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Rocky Flats Plant

**SEPTEMBER 1992**

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# Monthly Environmental Monitoring Report

**ENVIRONMENTAL PROTECTION MANAGEMENT DEPARTMENT**
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# Rocky Flats Plant Environmental Monitoring Report

## September Highlights

Summarized below are highlights from the major data categories presented. Remaining data presented in this report are within the ranges historically measured for their respective parameters and locations.

**Offsite Water Sampling Program** - Because of recent reductions in the Rocky Flats Plant (RFP) Fiscal Year 1993 budget for surface water sampling, the RFP offsite water sampling program will be discontinued effective November 1, 1992. This program has included sampling of four regional reservoirs (Great Western Reservoir, Standley Lake, Boulder Reservoir, and Dillon Reservoir), and nine community tap water locations (Arvada, Boulder, Broomfield, Denver, Golden, Lafayette, Louisville, Thornton, and Westminster). Analytical results for this program historically have been reported in the *Monthly Environmental Monitoring Report.*

Under an Agreement in Principle (AIP) entered into in 1989 by the State of Colorado and the Department of Energy (DOE), sampling and analysis for community water is to be performed by the Colorado Department of Health (CDH) using funds provided by DOE. The decision to discontinue the RFP sampling program does not affect the CDH program.

Since 1989, surface water discharges from RFP have been diverted around Standley Lake and Great Western Reservoir, and there is no discharge directly into a public drinking water supply. Surface water monitoring for RFP will emphasize source control for effluent discharges. RFP will continue to perform sampling and analysis for surface water effluent both prior to and during discharge to ensure continued preservation of surface water quality and compliance with applicable standards for environmental and public health protection. Predischarge samples will continue to be split between RFP and CDH for joint analysis and CDH concurrence prior to discharge.

**RFP Laboratory Status** - In August 1992, the General Laboratory of RFP was shut down because of concerns with the secondary containment for the laboratory's aqueous process waste system. Samples for nonradioactive parameters taken under the RFP Environmental Protection Agency (EPA) National Pollutant Discharge Elimination System (NPDES) permit and normally analyzed in the General Laboratory are being sent to offsite contract laboratories for analyses. Use of offsite laboratories for analyzing these samples will continue until the General Laboratory resumes full operation.

The Radiological Health Laboratory continues limited operations for radionuclide analyses. Work to upgrade secondary containment in the building is still proceeding. The date by which normal laboratory operations may resume remains uncertain. Continued delays in reporting analytical results for environmental monitoring samples are expected.

Total long-lived alpha and beta activity screening performed on air effluent sample filters prior to radiochemical processing and analysis has not been affected by the difficulties with the Radiological Health Laboratory, and is continuing on schedule. Total long-lived alpha and beta activity screening of surface water discharge samples was performed for the month of September by CDH. Predischarge samples were collected, screened, and approved by CDH prior to the actual discharge. Results of this screening for September are within normally expected ranges.

**Exhaust Air Flow Calculations** - EPA regulation 40 CFR 61, Subpart H, governs radionuclide emissions and methods of emission measurement at DOE facilities. Part 61.93(b)(1) of the regulation states that exhaust air flow rates that are used in calculating radionuclide emissions must be obtained using 40 CFR 60, Appendix A, Reference Method 2 (pitot tube transverse). To comply with the regulation, EG&G Rocky Flats, Inc., has installed the necessary duct access ports in qualifying ducts and has performed Reference Method 2 testing. This method of flow rate measurement is more accurate than previously used flow measuring devices. Previously used devices such as vortex shedding flowmeters generally gave higher than actual flow rate readings, which resulted in overestimated radionuclide emissions.

**Ambient Air Sampling Program** - On October 6, 1992, the RFP Radiological Health Laboratory reported to the Air Quality Division that identification numbers for June samples from the Community Radiation (ComRad) Monitoring Program Standley Lake Library location and onsite sampler location S-07 appeared to have been transposed. Both samples were in the same batch and had similar sample numbers (7331 and 7337). The measured plutonium in air activity for the ComRad location is higher than usual and the activity for the S-07 location is lower than usual.

Figure A shows the activity levels reported by the laboratory for these two sampling locations for April, May, June, and July sampling periods. The Air Quality Division reviewed historical ambient air data to investigate the laboratory's conclusion. Figure B shows activity levels at location S-37, a sampling location on Indiana Street midway between sampler locations S-07 and Standley Lake Library. Activity levels for S-37 typically are similar and somewhat higher than levels observed at Standley Lake Library. Activity levels for S-07, which is located adjacent to an area of known soil contamination, typically are at least ten times greater than either S-37 or Standley Lake Library values. Figure C indicates that, for the 3-year period 1990 - 1992, no concentrations from any of the community samplers in the vicinity of Standley Lake were as high as the S-07 values, and Standley Lake values remained significantly lower than S-07 results.

Air Quality Division staff agreed with the laboratory's conclusion that the identification numbers likely were transposed and reported the data as illustrated in Figure D to the data base. Technical representatives for the ComRad program agreed with this conclusion. The June Standley Lake Library and S-07 sample results are reported with annotation regarding the likely identification error. Air Quality Division staff are reviewing procedures for laboratory sample identification and tracking for possible revision to minimize future chances for transposition of sample identification numbers.

It is important to note that plutonium in air concentrations for both the Standley Lake Library location and the onsite S-07 location are well within radiation protection limits for the public established by the EPA and the DOE.

