl	8720	NR	< 5	6.	NA	82.	< 5.	< 5
POC	ug/L C	2600.	NR	17.	44.	62.	7200	6400.	19
TOC	ug/L C	3400.	NR	5500.	2000.	NA	6600	4300	3400.
Bromide	mg/L	27	NR	< 1.	< 1.	< 1.	< 1.	< 1.	< 1
Chloride	mg/L Cl-	160.	NR	7.9	94.	160.	260.	115.	52.
Nitrate	mg/L N	3.6	NR	< .3	< .3	< .3	2100	1.	< .3
Sulfate	mg/L SO4=	157.	NR	190.	590.	250.	300.	97	.0
Nitrite	mg/L	< .3	NR	< .3	< .3	< .3	< .3	< .3	< .3
Cyanide	ug/L	< 10.	NR	< 10.	< 10.	NA	< 10	NA	< 10
Phenol	ug/L	< 50.	NR	< 50	< 50.	< 1	< 100	< 1	< 50
Sulfide	mg/L	< 1.	NR	< 1.	< 1.	< 1.	< 1.	< 1	< 1.
Fluoride	mg/L F-	1.1	NR	1.4	< 1.	1.8	< 1.	1.6	< 1.

a) NR - Not reported.

b) Sample concentration is less than (<) the value shown.

TABLE C-5
FIELD MEASUREMENTS and
GENERAL CONSTITUENT ANALYSIS
ROCKY FLATS FACILITY, GOLDEN, COLORADO
SAMPLES COLLECTED: APRIL 1987

STATION:		WELL 43-86	WELL 48-86	WELL 49-86	WELL 54-86	WELL 57-86	WELL 59-86	WELL 62-86	WET WELL
SMO NO:		MQA759	MQA758	MQA757	MQA762	MQA765	MQA755	MQA863	c
PARAMETER	UNITS	VALUE	VALUE	VALUE	VALUE	VALUE	VALUE	VALUE	VALUE
pH	UNITS	7.7	11.	6.3	7.5	7.2	7.2	11.1	7.7
Conductance	umhos/cm	600.	350.	400.	755.	840	1340	460	3400
Temperature	'C	12.	13.	12	12.	9.	11	11.	8
POX	ug/L Cl	< 5. a	< 5.	< 5.	< 5	NR	< 5.	< 5	< 5.
TOX	ug/L Cl	15.	9.	20.	< 5.	NR	17.	9.	50.
POC	ug/L C	28	2600.	26.	36.	NR	36.	28	21.
TOC	ug/L C	2600.	1300.	2500.	67000.	NR	2900.	2200.	5300
Bromide	mg/L	< 1. b	< 1.	< 1.	< 1.	NR	< 1.	< 1.	< 1.
Chloride	mg/L Cl-	42	11.	20.	19.	NR	77.	25	93
Nitrate	mg/L N	5.5	< .3	15.	< .3	NR	1.1	3.	460.
Sulfate	mg/L SO4=	29.	18.	45.	50.	NR	166	53	120.
Nitrite	mg/L	< .3	< .3	< .3	< .3	NR	< .3	< .3	< .3
Cyanide	ug/L	< 10	< 10	10.	< 10.	NR	< 10.	< 10.	< 10
Phenol	ug/L	< 50.	< 50.	< 50.	< 50.	NR	< 50.	< 50	< 50
Sulfide	mg/L	< 1.	< 1.	< 1.	< 1.	NR	< 1	< 1	< 1
Fluoride	mg/L F-	< 1.	< 1.	< 1.	< 1.	NR	< 1.	1.3	< 1.

a) NR - Not reported

b) Sample concentration is less than (<) the value shown.

c) Average of three replicate sample analyses, SMO Numbers MQA760, MQA830, and MQA831

TABLE C-6
RADIONUCLIDE ANALYSIS RESULTS
ROCKY FLATS FACILITY, GOLDEN, COLORADO
SAMPLES COLLECTED. APRIL 1987

Values in pCi/L; statistical variation +/- indicated by +.

WELL NUMBER:	02-71	09-74	08-86	14-86	30-86	32-86	34-86	43-86
SMO NUMBER:	MQA792	MQA864	MQA764	MQA791	MQA828	MQA829	MQA756	MQA759
PARAMETER	ug/L	ug/L	ug/L	ug/L	ug/L	ug/L	ug/L	ug/L
-----	-----	-----	-----	-----	-----	-----	-----	-----
Gross Alpha	8 +3	7 +4	< 2	3 +2	155 +44	12 +5	7 +4	7 +3
Gross Beta	9 +1	7 +1	9 +1	8 +1	172 +14	23 +2	16 +2	16 +1
Gross Radium	5 +2	3 +1	< 2 b	2 +1	15 +5	14 +7	3 +1	9 +4
Radium 228	< 2	< 2	< 2 b	< 2	9.5	< 2	< 2	< 2
Strontium 90	< 2	< 2	< 4 b	< 2	< 3	< 2	< 5 b	< 3
Uranium 234	1.0 +0.3	8.4 +0.8	< 0.2 b	0.8 +0.2	21.4 +1.6	1.1 +0.3	0.8 +0.4 b	< 0.3
Uranium 235	< 0.2	0.7 +0.2	< 0.2 b	< 0.2	1.1 +0.3	0.2 +0.1	< 0.2 b	< 0.3
Uranium 238	0.8 +0.3	6.6 +0.7	< 0.2 b	0.3 +0.1	13.5 +1.2	0.8 +0.3	1.0 +0.4	< 0.3
Plutonium 239,240	< 0.2	< 0.2	< 0.2 b	< 0.2	< 0.3	< 0.3	< 0.2 b	< 0.3
Plutonium 238	< 0.2	< 0.2	< 0.2 b	< 0.2	< 0.3	< 0.3	< 0.2 b	< 0.3
Americium 241	< 0.2	< 0.2	< 0.2 b	< 0.2	< 0.4	< 0.4	< 0.2 b	< 0.3
Cesium 137	< 5	< 5	< 5	< 5	< 5	< 5	< 5	< 5 b
Ruthenium 106	< 5	< 5	< 5	< 5	< 5	< 5	< 5	< 5 b
Tritium	< 200	< 200	< 200	< 200	8811 +155 b	NA	< 200	308 +25 b

- a) Sample activity is less than the value shown
b) Average of duplicate analyses.
c) Not analyzed.

Analyzed with all parameters below limits of detection: Well 10-74, (MQA 790)
No results were reported for Well 27-86, (MQA 793)

TABLE C-6
RADIONUCLIDE ANALYSIS RESULTS
ROCKY FLATS FACILITY, GOLDEN, COLORAD
SAMPLES COLLECTED: APRIL 1987

Values in pCi/L, statistical variation +/- indicated by +

WELL NUMBER.	48-86	49-86	54-86	57-86	59-86	62-86	WET WELL
SMO NUMBER:	MQA758	MQA757	MQA762	MQA765	MQA755	MQA863	AVE (d)
PARAMETER	ug/L	ug/L	ug/L	ug/L	ug/L	ug/L	ug/L
Gross Alpha	3 +1	43 +13 b	7 +3	9 +3	12 +4	4 +2	64 +16
Gross Beta	7 +1	80 +6 b	8 +1	15 +1	12 +1	12 +1	59 +5
Gross Radium	< 2	7 +1	< 2 a	4 +2	< 2	< 2	< 2
Radium 228	< 2	< 2	< 2	< 4	< 3	< 2	< 2
Strontium 90	< 2	< 2	< 2	< 3	< 6	< 3	< 3
Uranium 234	< 0.2	< 0.2	1.2 +0.3	6 7 +1.2	11.6 +1 4	3.6 +0.6	14.8 +1 2
Uranium 235	< 0.2	< 0 2	0 3 +0.2	0.5 +0.3	0 6 +0.3	< 0.3	3.6 +0 6
Uranium 238	< 0.2	< 0 2	1.5 +0.3	5.1 +1.0	8.5 +1.2	2 1 +0 5	9 9 +1.0
Plutonium 239,240	< 0.2	< 0 2	< 0.2	< 0 5	< 0.5	< 0 3	< 0 2
Plutonium 238	< 0.2	< 0.2	< 0.2	< 0.5	< 0.5	< 0.3	< 0.2
Americium 241	< 0.2	< 0.2	< 0 2	< 0.7	< 0.7	< 0.4	< 0 2
Cesium 137	< 5	< 5	< 5	< 5 b	< 5	< 5	< 5
Ruthenium 106	< 5	< 5	< 5	< 5 b	< 5	< 5	< 5
Tritium	< 200	< 200	< 200	NA c	264 +30	NA	1931 + 64

a) Sample acitivity is less than the value shown

b) Average of duplicate analyses.

c) Not analyzed.

d) Average of triplicate analyses: MQA 760, 830 and 831

EPA/NEIC/DENVER

APPENDIX D

DOE GROUND-WATER MONITORING DATA FOR 1986

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RFP-ENV-86

ANNUAL ENVIRONMENTAL MONITORING REPORT
U. S. DEPARTMENT OF ENERGY, ROCKY FLATS PLANT
January Through December 1986

ENVIRONMENTAL MANAGEMENT SECTION

George H. Setlock, Manager
Dorothy L. Barr, Report Coordinator

ROCKWELL INTERNATIONAL
NORTH AMERICAN SPACE OPERATIONS
ROCKY FLATS PLANT
P.O. BOX 464
GOLDEN, COLORADO 80402-0464

Prepared under Contract DE-AC04-76DPO3533
for the
Albuquerque Operations Office
U.S. Department of Energy