## Sample Activity Report by Month
## As Reported by Laboratory

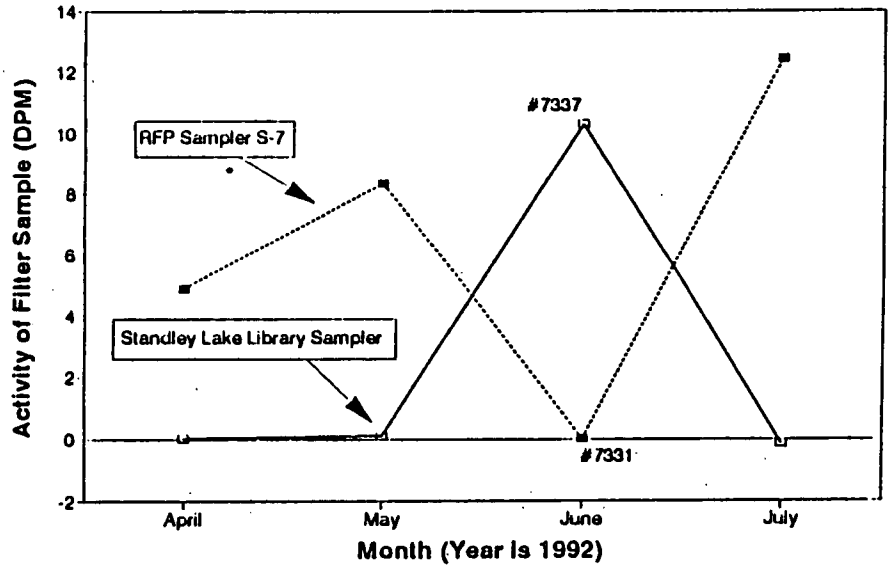



Figure A

## Ambient Concentration - Pu Activity
## Community, Perimeter and Onsite

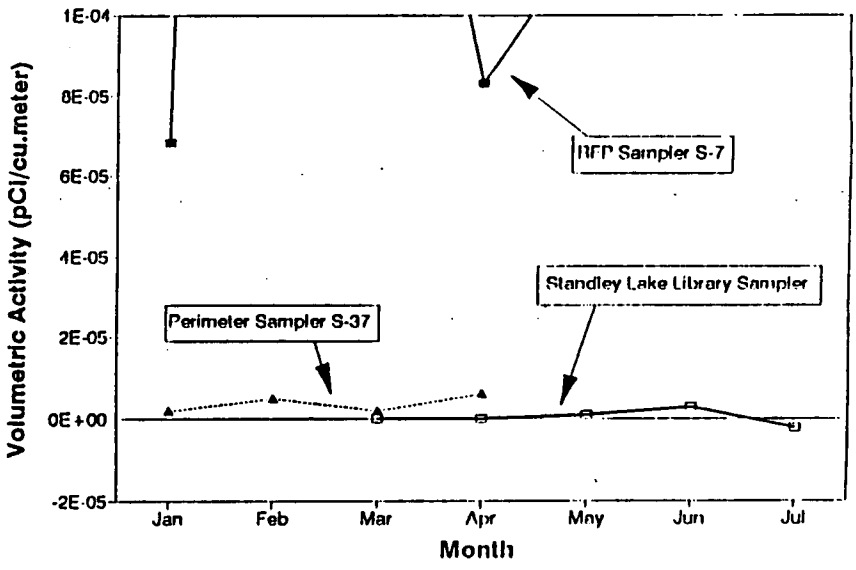



Figure B

## Ambient Concentration - Pu Activity
## Community Samplers: 3-year Overview

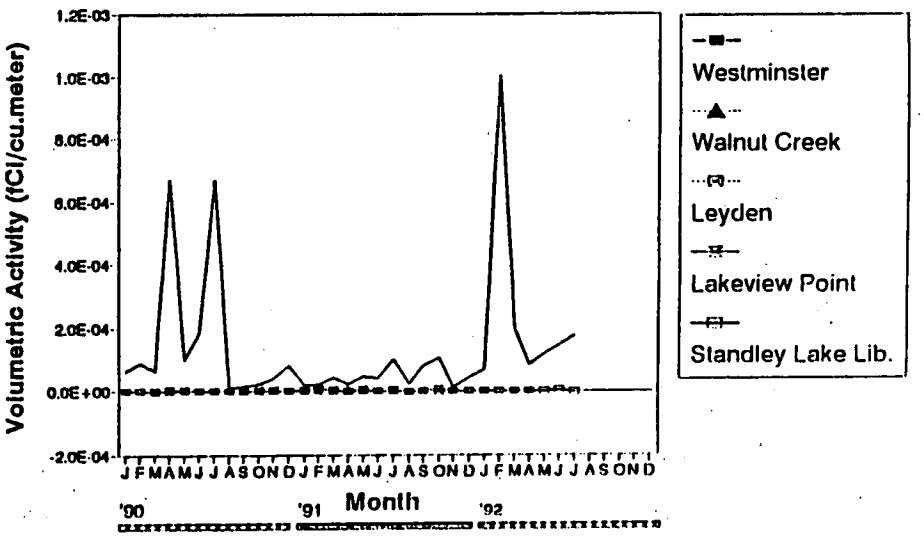



Figure C

## Sample Activity Report by Month
## Data Consistent with Past Observations

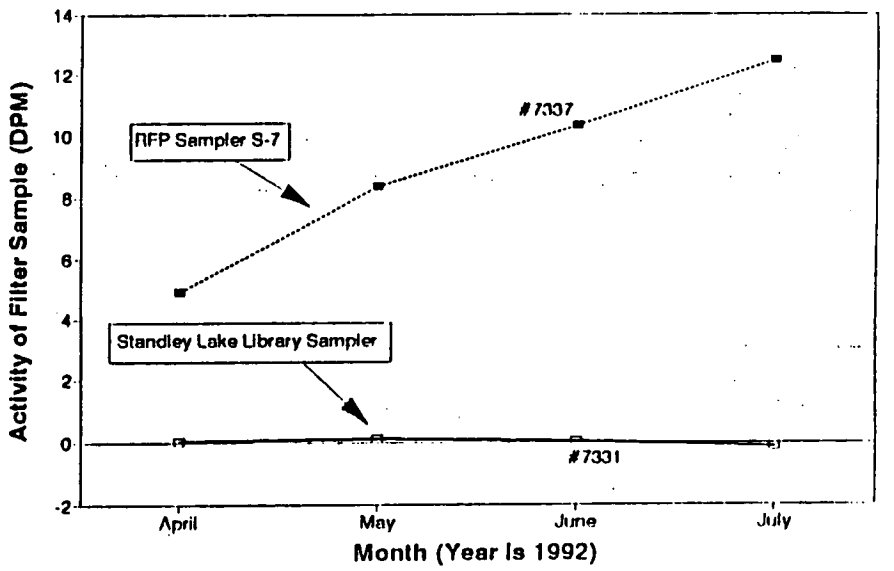



Figure D

# 1. Introduction

The Rocky Flats Plant (RFP) has been part of a nationwide Department of Energy (DOE) complex for the research, development, and production of nuclear weapons. The plant was responsible for fabricating nuclear weapons components from plutonium, uranium, beryllium, and stainless steel. The primary production activities included metal fabrication and assembly, chemical recovery and purification of process-produced transuranic radionuclides, and related quality control functions.

This mission changed with the announcement in early 1992 that certain planned weapons systems had been canceled. RFP no longer produces weapons components, and is now in a transition phase into decontamination and disposition (D&D). Primary objectives of this new mission include achieving and maintaining compliance with environmental regulatory requirements, as well as effecting proper D&D steps that are under development.

Because radioactive and chemically hazardous materials may be used or handled at RFP during transition, the plant maintains an extensive environmental protection program. Included in that program is regular monitoring for radioactive and hazardous constituents at onsite, plant boundary, and offsite locations.

This Monthly Environmental Monitoring Report summarizes the effluent and environmental monitoring programs at the RFP for August 1992. Data presented herein reflect the best information available to the RFP at this time. If subsequent analyses indicate that any data presented herein are inaccurate or misleading, revisions will be issued promptly.

Summarized in the Executive Summary are highlights from the major data categories presented. Remaining data presented in this report are within the ranges historically measured for their respective parameters and locations.

Radiation standards for protection of the public are discussed in Appendix A of this report. The primary standards are based on calculations of radiation dose. These calculations are performed annually using monitoring data presented in the Monthly Environmental Monitoring Report. Radiation doses to the public from RFP operations are typically well below any regulatory limit and far less than are received from naturally occurring radiation sources in the Denver metropolitan area.

Appendix B lists the Volatile Organic Compounds (VOCs) for which monitoring is required under the National Pollutant Discharge Elimination System/Federal Facilities Compliance Agreement (NPDES/FFCA). Appendix C describes Colorado Water Quality Control Commission standards for the Walnut Creek and Woman Creek drainages downstream of RFP.

Error terms in the form of "a±b" are included with some of the data. For a single sample, "a" is the analytical-blank corrected value; for multiple samples it represents the arithmetic mean, the volume-weighted mean, or the annual total, as indicated in the table. The error term "b" accounts for the propagated statistical counting uncertainty of the sample(s) and the associated analytical blanks at the 95 percent confidence level. These error terms represent a minimum estimate of error for the data.

Plutonium, uranium, americium, tritium, and beryllium measured concentrations are given in this report. Most of the measured concentrations are at or very near background levels, and often there is little or no amount of these materials in the media analyzed. When this occurs, the results of the laboratory analyses can be expected to show a statistical distribution of positive and negative numbers near zero and numbers that are less than the calculated minimum detectable concentration for the analyses. The laboratory analytical blanks, used to correct for background contributions to the measurements, show a similar statistical distribution around their average values. Negative sample values result when the measured value for a laboratory analytical blank is subtracted from a sample analytical result smaller than the analytical blank value. Results that are less than calculated minimum detectable levels indicate that the results are below the level of statistical confidence in the actual numerical values. All reported results, including negative values and values that are less than minimum detectable levels, are included in any arithmetic calculations on the data set. Reporting all values allows all of the data to be evaluated using appropriate statistical treatment. This assists in identifying any bias in the analyses, allows better evaluation of distributions and trends in environmental data, and helps in estimating the true sensitivity of the measurement process.

The reader should use caution in interpreting individual values that are negative or less than minimum detectable levels. A negative value has no physical significance. Values less than minimum detectable levels lack statistical confidence as to what the actual number is, although it is known with high confidence that it is below the specified

detection level. Such values should not be interpreted as being the actual amount of material in the sample, but should be seen as reflecting a range (from zero to the minimum detectable level) in which the actual amount would likely lie. These values are significant, however, when taken together with other analytical results that indicate that the distribution is near zero.

The data in this report are provided as a matter of courtesy and should not be construed as an application for a permit or license, or in support of such an application. Approval of the DOE should be obtained before publication of any data contained in this report.

Abbreviations used within this report are as defined.

## Abbreviations

| | |
|---|---|
| C Average | Average concentration |
| C Maximum | Maximum concentration |
| C Minimum | Minimum concentration |
| $m^3$ | Cubic meter |
| m/s | Meters per second |
| mCi | Millicurie |
| mg/l | Milligrams per liter |
| mrem | Millirem |
| pCi/l | Picocuries per liter |
| $pCi/m^3$ | Picocuries per cubic meter |
| pH | Hydrogen ion concentration |
| SU | Standard Unit |
| $\mu g/m^3$ | Micrograms per cubic meter |
| #/100 ml | Number per 100 milliliter |
| µCi | Microcurie |
| µg/l | Micrograms per liter |

# 2. Air

## 2.1 Airborne Effluent

RFP continuously monitors radionuclide air emissions at 53 locations in 17 buildings. The requirements outlined in the General Environmental Protection Programs (DOE Order 5400.1) and the National Emission Standards for Emissions of Radionuclides Other Than Radon From DOE Facilities (40 CFR 61, Subpart H), mandate the continuous monitoring of air emissions at all release points with the potential of discharging radionuclides into the air in quantities that could result in an effective dose equivalent (EDE) greater than 0.1 millirem per year.

The radiological particulate monitoring and sampling program uses a three-tier approach comprising Selective Alpha Air Monitors (SAAMs), total long-lived alpha screening of routine air duct emission sample filters, and radiochemical analysis of isotopes collected from air duct emission samples. This approach balances both sensitivity and timeliness of desired results. Figure 1 shows a typical radiological emission sampler configuration within an exhaust duct at the RFP.

For immediate detection of abnormal conditions, RFP building ventilation systems that service areas containing plutonium are equipped with SAAMs. SAAMs are sensitive to specific alpha particle energies and are set to detect plutonium-239 and -240. These detectors are subjected to daily operational checks, monthly performance testing and calibration for airflow, and an annual radioactive source calibration to maintain sensitivity and reliability. Monitors alarm automatically if out-of-tolerance conditions are experienced.

At regular intervals, particulate material samples from a continuous sampling system are removed from each exhaust system and radiometrically analyzed for long-lived alpha and beta emitters. The concentration of long-lived alpha and beta emitters is indicative of effluent quality and overall performance of the High Efficiency Particulate Air (HEPA) filtration system. If the total long-lived alpha concentration for an effluent sample exceeds the RFP action value of 0.020 x $10^{-12}$ microcuries per milliliter, a follow-up investigation is conducted to determine the cause and to evaluate the need for corrective action. The action value is equal to the most restrictive offsite Derived Concentration Guide (DCG) for plutonium activity in air.

At the end of each month, individual samples from each exhaust system are composited by location. An aliquot of each dissolved composite sample is analyzed for beryllium particulate materials. The remainder of the dissolved sample is subjected to radiochemical separation and alpha spectral analysis that quantifies specific alpha-emitting radionuclides. Analyses for uranium isotopes are conducted for each composite sample.

Forty-one of the ventilation exhaust systems are located in buildings where plutonium processing is conducted. Particulate material samples from these exhaust systems are analyzed for specific isotopes of plutonium and americium. Typically, americium contributes only a small fraction of the total alpha activity release from RFP.

Processes ventilated from several exhaust systems potentially exhibit trace quantities of tritium contamination. Impingers-type samplers are used to collect samples three times each week from the monitored locations. Tritium concentrations in the sample are measured using a liquid scintillation photospectrometer.

Tables 1 through 3 show monitoring results for radioactive and nonradioactive airborne effluents continuously sampled from plant buildings.

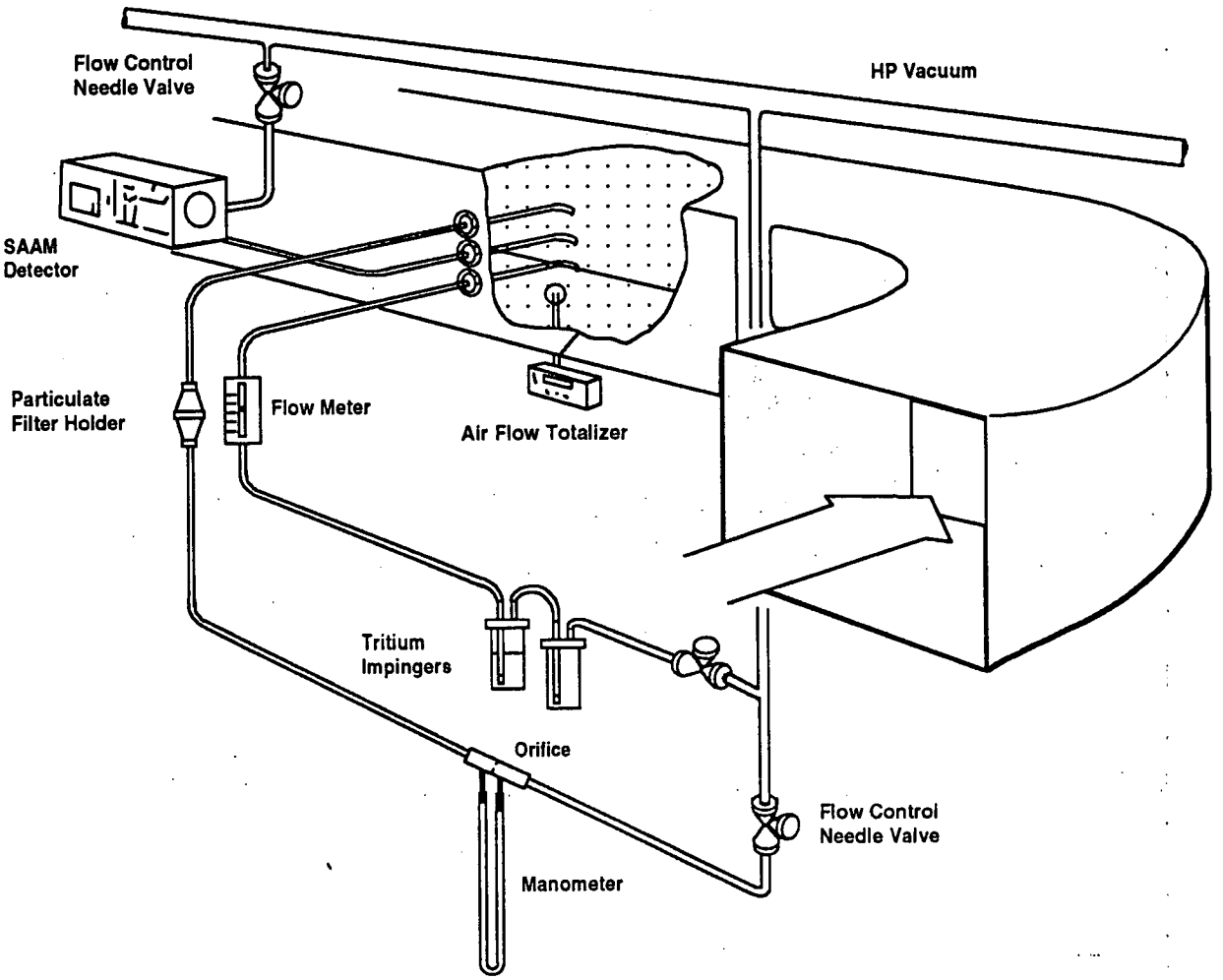



**Figure 1: Radiological Effluent Air Sampling System**

## *Table 1*

## *Plutonium and Americium Airborne Effluent Data*

| Month | Plutonium-239, -240 (08/14/92 - 09/15/92) Release (μCi) | C Maximum (pCi/m³) | Americium-241 (07/14/92 - 08/13/92) Release (μCi) | C Maximum (pCi/m³) |
|---|---|---|---|---|
| **1991** | | | | |
| Year to Date | 0.843 ± 0.167 | 0.0030 ± 0.0006 | 0.1500 ± 0.0680 | 0.0006 ± 0.0001 |
| **1992** | | | | |
| January | 0.031 ± 0.011 | 0.0005 ± 0.0001 | 0.0103 ± 0.0056 | 0.0003 ± 0.0001 |
| February | 0.024 ± 0.007 | 0.0002 ± 0.0000 | 0.0090 ± 0.0061 | 0.0003 ± 0.0001 |
| March | 0.026 ± 0.006[a] | 0.0002 ± 0.0001[a] | 0.024 ± 0.005[b] | 0.0012 ± 0.0002 |
| April | 0.023 ± 0.007[c] | 0.0001 ± 0.0000 | [d] | [d] |
| May | [d] | [d] | [d] | [d] |
| June | [d] | [d] | [d] | [d] |
| July | [d] | [d] | [d] | [d] |
| August | [d] | [d] | [d] | [d] |
| September | [e] | [e] | [e] | [e] |

a Nine locations missing because of incomplete laboratory analysis.
b Six locations missing because of incomplete laboratory analysis.
c Four locations missing because of incomplete laboratory analysis.
d Incomplete data analysis.
e Incomplete laboratory analysis.