TABLE 16. Radioactivity Concentrations in Groundwater Monitoring Wells

Station	Gross Alpha ($\times 10^{-9}$ $\mu\text{Ci}/\text{mL}$) ^a	Gross Beta ($\times 10^{-9}$ $\mu\text{Ci}/\text{mL}$)	Plutonium-239 -240 ($\times 10^{-9}$ $\mu\text{Ci}/\text{mL}$)	Americium-241 ($\times 10^{-9}$ $\mu\text{Ci}/\text{mL}$)	Uranium-233, -234 ($\times 10^{-9}$ $\mu\text{Ci}/\text{mL}$)	Uranium-238 ($\times 10^{-9}$ $\mu\text{Ci}/\text{mL}$)	Tritium ($\times 10^{-9}$ $\mu\text{Ci}/\text{mL}$)
2-60	22 \pm 51	68 \pm 44	-0.05 \pm 0.06	-0.01 \pm 0.02	4.4 \pm 0.6	3.4 \pm 0.5	670 \pm 0.22
4-60	28 \pm 10	27 \pm 9	0.03 \pm 0.46	0.02 \pm 0.06	30 \pm 1	9.3 \pm 0.7	210 \pm 0.2
1-71	6 \pm 3	6 \pm 3	-0.01 \pm 0.07	0.4 \pm 0.07	3.9 \pm 0.5	2.5 \pm 0.4	250 \pm 0.21
2-71	350 \pm 500	1000 \pm 900	32 \pm 3	4.4 \pm 2.3	30 \pm 5	33 \pm 5	-20 \pm 0.27
6-71	36 \pm 29	2 \pm 2	0.04 \pm 0.08	0.05 \pm 0.05	16 \pm 1	11 \pm 1	1500 \pm 0.3
1-74	9 \pm 5	3 \pm 3	0.03 \pm 0.10	0.04 \pm 0.50	3.2 \pm 0.7	2.7 \pm 0.7	260 \pm 0.23
3-74	13 \pm 7	10 \pm 5	-0.16 \pm 0.31	-0.01 \pm 0.09	-0.04 \pm 0.11	-0.03 \pm 0.08	250 \pm 0.22
9-74	28 \pm 16	28 \pm 11	-0.02 \pm 0.07	0.01 \pm 0.08	11 \pm 2	8.2 \pm 1.4	110 \pm 0.22
10-74	Dry						
14-74	Dry						
16-74	Dry						
22-74	13 \pm 7	12 \pm 4	0.13 \pm 0.16	0.05 \pm 0.06	6.0 \pm 0.6	2.4 \pm 0.4	70 \pm 0.22
1-81	22 \pm 16	32 \pm 12	0.05 \pm 0.32	0.01 \pm 0.03	3.3 \pm 0.4	1.8 \pm 0.3	100 \pm 0.22
2-81	43 \pm 18	27 \pm 11	0.15 \pm 0.12	-0.06 \pm 0.08	1.3 \pm 0.3	1.0 \pm 0.3	-20 \pm 0.21
4-81	Dry						
6-81	13 \pm 6	8 \pm 5	0.02 \pm 0.09	-0.03 \pm 0.06	59 \pm 0.20	0.48 \pm 0.18	-40 \pm 0.22
7-81	47 \pm 17	24 \pm 6	-0.06 \pm 0.09	0.01 \pm 0.04	2.1 \pm 0.4	2.0 \pm 0.4	100 \pm 0.21
8-81	5 \pm 4	2 \pm 3	0.16 \pm 0.10	0.00 \pm 0.04	3.2 \pm 0.4	1.7 \pm 0.3	0.20 \pm 0.22
9-81	4 \pm 5	4 \pm 3	-0.03 \pm 0.04	0.04 \pm 0.04	0.57 \pm 0.17	0.25 \pm 0.11	0 \pm 0.22
10-81	22 \pm 7	22 \pm 3	0.03 \pm 0.06	0.03 \pm 0.04	0.96 \pm 0.24	0.59 \pm 0.19	33 \pm 0.23
3-82	10 \pm 7	17 \pm 6	-0.07 \pm 0.10	0.00 \pm 0.04	0.54 \pm 0.29	0.44 \pm 0.27	140 \pm 0.22
5-82	2 \pm 3	3 \pm 2	-0.03 \pm 0.04	0.05 \pm 0.05	-0.01 \pm 0.04	0.00 \pm 0.01	-20 \pm 0.22
6-82	79 \pm 39	110 \pm 30	0.05 \pm 0.17	0.03 \pm 0.07	4.0 \pm 0.6	3.7 \pm 0.6	
7-82	Dry						
1-86	Dry						
2-86	Dry						
3-86	170 \pm 80	220 \pm 40	0.01 \pm 0.07	0.02 \pm 0.13	7.0 \pm 0.7	5.0 \pm 0.6	160 \pm 0.22
4-86	Dry						
5-86	Dry						
6-86	Dry						
7-86	Dry						
8-86	NA	NA	NA	NA	NA	NA	NA
9-86	NA	NA	NA	NA	NA	NA	NA
10-86	NA	NA	NA	NA	NA	NA	NA
11-86	NA	NA	NA	NA	NA	NA	NA
12-86	82 \pm 28	86 \pm 12	-0.05 \pm 0.06	0.00 \pm 0.03	8.8 \pm 0.8	7.0 \pm 0.7	240 \pm 0.22
13-86	Dry						
14-86	54 \pm 24	36 \pm 12	-0.04 \pm 0.07	0.01 \pm 0.03	7.4 \pm 0.7		\pm 0.22
15-86	200 \pm 80	220 \pm 50	-0.03 \pm 0.04	0.08 \pm 0.21	24 \pm 2	24 \pm 2	22 \pm 0.22
16-86	22 \pm 20	33 \pm 21	-0.48 \pm 0.67	0.01 \pm 0.25	3.0 \pm 1.0	2.1 \pm 0.8	\pm 0.23
17-86	160 \pm 80	77 \pm 40	-0.21 \pm 0.26	-0.03 \pm 0.09	33 \pm 1	27 \pm 1	690 \pm 0.24
18-86	NA	NA	NA	NA	NA	NA	NA
19-86	170 \pm 240	470 \pm 130	0.01 \pm 0.08	0.00 \pm 0.13	23 \pm 2	22 \pm 2	140 \pm 0.22
20-86	Dry						
21-86	NA	NA	NA	NA	NA	NA	NA
22-86	300 \pm 160	240 \pm 60	0.95 \pm 0.39	0.12 \pm 0.14	24 \pm 3	21 \pm 3	580 \pm 0.23
23-86	NA	NA	NA	NA	NA	NA	NA
24-86	Dry						
25-86	NA	NA	NA	NA	NA	NA	NA
26-86	NA	NA	NA	NA	NA	NA	NA
27-86	NA	NA	NA	NA	NA	NA	NA
28-86	NA	NA	NA	NA	NA	NA	NA
29-86	Dry						
30-86	NA	NA	NA	NA	NA	NA	NA

^a To obtain proper concentration, multiply the numbers in the table by 10^{-9} $\mu\text{Ci}/\text{mL}$.

For example uranium-233, -234 in well 55-86 is 5.4×10^{-9} $\mu\text{Ci}/\text{mL}$.

^b NA = Not available.