## *Table 2*

## *Uranium Airborne Effluent Data*

| Month | Uranium-233, -234 (08/15/92 - 09/15/92) Release (µCi) | Uranium-233, -234 (08/15/92 - 09/15/92) C Maximum (pCi/m³) | Uranium-238 (08/15/92 - 09/15/92) Release (µCi) | Uranium-238 (08/15/92 - 09/15/92) C Maximum (pCi/m³) |
|---|---|---|---|---|
| **1991** | | | | |
| Year to Date | 0.629 ± 0.233 | 0.0001 ± 0.0001 | 1.002 ± 0.235 | 0.0005 ± 0.0002 |
| **1992** | | | | |
| January | -0.1012 ± 0.014 | 0.0001 ± 0.0000 | 0.046 ± 0.016 | 0.0001 ± 0.0001 |
| February | 0.0407 ± 0.019 | 0.0001 ± 0.0000 | 0.115 ± 0.024 | 0.0004 ± 0.0001 |
| March | 0.036 ± 0.013[a] | 0.0001 ± 0.0000 | 0.071 ± 0.013[a] | 0.0007 ± 0.0002 |
| April | 0.039 ± 0.019[b] | 0.0001 ± 0.0000 | 0.065 ± 0.020[b] | 0.0001 ± 0.0000 |
| May | [c] | [c] | [c] | [c] |
| June | [c] | [c] | [c] | [c] |
| July | [c] | [c] | [c] | [c] |
| August | [c] | [c] | [c] | [c] |
| September | [d] | [d] | [d] | [d] |

a Ten locations missing because of incomplete laboratory analysis.
b Twelve locations missing because of incomplete laboratory analysis.
c Incomplete data analysis.
d Incomplete laboratory analysis.

## *Table 3*

## *Tritium and Beryllium Airborne Effluent Data*

| Month | Tritium (H-3) (09/01/92 - 09/30/92) Release (μCi) | C Maximum (pCi/m³) | Beryllium (08/15/92 - 09/15/92) Release (grams) | C Maximum (μg/m³) |
|---|---|---|---|---|
| **1991** | | | | |
| Year to Date | 4.760 | 94 ± 55 | 1.2538 ± 0.083 | 0.00184 |
| **1992** | | | | |
| January | 0.129 | 34 ± 9 | 0.0485 ± 0.011 | 0.00042 |
| February | 0.090 | 28 ± 15 | 0.0496 ± 0.009 | 0.00019 |
| March | 0.115 | 39 ± 7 | [a] | |
| April | 0.041 | 23 ± 5 | [a] | |
| May | 0.075 | 24 ± 7 | [a] | |
| June | 0.085 | 22 ± 5 | [a] | |
| July | 0.042 | 24 ± 6 | [a] | |
| August | | [b] | [b] | |
| September | | [a] | [a] | |

*NOTE: Beryllium measured at the remaining 44 locations was below the screening level of 0.1 gram per month. Beryllium emissions from Rocky Flats Plant are regulated by the State of Colorado under Colorado Air Quality Control Regulation #8. The limit for beryllium air emissions is 10 grams per stationary source in a 24-hour period.*

*The calibration methodology for the beryllium analyses was changed beginning with the September 1990 samples to improve quality assurance. The previous procedure used the single-point, "simple method of additions," one of the methods recommended by the manufacturer of the graphite furnace atomic absorption analytical equipment. The current method is based on EPA Contract Laboratory Program protocol. It uses multi-point calibration curves, periodic validation of the curve with EPA validation standards, and periodic blank and sample checks to assure absence of equipment contamination and matrix effects during the analysis. No blank corrections are made to any beryllium data.*

[a] Incomplete laboratory analysis.
[b] Incomplete data analysis.

## 2.2 Ambient

Ambient air samplers monitor plutonium concentrations in air in the surrounding environment. This monitoring is performed in accordance with DOE Order 5400.1. The data are used to determine the air-inhalation dose to the public for comparison with the DOE standard of 100 millirem per year effective dose equivalent from all modes of exposure from routine plant operations.

Samplers are designated in three categories by their proximity to the main facilities area. Twenty-five onsite samplers are located within RFP, generally downwind of RFP production facilities areas and near areas of known plutonium contamination. Fourteen perimeter samplers border RFP along major highways on the north (Highway 128), east (Indiana Street), south (Highway 72), and west (Highway 93) (Figure 2). Fourteen community samplers are located in metropolitan areas adjacent to RFP (Figure 3).

Samplers operate continuously at a volumetric flow rate of approximately 0.84 cubic meters per minute, collecting air particulates on 20- by 25-centimeter fiberglass filters. Manufacturer's test specifications rate this filter media to be 99.97 percent efficient for relevant particle sizes under conditions typically encountered in routine ambient air sampling.

Ambient air filters are collected biweekly and composited monthly by location before isotopic analysis. All routine ambient air filters are analyzed for plutonium-239 and -240.

Tables 4 through 6 summarize environmental monitoring data from the RFP ambient air sampling network.

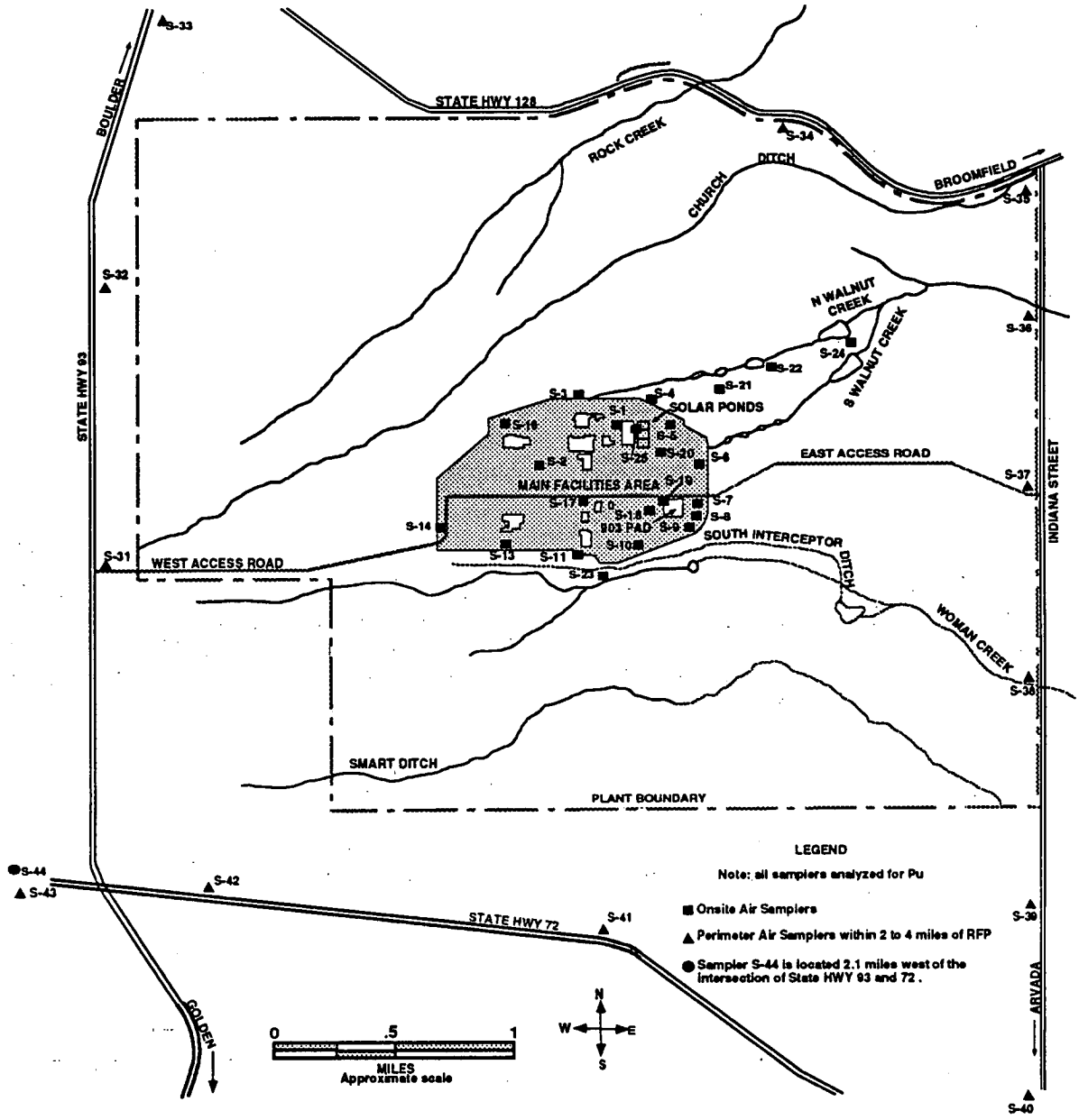



**Figure 2: Location of Onsite and Perimeter Air Samplers**

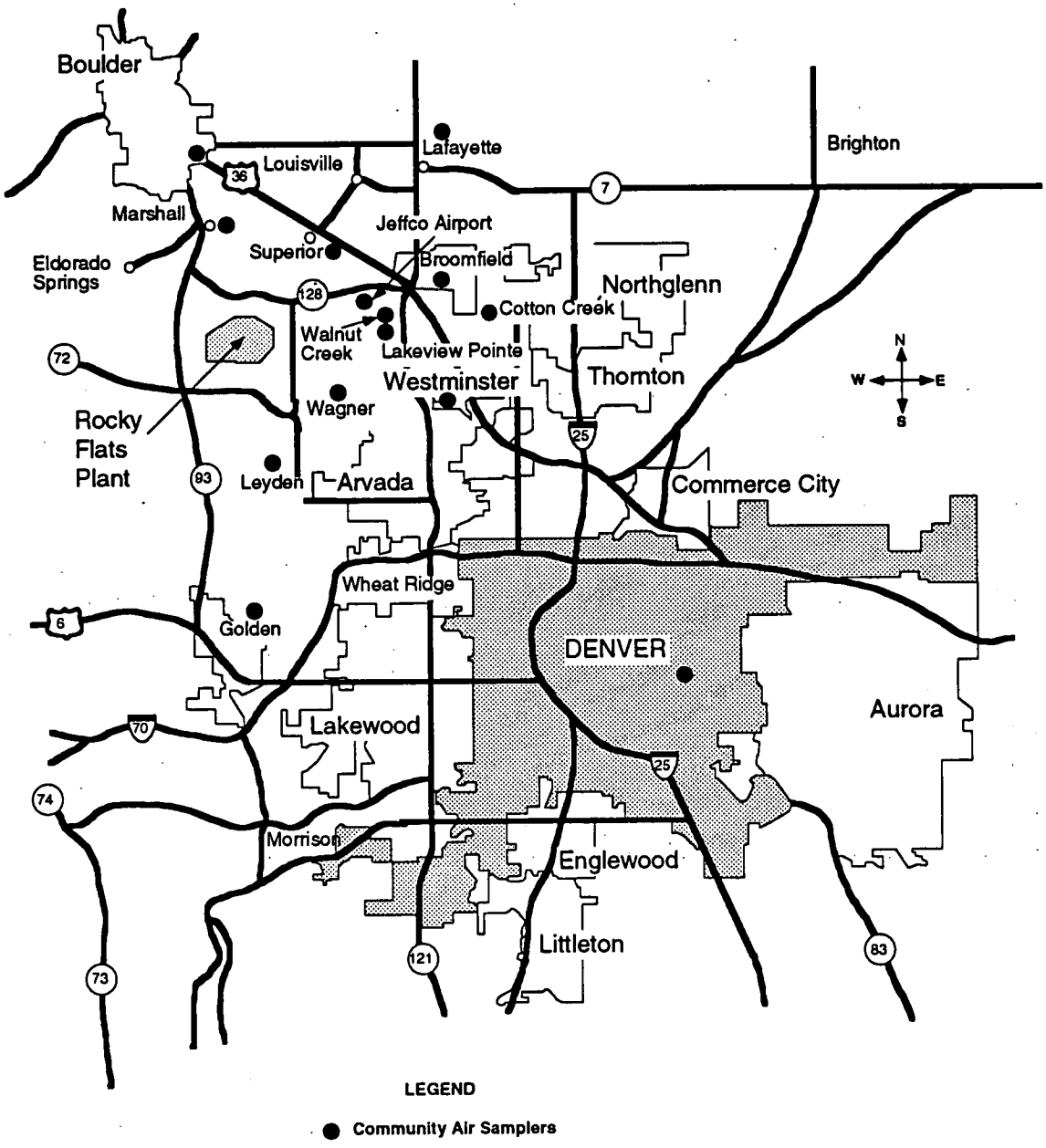



**Figure 3: Location of Community Air Samplers**

## *Table 4*

## *Plutonium Concentrations in Ambient Air for Onsite Samplers*

(08/31/92 - 09/28/92)

| Location | Volume ($m^3$) | Plutonium Concentration ($pCi/m^3$) | ± 95 percent Confidence Interval ($pCi/m^3$) |
|---|---|---|---|
| S-01[a] | | | |
| S-02[a] | | | |
| S-03[a] | | | |
| S-04[a] | | | |
| S-05[a] | | | |
| S-06[a] | | | |
| S-07[a] | | | |
| S-08[a] | | | |
| S-09[a] | | | |
| S-10[a] | | | |
| S-11[a] | | | |
| S-13[a] | | | |
| S-14[a] | | | |
| S-16[a] | | | |
| S-17[a] | | | |
| S-18[a] | | | |
| S-19[a] | | | |
| S-20[a] | | | |
| S-21[a] | | | |
| S-22[a] | | | |
| S-23[a] | | | |
| S-24[a] | | | |
| S-25[a] | | | |
| S-81[a] | | | |

[a] Incomplete laboratory analysis.

## *Table 5*

## *Plutonium Concentrations in Ambient Air for Perimeter Samplers*

(08/25/92 - 09/22/92)

| Location | Volume ($m^3$) | Plutonium Concentration ($pCi/m^3$) | ± 95 percent Confidence Interval ($pCi/m^3$) |
|---|---|---|---|
| S-31[a] | | | |
| S-32[a] | | | |
| S-33[a] | | | |
| S-34[a] | | | |
| S-35[a] | | | |
| S-36[a] | | | |
| S-37[a] | | | |
| S-38[a] | | | |
| S-39[a] | | | |
| S-40[a] | | | |
| S-41[a] | | | |
| S-42[a] | | | |
| S-43[a] | | | |
| S-44[a] | | | |

a Incomplete laboratory analysis.

## *Table 6*

## *Plutonium Concentrations in Ambient Air for Community Samplers*

(08/26/92 - 09/23/92)

| Location | Community Name | Volume ($m^3$) | Plutonium Concentration ($pCi/m^3$) | ± 95 percent Confidence Interval ($pCi/m^3$) |
|---|---|---|---|---|
| S-51[a] | Marshall | | | |
| S-52[a] | Jeffco Airport | | | |
| S-53[a] | Superior | | | |
| S-54[a] | Boulder | | | |
| S-55[b] | Lafayette | | | |
| S-56[a] | Broomfield | | | |
| S-57[b] | Walnut Creek | | | |
| S-58[a] | Wagner | | | |
| S-59[a] | Leyden | | | |
| S-60[a] | Westminster | | | |
| S-61[c] | Denver | | | |
| S-62[a] | Golden | | | |
| S-68[a] | Lakeview Pointe | | | |
| S-73[a] | Cotton Creek | | | |

a Incomplete laboratory analysis.

b This sampler was damaged beyond repair and must be replaced.

c Sampler S-61 located in Denver was inoperative during this period. This sampler has been temporarily removed because of construction activities on the building where it is installed.