RFP-ENV-86/MONITORING DATA: COLLECTION, ANALYSES, AND EVALUATION

TABLE 16. Radioactivity Concentrations in Groundwater Monitoring Wells (Continued)

Station	Gross Alpha ($\times 10^{-9}$ $\mu\text{Ci}/\text{mL}$)	Gross Beta ($\times 10^{-9}$ $\mu\text{Ci}/\text{mL}$)	Plutonium-239, -240 ($\times 10^{-9}$ $\mu\text{Ci}/\text{mL}$)	Americium-241 ($\times 10^{-9}$ $\mu\text{Ci}/\text{mL}$)	Uranium-233, -234 ($\times 10^{-9}$ $\mu\text{Ci}/\text{mL}$)	Uranium-238 ($\times 10^{-9}$ $\mu\text{Ci}/\text{mL}$)	Tritium ($\times 10^{-9}$ $\mu\text{Ci}/\text{mL}$)
31-86	Dry						
32-86	Dry						
33-86	Dry						
34-86	17 \pm 25	35 \pm 18	-0.05 \pm 0.07	0.06 \pm 0.11	2.6 \pm 0.4	2.7 \pm 0.4	-150 \pm 0.22
35-86	25 \pm 19	34 \pm 10	-0.03 \pm 0.07	-0.01 \pm 0.02	13 \pm 1	5.7 \pm 0.6	140 \pm 0.23
36-86	Dry						
37-86	Dry						
38-86	Dry						
39-86	44 \pm 21	39 \pm 13	0.00 \pm 0.09	-0.01 \pm 0.03	3.7 \pm 0.4	3.5 \pm 0.4	180 \pm 0.22
40-86	Dry						
41-86	140 \pm 40	94 \pm 18	0.01 \pm 0.08	-0.03 \pm 0.10	6.6 \pm 0.7	6.5 \pm 0.7	130 \pm 0.22
42-86	130 \pm 70	180 \pm 40	0.50 \pm 0.16	0.07 \pm 0.16	9.8 \pm 1.1	11 \pm 1	210 \pm 0.23
43-86	Dry						
44-86	NA	NA	NA	NA	NA	NA	NA
45-86	200 \pm 80	140 \pm 30	0.13 \pm 0.21	0.03 \pm 0.07	11 \pm 1	10 \pm 1	100 \pm 0.22
46-86	NA	NA	NA	NA	NA	NA	NA
47-86	NA ^b	NA	NA	NA	NA	NA	NA
48-86	NA	NA	NA	NA	NA	NA	NA
49-86	NA	NA	NA	NA	NA	NA	NA
50-86	NA	NA	NA	NA	NA	NA	NA
51-86	NA	NA	NA	NA	NA	NA	NA
52-86	NA	NA	NA	NA	NA	NA	NA
53-86	Dry						
54-86	NA	NA	NA	NA	NA	NA	NA
55-86	170 \pm 70	130 \pm 30	-0.05 \pm 0.07	-0.02 \pm 0.04	5.4 \pm 0.5	6.7 \pm 0.6	200 \pm 0.22
56-86	14 \pm 11	24 \pm 5	0.09 \pm 0.06	0.01 \pm 0.06	1.5 \pm 0.3	1.5 \pm 0.3	60 \pm 0.22
57-86	Dry						
58-86	Dry						
59-86	NA	NA	NA	NA	NA	NA	NA
61-86	NA	NA	NA	NA	NA	NA	NA
62-86	NA	NA	NA	NA	NA	NA	NA
63-86	Dry						
64-86	Dry						
65-86	29 \pm 12	21 \pm 6	0.02 \pm 0.10	0.01 \pm 0.03	7.9 \pm 0.7	6.5 \pm 0.7	70 \pm 0.23
66-86	Dry						
67-86	NA	NA	NA	NA	NA	NA	NA
68-86	20 \pm 11	27 \pm 9	-0.02 \pm 0.08	0.00 \pm 0.03	2.4 \pm 0.4	2.2 \pm 0.4	20 \pm 0.21
69-86	200 \pm 60	130 \pm 30	-0.01 \pm 0.08	0.01 \pm 0.04	14 \pm 1	11 \pm 1	20 \pm 0.21
70-86	210 \pm 70	170 \pm 30	0.07 \pm 0.11	0.04 \pm 0.14	9.3 \pm 1.0	10 \pm 1	-60 \pm 0.22
WS-1	8 \pm 5	10 \pm 3	0.08 \pm 0.16	0.02 \pm 0.04	0.53 \pm 0.20	0.30 \pm 0.15	-40 \pm 0.24
WS-2	Dry						

a. To obtain proper concentration, multiply the numbers in the table by 10^{-9} $\mu\text{Ci}/\text{mL}$. For example uranium-233, -234 in well 55-86 is 5.4×10^{-9} $\mu\text{Ci}/\text{mL}$.

b. NA = Not Available.