# 3. Water

## 3.1 Radionuclide

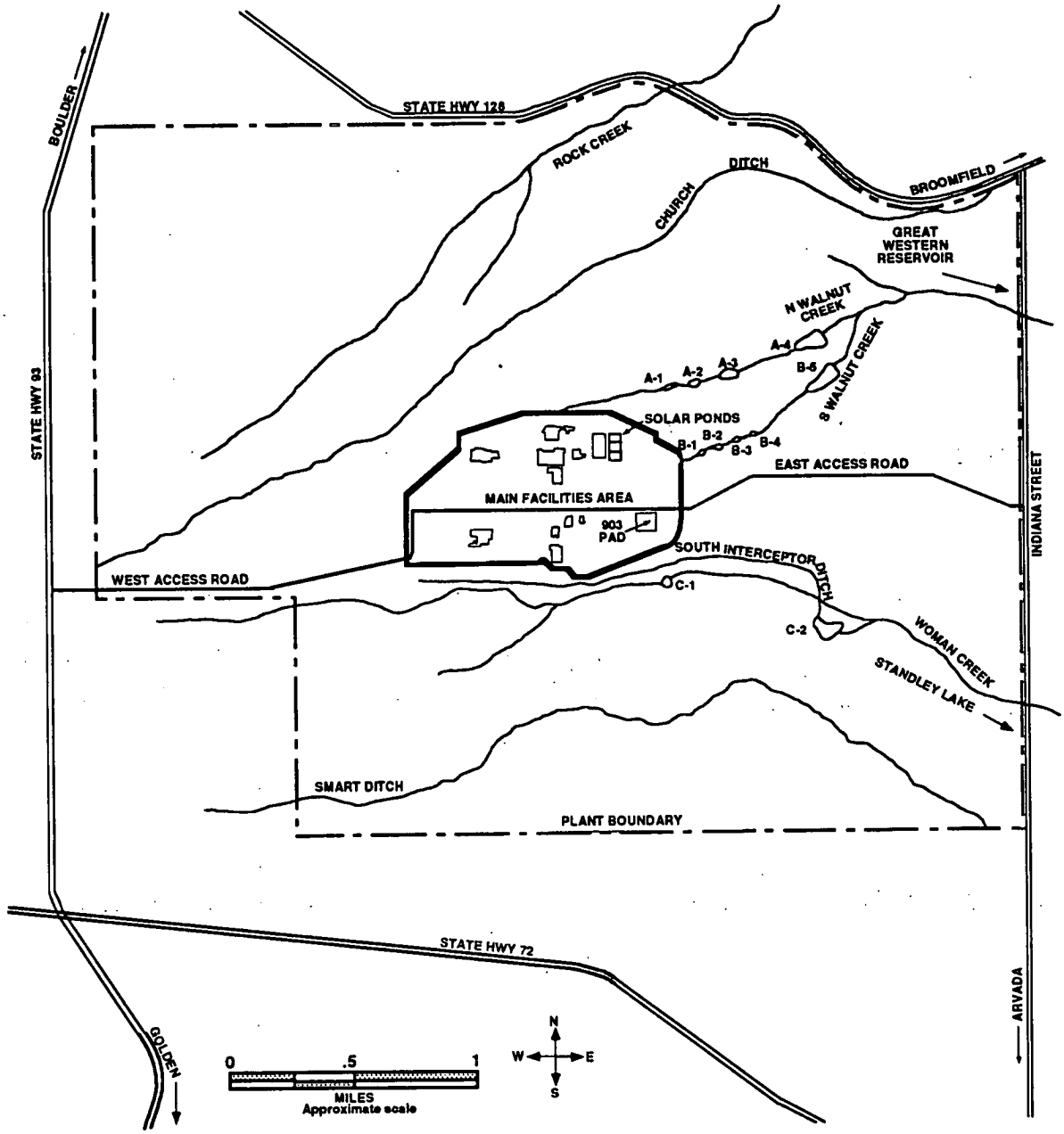
RFP samples for and analyzes radionuclides that may be present in the plant surface water control ponds, drinking water reservoirs, and tap water for neighboring communities. Radionuclide standards for discharge of surface water effluents are given in DOE Order 5400.5, "Radiation Protection of the Public and the Environment." In addition, the Colorado Water Quality Control Commission has issued stream segment standards for drainages downstream of RFP. These standards address both radioactive and nonradioactive parameters.

Onsite water sampling is performed at several locations at RFP. These include ponds A-4, B-5, C-1, and C-2 as well as Walnut Creek at Indiana Street. Daily samples are collected during discharges or periods of flow for these locations, and composited into weekly samples. Analyses are then performed for plutonium, americium, and uranium isotopic concentrations.

Community water monitoring includes sampling and analysis of public water supplies and tap water from several surrounding communities. Great Western Reservoir, one of the water supplies for the city of Broomfield, and Standley Lake Reservoir, a water supply for the cities of Westminster, Thornton, and Northglenn, may receive run-off from RFP drainage systems (Walnut Creek and Woman Creek respectively). However, these drainage systems have been diverted by way of the Broomfield Division Ditch since 1990. The city of Federal Heights purchases a portion of its water supply from the city of Westminster. Weekly samples are collected and composited into monthly samples, and analyses are performed for plutonium, americium, and uranium isotopic concentrations. Tritium analyses are conducted on weekly grab samples.

Drinking water from Boulder, Broomfield, and Westminster is collected weekly, composited monthly, and analyzed for plutonium, americium, and uranium isotopic concentrations. Analyses for tritium are performed weekly. Quarterly tap water samples are collected from the communities of Arvada, Denver, Golden, Lafayette, Louisville, and Thornton. These samples are analyzed for plutonium, uranium, americium, and tritium.

Water sampling results for radioactive constituents are given in Tables 7 through 11.




Note: Stream flow in the Rocky Flats area is to the east.

Figure 4: Holding Pond and Liquid Effluent Water Courses

# *Table 7*

## *Onsite Water Sample Results - Plutonium and Americium*

**Holding Pond Outfall (pCi/l)**

| Location | Plutonium-239, -240 | Americium-241 |
|---|---|---|
| **Pond A-4** | | |
| 09/05/92 - 09/11/92 | [a] | [a] |
| 09/12/92 - 09/18/92 | 0.000 ± 0.001 | 0.002 ± 0.002 |
| 09/19/92 - 09/21/92 | 0.011 ± 0.007 | [a] |
| Volume weighted average concentration | [a] | [a] |
| **Pond B-5** - No discharge | | |
| **Pond C-1** | | |
| 09/05/92 - 09/11/92 | [a] | [a] |
| 09/12/92 - 09/17/92 | [a] | 0.000 ± 0.002 |
| 09/22/92 - 09/25/92 | 0.019 ± 0.010 | [a] |
| 09/27/92 - 10/02/92 | 0.011 ± 0.004 | 0.015 ± 0.004 |
| Average concentration | [a] | [a] |
| **Pond C-2** - No discharge | | |
| **Walnut Creek at Indiana** | | |
| 09/06/92 - 09/11/92 | 0.008 ± 0.004 | [a] |
| 09/12/92 - 09/18/92 | [a] | 0.005 ± 0.002 |
| 09/19/92 - 09/22/92 | 0.014 ± 0.006 | [a] |
| Volume weighted average concentration | [a] | [a] |

[a] Incomplete laboratory analysis.