TABLE 17. Volatile Organic Concentrations in Groundwater Monitoring Wells

Station	1,1 DCE (µg/l)	1,1 DCA (µg/l)	1,1,2 DCE (µg/l)	CHC13 (µg/l)	1,2 DCA (µg/l)	MEK (µg/l)	1,1,1 TCA (µg/l)	CC14 (µg/l)	TCE (µg/l)	1,1,2 TCA (µg/l)	PCE (µg/l)
2-60	ND ^a	ND	ND	10	ND	ND	ND	ND	ND	ND	ND
4-60	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
1-71	5	ND	13	180	ND	ND	ND	1,600	350	ND	65
2-71	ND	ND	79	79	ND	ND	ND	ND	4,500	ND	15
6-71	ND	ND	ND	24	ND	ND	ND	14	30	ND	ND
1-74	ND	ND	38	ND	ND	ND	ND	ND	7,000	ND	120,000
									2,400 ^b		25,000 ^b
3-74	ND	ND	ND	ND	ND	ND	ND	280	240	ND	450
9-74	7,200	35	42	5	38	22	14,000		11,000	91	4,800
10-74	Dry										
14-74	Dry										
16-74	Dry										
22-74	ND	ND	ND	ND	ND	ND	ND	23	7	ND	6
1-81	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
2-81	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
4-81	Dry										
6-81	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
7-81	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
8-81	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
9-81	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
10-81	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
3-82	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
5-82	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
6-82	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
7-82	Dry										
1-86	Dry										
2-86	Dry										
3-86	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
4-86	Dry										
5-86	Dry										
6-86	Dry										
7-86	Dry										
8-86	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
9-86	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
10-86	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
11-86	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
12-86	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
13-86	Dry										
14-86	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
15-86	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
16-86	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
17-86	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
18-86	Dry										
19-86	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
20-86	Dry										
21-86	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
22-86	ND	ND	36	147	ND	ND	ND	350	410	ND	ND
23-86	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
24-86	Dry										
25-86	ND	ND	ND	ND	ND	15	ND	ND	ND	ND	ND
26-86	ND	ND	ND	ND	ND	ND	ND	ND	6	ND	ND
27-86	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
28-86	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
29-86	Dry										
30-86	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
31-86	Dry										
32-86	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
33-86	Dry										
34-86	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND

a. ND = Not Detected.

b. Values determined by resampling.

c. NA = Not Available.

RFP-ENV-86/MONITORING DATA: COLLECTION, ANALYSES, AND EVALUATION

TABLE 17. Volatile Organic Concentrations in Groundwater Monitoring Wells (Continued)

Station	1,1 DCE ($\mu\text{g}/\ell$)	1,1 DCA ($\mu\text{g}/\ell$)	1,1,2 DCE ($\mu\text{g}/\ell$)	CHC13 ($\mu\text{g}/\ell$)	1,2 DCA ($\mu\text{g}/\ell$)	MEK ($\mu\text{g}/\ell$)	1,1,1 TCA ($\mu\text{g}/\ell$)	CC14 ($\mu\text{g}/\ell$)	TCE ($\mu\text{g}/\ell$)	1,1,2 TCA ($\mu\text{g}/\ell$)	PCE ($\mu\text{g}/\ell$)
35-86	28	54	1,070	ND	ND	ND	17	ND	ND	ND	ND
36-86	Dry										
37-86	Dry										
38-86	Dry										
39-86	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
40-86	Dry										
41-86	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
42-86	ND	ND	53	159	ND	ND	ND	1,560	260	ND	320
43-86	Dry										
44-86	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	17
45-86	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
46-86	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
47-86	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
48-86	NA ^c	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
49-86	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
50-86	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
51-86	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
52-86	NA ^b	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
53-86	Dry										
54-86	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
55-86	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
56-86	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
57-86	Dry										
58-86	Dry										
59-86	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
60-86	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
61-86	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
62-86	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
63-86	Dry										
64-86	Dry										
65-86	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
66-86	Dry										
67-86	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
68-86	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
69-86	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
70-86	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
WS-1	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
WS-2	Dry										

a. ND = Not Detected.

b. Values determined by resampling.

c. NA = Not Available.

Legend

1,1 DCE	1,1-Dichloroethene	1,1 DCA	1,1-Dichloroethane
1,1,2 DCE	trans-1,2-Dichloroethene	CHC13	Chloroform
1,2 DCA	1,2-Dichloroethane	1,2 DCA	1,2-Dichloroethane
MEK	2-Butanone	1,1,1 TCA	1,1,1-Trichloroethane
CC14	Carbon Tetrachloride	TCE	Trichloroethene
1,1,2 TCA	1,1,2-Trichloroethane	PCE	Tetrachloroethene