## *Table 8*

## *Onsite Water Sample Results - Uranium*

| Location | Holding Pond Outfall (pCi/l) Uranium-233, -234 | Uranium-238 |
|---|---|---|
| **Pond A-4** | | |
| 09/05/92 - 09/11/92 | a | a |
| 09/12/92 - 09/18/92 | a | a |
| 09/19/92 - 09/21/92 | 0.39 ± 0.11 | 0.52 ± 0.11 |
| Volume weighted average concentration | a | a |
| **Pond B-5** - No discharge | | |
| **Pond C-1** | | |
| 09/05/92 - 09/11/92 | a | a |
| 09/12/92 - 09/17/92 | a | a |
| 09/22/92 - 09/25/92 | 1.09 ± 0.16 | 1.06 ± 0.15 |
| 09/27/92 - 10/02/92 | 1.05 ± 0.15 | 0.79 ± 0.12 |
| Average concentration | a | a |
| **Pond C-2** - No discharge | | |
| **Walnut Creek at Indiana** | | |
| 09/06/92 - 09/11/92 | 0.49 ± 0.12 | 0.48 ± 0.11 |
| 09/12/92 - 09/18/92 | a | a |
| 09/19/92 - 09/22/92 | 0.37 ± 0.10 | 0.49 ± 0.10 |
| Volume weighted average concentration | a | a |

a Incomplete laboratory analysis.

## *Table 9*

## *Offsite Water Sample Results - Plutonium and Americium*

**Reservoirs (pCi/l)**

| Location | Number of Samples | Plutonium-239, -240[a] | Americium-241[a] |
|---|---|---|---|
| Great Western | 1[a] | b | b |
| Standley Lake | 1[a] | b | b |

**Community Tap Water (pCi/l)[a]**

| | | | |
|---|---|---|---|
| Arvada | 1 | b | b |
| Boulder | 1 | b | b |
| Broomfield | 1[a] | b | b |
| Denver | 1 | b | b |
| Golden | 1 | b | b |
| Lafayette | 1 | b | b |
| Louisville | 1 | b | b |
| Thornton | 1 | b | b |
| Westminster | 1[a] | b | b |

a Plutonium and americium analyses were performed on one sample composited from four weekly grab samples.
b Incomplete laboratory analysis.

## *Table 10*

## *Offsite Water Sample Results - Uranium*

| Location | Number of Samples | Uranium-233, -234[a] | Uranium-238[a] |
|---|---|---|---|
| **Reservoirs (pCi/l)** | | | |
| Great Western | 1[a] | b | b |
| Standley Lake | 1[a] | b | b |
| **Community Tap Water (pCi/l)[a]** | | | |
| Arvada | 1 | b | b |
| Boulder | 1 | b | b |
| Broomfield | 1[a] | b | b |
| Denver | 1 | b | b |
| Golden | 1 | b | b |
| Lafayette | 1 | b | b |
| Louisville | 1 | b | b |
| Thornton | 1 | b | b |
| Westminster | 1[a] | b | b |

a Uranium analyses were performed on one sample composited from four weekly grab samples.
b Incomplete laboratory analysis.

# Table 11

## Onsite and Offsite Water Sample Results - Tritium

| Location | Number of Samples | Tritium (pCi/l) C Minimum[a] | C Maximum[a] | C Average[a] |
|---|---|---|---|---|
| Arvada | 1 | a | a | a |
| Boulder | 1 | a | a | a |
| Broomfield | 4 | a | a | a |
| Denver | 1 | a | a | a |
| Golden | 1 | a | a | a |
| Great Western | 4 | a | a | a |
| Lafayette | 1 | a | a | a |
| Louisville | 1 | a | a | a |
| Pond A-4[b] | 17 | a | a | a |
| Pond C-1 | 4 | a | a | a |
| Standley Lake | 4 | -30 ± 90 | 120 ± 80 | 30 ± 90 |
| Thornton | 1 | a | a | a |
| Westminster | 4 | a | a | a |
| Walnut at Indiana[b] | 17 | a | a | a |

a Incomplete laboratory analysis.
b Volume weighted average concentration.

## 3.2 Nonradionuclide

RFP conducts sitewide surface water sampling programs to monitor discharges from detention ponds, evaluate potential contaminant releases, and characterize baseline water quality. For nonradioactive parameters requirements for this monitoring are derived from the RFP EPA National Pollutant Discharge Elimination System (NPDES) permit as modified in March 1991, by a Federal Facilities Compliance Agreement (FFCA). The NPDES/FFCA permit sets limits for nonradioactive pollutants in effluent water from federal facilities.

The EPA has issued to the RFP an NPDES permit for control of surface water discharges. The RFP NPDES permit establishes effluent limitations for seven surface water discharge points, which may discharge into drainages leading off of the RFP.

Nitrate monitoring for Great Western Reservoir and Standley Lake, the two drinking water reservoirs that may receive surface water discharges from the plant, are summarized in Table 12. Surface water discharges from RFP are currently being diverted around these drinking water reservoirs.

Water sampling results associated with the NPDES/FFCA permit are reported in Table 13. Applicable NPDES/FFCA limits are included in Table 13 for comparison. Monitoring results for which no limits have been established under the NPDES/FFCA are reported in Table 14. Analytical results for nonradioactive parameters in water at Walnut Creek at the Indiana Street location are summarized in Table 15.

## *Table 12*

## *Offsite Water Sample Results - Nitrate as Nitrogen*

**Nitrate (as N) at Great Western Reservoir**

| Sample Date | Nitrate (as N) (mg/l) |
|---|---|
| 09/03/92 | a |
| 09/10/92 | a |
| 09/17/92 | a |
| 09/24/92 | a |

**Nitrate (as N) at Standley Lake**

| | |
|---|---|
| 09/03/92 | a |
| 09/10/92 | a |
| 09/17/92 | a |
| 09/24/92 | a |

a Incomplete laboratory analysis.

**Note:** For some nonradioactive parameters, the concentrations that are measured at or below the Minimum Detectable Concentration (MDC) are assigned to MDC. The less than symbol (<) indicates MDC values and calculated values that include one or more MDCs.

# Table 13

## NPDES/FFCA Permit Water Sample Results

***Discharge 001-A (Pond B-3)*** Discharged continuously from 09/01/92 - 09/30/92.

| Parameters | | Measured 30-Day Average | Limit 30-Day Average | Measured Max. 7-Day Average | Limit Max. 7-Day Average |
|---|---|---|---|---|---|
| Nitrate | mg/l | 3 | 10 | 4 | 20 |

| | | Measured Maximum | Limit Maximum |
|---|---|---|---|
| Total Residual Chlorine | mg/l | 0.22 | 0.5 |

***Discharge 001-B (Sewage Treatment Plant)*** Discharged continuously from 09/01/92 - 09/30/92.

| Parameters | | Measured 30-Day Average | Limit 30-Day Average | Measured Maximum | Limit Maximum |
|---|---|---|---|---|---|
| $CBOD_5$ | mg/l | 2 | 10 | 2 | 25 |
| Total Phosphorus | mg/l | 0.09 | 8 | 0.35 | 12 |
| Total Chromium | mg/l | 0.003 | 0.05 | 0.004 | 0.10 |

| | | Measured 30-Day Average | Limit 30-Day Average | Measured Max. 7-Day Average | Limit Max. 7-Day Average |
|---|---|---|---|---|---|
| Fecal Coliforms | #/100 ml | 1 (Geometric) | 200 (Geometric) | 1 (Geometric) | 400 (Geometric) |
| Total Suspended Solids | mg/l | 7 | 30 | 9 | 45 |

| | | Measured Minimum | Limit Minimum | Measured Maximum | Limit Maximum |
|---|---|---|---|---|---|
| pH | SU | 6.7 | 6.0 | 7.4 | 9.0 |

| | Observed Sheen | Limit Sheen |
|---|---|---|
| Oil and Grease | No visual | No visual |

***Discharge 002 (Pond A-3)*** Discharged continuously from 09/22/92 - 09/28/92.

| Parameters | | Measured 30-Day Average | Limit 30-Day Average | Measured Maximum | Limit Maximum |
|---|---|---|---|---|---|
| Nitrates as N | mg/l | 0.2 | 10 | 0.9 | 20 |

| | | Measured Minimum | Limit Minimum | Measured Maximum | Limit Maximum |
|---|---|---|---|---|---|
| pH | SU | 7.4 | 6.0 | 8.3 | 9.0 |

## Table 13

## NPDES/FFCA Permit Water Sample Results (Continued)

***Discharge 003 (RO Pilot Plant) and Discharge 004 (RO Plant) are inactive outfalls and will be eliminated from the new NPDES permit.***

***Discharge 005 (Pond A-4)*** Discharged continuously from 09/05/92 - 09/21/92.

| Parameters | | Measured Maximum | Limit Maximum |
|---|---|---|---|
| Total Chromium | mg/l | <0.003 | 0.05 |

***Discharge 006 (Pond B-5)*** No discharge.

| Parameters | | Measured 30-Day Average | Limit 30-Day Average | Measured Max. 7-Day Maximum | Limit Max. 7-Day Maximum |
|---|---|---|---|---|---|
| Nitrate as N[a] | mg/l | | 10 | | 20 |

| | | Measured Maximum | Limit Maximum |
|---|---|---|---|
| Total Residual Chlorine[a] | mg/l | | 0.5 |
| Total Chromium | mg/l | | 0.05 |

***Discharge 007 (Pond C-2)*** No discharge.

| Parameters | | Measured Maximum | Limit Maximum |
|---|---|---|---|
| Total Chromium | mg/l | | 0.05 |

a. These parameters are measured only in the event that Waste Water Treatment Plant effluent bypasses Pond B-3 and flows directly into Pond B-5.