TABLE 18 Metal Concentrations in Groundwater Monitoring Wells

Station	Al (µg/l)	Sb (µg/l)	As (µg/l)	Ba (µg/l)	Be (µg/l)	Cd (µg/l)	Co (µg/l)	Cr (µg/l)	Cu (µg/l)	Fe (µg/l)	Pb (µg/l)	Mn (µg/l)	Hg (µg/l)	Mo (µg/l)	Ni (µg/l)	Se (µg/l)	Ag (µg/l)	Sr (µg/l)	Li (µg/l)	V (µg/l)	Zn (µg/l)	
2-60	ND ^a	ND	ND	ND	ND	ND	ND	ND	52	ND	480	ND	410	ND	ND	ND	ND	12,900	290	89	4,330	
4-60	ND	ND	ND	ND	ND	ND	ND	ND	120	ND	84	ND	52	1.2	ND	ND	19	14	1,250	ND	ND	250
1-71	ND	ND	ND	ND	ND	ND	ND	ND	170	ND	270	ND	143	ND	ND	ND	15	20	580	ND	ND	ND
2-71	ND	ND	ND	ND	ND	ND	ND	ND	110	ND	54,300	88	800	0.24	192	ND	18	20	570	ND	ND	ND
6-71	ND	ND	ND	ND	10	ND	ND	ND	ND	20	500	ND	30	ND	300	ND	ND	ND	3,750	ND	ND	ND
1-74	ND	ND	ND	ND	9.7	ND	ND	ND	ND	ND	ND	ND	340	ND	ND	ND	ND	ND	830	ND	ND	ND
3-74	ND	ND	ND	ND	9.7	ND	ND	ND	ND	ND	ND	16	ND	ND	ND	ND	ND	ND	360	ND	ND	25
9-74	2,380	ND	ND	ND	ND	ND	ND	ND	140	ND	1,310	ND	84	2.3	ND	ND	21	31	1,960	ND	ND	ND
10-74	Dry																					
14-74	Dry																					
16-74	Dry																					
22-74	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	65	ND	190	ND	17	14	1,110	ND	ND	ND
1-81	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	
2-81	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	220	ND	570	ND	ND	ND	ND	ND	1,080	ND	ND	28
4-81	Dry																					
6-81	180	ND	ND	ND	ND	ND	ND	ND	220	ND	590	ND	1,480	0.88	ND	ND	15	20	350	ND	ND	ND
7-81	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	520	ND	ND	ND	3.4	ND	235	ND	ND	54
8-81	ND	ND	ND	ND	80	ND	ND	13	ND	30	ND	ND	ND	ND	ND	ND	8.2	ND	250	ND	ND	ND
9-81	ND	ND	ND	ND	ND	ND	ND	7.5	ND	ND	6	ND	0.22	ND	ND	ND	ND	ND	350	19	ND	90
10-81	680	ND	ND	ND	37	ND	360	ND	100	ND	270	ND	ND	0.7	510	77	ND	ND	68	7	850	26
3-82	ND	ND	ND	280	40	ND	ND	16	ND	20	ND	ND	80	ND	ND	ND	17	ND	110	ND	ND	75
5-82	ND	ND	ND	150	ND	ND	ND	ND	ND	ND	ND	ND	30	1.2	ND	ND	ND	180	14	ND	ND	1,580
6-82	ND	ND	ND	290	40	ND	ND	22	ND	ND	180	16	140	ND	ND	60	ND	ND	ND	ND	102	
7-82	Dry																					
1-86	Dry																					
2-86	Dry																					
3-86	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	38	0.24	ND	ND	15	ND	1,580	ND	ND	34
4-86	Dry																					
5-86	Dry																					
6-86	Dry																					
7-86	Dry																					
8-86	380	ND	156	ND	ND	ND	ND	ND	ND	94	ND	16	ND	133	ND	10	ND	ND	1,310	ND	ND	29
9-86	ND	ND	ND	160	ND	ND	ND	ND	ND	ND	ND	5	28	ND	ND	ND	ND	ND	175	ND	ND	ND
10-86	36,600	ND	ND	340	26	ND	ND	ND	ND	24	28,200	ND	634	ND	ND	ND	19	238	ND	ND	57	55
11-86	8,400	ND	ND	170	ND	ND	ND	ND	ND	ND	3,500	ND	128	ND	ND	ND	ND	ND	590	ND	ND	27
12-86	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	20	ND	ND	ND	ND	ND	828	ND	ND	25
13-86	Dry																					
14-86	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	42	ND	ND	ND	ND	ND	1,370	ND	ND	ND
15-86	ND	ND	ND	120	ND	ND	ND	ND	65	ND	ND	ND	26	ND	ND	ND	ND	ND	1,700	24	ND	ND

a. ND = Not Detected

b. NA = Not Available.

P-ENV-86/MONITORING DATA COLLECTION, ANALYSES, AND EVALUATION

D-7

Station	Al (µg/g)	Sb (µg/g)	As (µg/g)	Ba (µg/g)	Bc (µg/g)	Cd (µg/g)	Cs (µg/g)	Cr (µg/g)	Co (µg/g)	Cu (µg/g)	Fe (µg/g)	Pb (µg/g)	Mn (µg/g)	Hg (µg/g)	Mo (µg/g)	Ni (µg/g)	Se (µg/g)	Ag (µg/g)	Sr (µg/g)	Tl (µg/g)	V (µg/g)	Zn (µg/g)	
16-86	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	63	0.30	ND	ND	ND	4.5	ND	1,880	ND	ND	ND
17-86	ND	ND	ND	160	5	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	1,950	120	ND	ND	ND
18-86	NA ^b	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
19-86	ND	ND	ND	170	ND	ND	ND	ND	ND	ND	ND	ND	2,230	ND	ND	ND	ND	ND	1,240	30	ND	ND	ND
20-86	Dry	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	77	ND	ND	ND	ND	10	324	ND	ND	ND	ND
21-86	ND	62	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	15	0.67	ND	ND	7.6	ND	320	ND	ND	ND	ND
22-86	ND	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
23-86	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
24-86	Dry	ND	ND	ND	ND	ND	ND	ND	25	ND	ND	ND	237	ND	31.3	96.5	ND	9	2,850	ND	ND	ND	59
25-86	610	ND	ND	150	ND	ND	ND	ND	ND	ND	ND	ND	117	0.26	ND	ND	ND	ND	2,130	44	ND	ND	ND
26-86	ND	ND	ND	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
27-86	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
28-86	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
29-86	Dry	ND	ND	580	ND	ND	ND	ND	ND	ND	478	ND	631	1.1	ND	ND	10	30	21,500	544	ND	ND	23
30-86	170	ND	ND	100	ND	ND	ND	ND	ND	ND	ND	12	23	ND	ND	ND	ND	10	580	ND	ND	ND	77
31-86	Dry	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	82	ND	190	ND	8.3	ND	3,240	39	ND	ND	42
32-86	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	2,100	ND	ND	ND	2.8	ND	959	ND	ND	ND	31
33-86	Dry	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
34-86	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
35-86	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
36-86	Dry	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
37-86	Dry	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
38-86	Dry	ND	ND	280	ND	ND	ND	ND	ND	ND	ND	ND	35	ND	ND	ND	ND	ND	523	ND	ND	ND	ND
39-86	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	854	ND	ND	ND	ND	ND	420	ND	ND	ND	ND
40-86	Dry	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	578	ND	ND	ND	ND	ND	308	ND	ND	ND	ND
41-86	ND	ND	ND	150	5	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
42-86	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	2,840	ND	173	ND	ND	ND	ND	ND	285	ND	ND	ND	57
43-86	Dry	ND	ND	280	ND	ND	ND	ND	ND	ND	252	ND	79	0.21	ND	ND	ND	ND	190	ND	ND	ND	6
44-86	4,300	ND	ND	160	11	ND	ND	ND	ND	ND	ND	13	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
45-86	480	ND	ND	144	ND	ND	ND	ND	ND	132	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
46-86	350	ND	ND	100	ND	7	ND	ND	ND	ND	ND	ND	86	ND	ND	ND	ND	ND	ND	ND	47	ND	ND
47-86	ND	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
48-86	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	205	ND	ND	ND	63
49-86	ND	ND	ND	116	ND	ND	ND	ND	ND	ND	181	54	347	ND	ND	ND	ND	ND	164	ND	ND	ND	39
50-86	190	ND	ND	190	ND	ND	ND	ND	ND	ND	ND	ND	71	ND	ND	ND	ND	ND	ND	ND	ND	ND	NA
51-86	ND	ND	ND	110	ND	6	ND	27	ND	23	ND	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
52-86	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
53-86	Dry	ND	ND	ND	ND	ND	ND	15	ND	ND	110	ND	100	ND	ND	ND	ND	ND	326	ND	ND	ND	ND
54-86	150	ND	ND	ND	ND	ND	ND	ND	ND	ND	537	ND	547	ND	ND	ND	ND	ND	154	ND	ND	ND	7
55-86	740	58	ND	140	11	ND	ND	ND	ND	ND	ND	ND	340	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND

a. ND = Not Detected.
b. NA = Not Available.

TABLE 18. Metal Concentrations in Groundwater Monitoring Wells (Continued)

Station	Al (µg/l)	Sb (µg/l)	As (µg/l)	Ba (µg/l)	Be (µg/l)	Cd (µg/l)	Cs (µg/l)	Cr (µg/l)	Co (µg/l)	Cu (µg/l)	Fe (µg/l)	Pb (µg/l)	Mn (µg/l)	Hf (µg/l)	Mo (µg/l)	Ni (µg/l)	Sc (µg/l)	Ag (µg/l)	Si (µg/l)	Li (µg/l)	V (µg/l)	Zn (µg/l)
59-86	230	185	ND	100	29	ND	ND	ND	ND	ND	ND	24	107	1.2	ND	ND	ND	ND	1,110	ND	ND	12
61-86	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
62-86	4,750	58	ND	130	9	ND	ND	39	ND	ND	2,900	ND	52	0.28	ND	ND	ND	ND	305	ND	ND	23
63-86	Dry																					
64-86	Dry																					
65-86	ND	78	ND	ND	10	ND	ND	ND	ND	ND	103	ND	127	1.9	ND	ND	8.9	ND	630	ND	ND	28
66-86	Dry																					
67-86	ND	ND	ND	243	ND	ND	ND	ND	ND	ND	ND	ND	161	ND	ND	ND	ND	16	719	ND	ND	30
68-86	ND	95	ND	100	6	ND	ND	ND	ND	ND	76	ND	1,050	ND	ND	ND	ND	ND	137	ND	ND	ND
69-86	110	208	ND	160	6	ND	ND	ND	ND	ND	ND	37	58	ND	ND	ND	ND	ND	1,190	16	ND	5
70-86	ND	ND	ND	ND	7	ND	ND	ND	ND	ND	ND	ND	72	0.50	ND	ND	ND	ND	656	ND	ND	ND
WS-1	ND	ND	ND	ND	30	ND	ND	ND	ND	ND	ND	ND	70	ND	100	ND	ND	ND	120	ND	ND	78
WS-2	Dry																					

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TABLE 19. Other Inorganic Concentrations in Groundwater Monitoring Wells

Station	Calcium (µg/ℓ)	Magnesium (µg/ℓ)	Potassium (µg/ℓ)	Sodium (µg/ℓ)	Bicarbonate (mg/ℓ)	Carbonate (mg/ℓ)	Chloride (mg/ℓ)	Cyanide (mg/ℓ)	Phosphate (mg/ℓ)	Sulfate (mg/ℓ)	Nitrate (mg/ℓ)
2-60	1,500,000	270,000	72,400	540,000	17	80	730	0.014	1.4	400	5060
4-60	171,000	49,000	3,300	127,000	26	350	40	ND	0.52	91	22.0
1-71	84,000	15,000	1,660	11,200	37	240	17	ND	1.6	22	19.9
2-71	84,000	12,500	2,200	135,000	108	35	320	0.016	ND	97	<5.0
6-71	635,000	6,000	6,000	24,000	50	270	95	ND	1.8	100	2120
1-74	105,000	32,000	3,800	106,000	62	250	23	ND	1.8	37	44.8
3-74	25,500	14,000	920	15,500	18	290	40	ND	1.6	30	25.2
9-74	314,000	51,000	2,100	116,000	18	301	400	ND	3.7	320	91.2
10-74	Dry										
14-74	Dry										
16-74	Dry										
22-74	1,420	22,500	4,100	22,400	ND	250	57	ND	1.9	22	23.6
1-81	210	ND	90	76	75	330	37	ND	2.0	250	<5.0
2-81	84,000	41,000	4,250	117,000	108	430	29	ND	2.3	200	<5.0
4-81	Dry										
6-81	84,000	12,500	1,730	4,500	30	210	10	ND	4.4	ND	7.2
7-81	56,000	42,000	980	12,000	26	210	3.1	ND	1.4	9	<5.0
8-81	73,300	5,780	ND	13,800	4.9	130	8.6	0.005	ND	17	<5.0
9-81	28,200	1,480	5,880	15,900	NA	NA	NA	NA	NA	NA	<5.0
10-81	18,000	6,600	560	11,000	19	21	5.7	0.0016	1.3	ND	<5.0
3-82	22,000	3,680	ND	13,800	10	19	15	ND	1.8	28	74.7
5-82	36,200	4,130	15,500	23,300	56	ND	55	ND	0.92	77	32.4
6-82	8,700	1,200	ND	5,100	15	22	3.3	ND	1.5	20	<5.0
7-82	Dry										
1-86	Dry										
2-86	Dry										
3-86	88,000	32,000	2,630	26,600	13	330	58	ND	2.6	66	5.7
4-86	Dry										
5-86	Dry										
6-86	Dry										
7-86	Dry										
8-86	91,500	ND	41,100	177,000	ND	442	NA	NA	4.0	NA	41.0
9-86	21,100	5,250	3,620	60,700	220	ND	11	ND	1.8	15	<5.0
10-86	22,100	7,880	12,900	12,200	16	66	4.3	ND	4.4	17	<5.0
11-86	77,400	24,500	6,840	112,000	NA	NA	NA	NA	NA	NA	NA
12-86	170,000	264,000	1,920	167,000	33	420	47	ND	2.9	240	9.6
13-86	Dry										
14-86	95,100	29,200	7,920	267,000	13	180	160	ND	1.5	310	<5.0
15-86	324,000	61,500	2,600	88,000	35	410	63	0.040	11	170	243
16-86	142,000	45,500	6,260	297,000	22	450	220	ND	ND	510	<5.0
17-86	193,000	142,000	8,800	322,000	53	320	140	ND	2.1	330	2320
18-86	Dry										
19-86	148,000	45,400	5,500	232,000	NA	NA	NA	NA	NA	NA	<5.0
20-86	Dry										
21-86	44,200	9,960	8,030	37,600	4.4	259	5.2	ND	4.7	56	<5.0
22-86	57,000	9,180	4,040	99,700	23	340	37	ND	3	75	22.6
24-86	Dry										
25-86	224,000	80,500	35,000	33,800	NA	NA	NA	NA	NA	NA	NA
26-86	97,000	106,000	3,300	338,000	41	730	77	NR ^c	ND	500	300
27-86	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
28-86	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
29-86	Dry										
30-86	193,000	165,000	38,600	1,440,000	46	240	430	ND	1.3	100	9640
31-86	Dry										
32-86	31,100	7,660	8,350	118,000	ND	199	122	ND	9.5	101	60.2

a. ND = Not Detected

b. NA = Not Available

c. NR = Not Requested

TABLE 19 Other Inorganic Concentrations in Groundwater Monitoring Wells (Continued)

Station	Calcium (µg/L)	Magnesium (µg/L)	Potassium (µg/L)	Sodium (µg/L)	Bicarbonate (mg/L)	Carbonate (mg/L)	Chloride (mg/L)	Cyanide (mg/L)	Phosphate (mg/L)	Sulfate (mg/L)	Nitrate (mg/L)
33-86	Dry										
34-86	388,000	30,000	7,800	170,000	14	400	47	ND	2.2	1,000	<5.0
35-86	170,000	68,000	2,310	182,000	61	720	110	ND	2.6	200	<5.0
36-86	Dry										
37-86	Dry										
38-86	Dry										
39-86	110,000	9,570	1,780	17,300	6	270	36	ND	2.2	74	<5.0
40-86	Dry										
41-86	96,900	15,600	3,720	51,300	15	360	34	ND	12	100	<5.0
42-86	122,000	11,900	1,730	13,400	27	350	50	ND	2.6	21	30.2
43-86	Dry										
44-86	54,500	6,470	3,600	22,000	NR	NR	12	NR	NR	NR	24.8
45-86	26,200	5,900	623	13,400	12	110	6.1	ND	4.7	14	<5.0
46-86	13,900	1,190	7,200	31,400	NA	NA	NA	NA	NA	NA	NA
47-86	15,400	2,230	ND ^a	164,000	5.4	88	2.9	ND	8.7	20	<5.0
48-86	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
49-86	35,200	7,640	ND	29,500	7.0	45	30	ND	4.4	29	14.8
50-86	30,000	5,430	1,490	12,100	130	ND	7.6	ND	2.0	16	37.4
51-86	12,300	1,920	1,070	21,400	ND	42	7.3	ND	4.7	31	
52-86	NA ^b	NA	NA	NA	NA	NA	NA	NA	NA	NA	
53-86	Dry										
54-86	43,300	10,400	6,030	36,800	8.8	257	15	ND	4.7		
55-86	22,800	4,280	4,700	8,770	17	76	7.4	ND	3.3	22	<5.0
56-86	26,300	6,210	1,600	17,800	16	120	15	ND	ND	15	<5.0
57-86	Dry										
58-86	Dry										
59-86	112,000	36,100	41,300	156,000	30	510	92	NR	1.2	190	<5.0
61-86	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
62-86	26,200	3,620	44,500	62,200	ND	200	26	ND	2.8	58	<5.0
63-86	Dry										
64-86	Dry										
65-86	93,100	24,200	1,840	98,300	25	370	70	ND	0.9	220	<5.0
66-86	Dry										
67-86	49,800	23,200	ND	63,400	9.7	345	35	ND	ND	65	<5.0
68-86	28,500	7,380	1,700	56,300	31	210	16	ND	4.7	37	55
69-86	144,000	40,400	54,800	163,000	38	410	130	ND	2.2	320	<5.0
70-86	42,900	8,680	13,700	41,800	ND	340	13	ND	1.2	72	<5.0
WS-1	26,000	8,880	ND	8,000	61	38	4.3	ND	1.8	39	23
WS-2	Dry										

ND = Not Detected.
 NA = Not Available.
 NR = Not Requested.

U.S. Environmental Protection Agency
Region 5, Library (PL-12J)
77 West Jackson Boulevard, 12th Floor
Chicago, IL 60604-3590