# Table 14

## NPDES/FFCA Effluent Monitoring

***Discharge 001-A (Pond B-3)*** Discharged continuously from 09/01/92 - 09/30/92.

| Parameters | | Measured Maximum | Measured 30-Day Average |
|---|---|---|---|
| BOD5 | mg/l | 5 | 3 |
| CBOD5 | mg/l | 2 | 2 |
| Total Suspended Solids | mg/l | 14 | 7 |

***Discharge 001-B (Sewage Treatment Plant [STP])*** Discharged continuously from 09/01/92 - 09/30/92.

| Parameters | | Measured Maximum | Measured 30-Day Average |
|---|---|---|---|
| Nitrate as N | mg/l | 6.9 | 4.01 |
| Total Residual Chlorine | mg/l | 0.13 | 0.02 |

Whole Effluent Toxicity[a]

| | | |
|---|---|---|
| Ceriodaphnia | % Eff to $LC_{50}$: | 83.9 |
| Fathead Minnows | % Eff to $LC_{50}$: | >100 |

| Metals | | Measured 30-Day Average |
|---|---|---|
| Antimony | µg/l | <22 |
| Arsenic | µg/l | <0.75 |
| Beryllium | µg/l | <0.6 |
| Cadmium | µg/l | <3.1 |
| Copper | µg/l | <5.9 |
| Iron | µg/l | 112 |
| Lead | µg/l | <1.3 |
| Manganese | µg/l | 41 |
| Mercury | µg/l | <0.2 |
| Nickel | µg/l | <9.9 |
| Silver | µg/l | <2.3 |
| Zinc | µg/l | 40 |

Metals were sampled on 09/02/92 and 09/09/92.

| | | PQL[b] | Concentrations above PQL | |
|---|---|---|---|---|
| Volatile Organic Compounds (VOCs) | | | | |
| Chloroform | µg/l | 5 | 6 | sampled 09/02/92 |
| Chloroform | µg/l | 5 | 5 | sampled 09/16/92 |

# *Table 14*

## *NPDES/FFCA Effluent Monitoring (Continued)*

***Discharge 003 (Reverse Osmosis Pilot Plant) and Discharge 004 (Reverse Osmosis Plant) are inactive outfalls and will be eliminated from the new NPDES permit.***

***Discharge 005 (Pond A-4)*** Discharged 09/05/92 - 09/21/92.

Whole Effluent Toxicity[a]

| | | |
|---|---|---|
| Ceriodaphnia | % Eff to $LC_{50}$: | >100 |
| Fathead Minnows | % Eff to $LC_{50}$: | >100 |

***Discharge 006 (Pond B-5)*** No discharge.

Whole Effluent Toxicity[a]

| | |
|---|---|
| Ceriodaphnia | % Eff to $LC_{50}$: |
| Fathead Minnows | % Eff to $LC_{50}$: |

***Discharge 007 (Pond C-2)*** No discharge.

Whole Effluent Toxicity[a]

| | |
|---|---|
| Ceriodaphnia | % Eff to $LC_{50}$: |
| Fathead Minnows | % Eff to $LC_{50}$: |

a Results for whole effluent toxicity are given in percentage of effluent sample that will cause mortality to half the test result organisms within the time frame of the test. For example, >100 percent indicates that 100 percent pure effluent did not cause acute toxicity to at least half of the organisms. A lower percentage $LC_{50}$ (lethal concentration to 50 percent of test organisms) indicates a greater toxic effect since less of the sample is required to observe a sufficiently extensive adverse effect.

b PQL is the Practical Quantitation Limit. It is equal to ten times the Method Detection Limit and represents the quantity at which 70 percent of laboratories can report in the 95 percent confidence interval.

## *Table 15*

## *Water Sample Results, Nonradioactive Parameters*

**Walnut Creek at Indiana Street**

| Parameters | | Number of Samples | C Minimum | C Maximum | C Average |
|---|---|---|---|---|---|
| pH | SU | 17 | 6.9 | 9.3 | N/A |
| Nitrates as N | mg/l | 17 | 1.3 | 1.9 | 1.6 |

Flow was measured and sampled from 09/06/92 - 09/22/92. This flow is representative of Pond A-4 discharge.

## 3.3 Flow

Daily flow data for surface water from the two plant drainage systems (Walnut Creek and Woman Creek) are given in Tables 16 and 17. The current NPDES/FFCA permit requires flow measurement for terminal ponds when discharged offsite (A-4, B-5, and C-2). Other flow data are reported for informational purposes.

Daily flow data for water transferred from Pond B-5 to Pond A-4, for subsequent discharge offsite, are given in Table 18. Meteorological data are given in Tables 19 and 20.

## Table 16

## Daily Flow Data Recorded at the Walnut Creek at Indiana Gaging Station, Ponds A-4 and B-5

| Date | Walnut Creek at Indiana (Gallons) | Pond A-4 (Gallons) | Pond B-5 (Gallons) |
|---|---|---|---|
| 09/01/92 | No flow | No discharge | No discharge |
| 09/02/92 | | | |
| 09/03/92 | | | |
| 09/04/92 | | No discharge | |
| 09/05/92 | No flow | 1,139,000 | |
| 09/06/92 | 1,264,000 | 1,569,000 | |
| 09/07/92 | 1,324,000 | 1,686,000 | |
| 09/08/92 | 1,431,000 | 1,621,000 | |
| 09/09/92 | 1,421,000 | 1,613,000 | |
| 09/10/92 | 1,399,000 | 1,586,000 | |
| 09/11/92 | 1,692,000 | 2,138,000 | |
| 09/12/92 | 2,147,000 | 2,362,000 | |
| 09/13/92 | 2,184,000 | 2,161,000 | |
| 09/14/92 | 1,802,000 | 1,761,000 | |
| 09/15/92 | 1,584,000 | 1,665,000 | |
| 09/16/92 | 1,426,000 | 1,443,000 | |
| 09/17/92 | 1,395,000 | 1,413,000 | |
| 09/18/92 | 1,408,000 | 1,397,000 | |
| 09/19/92 | 1,378,000 | 1,400,000 | |
| 09/20/92 | 1,444,000 | 1,471,000 | |
| 09/21/92 | 1,417,000 | 1,401,000 | |
| 09/22/92 | 798,000 | No discharge | |
| 09/23/92 | No flow | | |
| 09/24/92 | | | |
| 09/25/92 | | | |
| 09/26/92 | | | |
| 09/27/92 | | | |
| 09/28/92 | | | |
| 09/29/92 | | | |
| 09/30/92 | No flow | No discharge | No discharge |
| Total | 25,514,000 | 27,828,000 | No discharge |

[a] Flow measurement is representative of precipitation.

## *Table 17*

## *Daily Flow Data Recorded at Ponds C-1 and C-2 (Woman Creek)*

| Date | Pond C-1 (Gallons) | Pond C-2 (Gallons) |
|---|---|---|
| 09/01/92 | Low flow | No discharge |
| 09/02/92 | | |
| 09/03/92 | | |
| 09/04/92 | | |
| 09/05/92 | | |
| 09/06/92 | | |
| 09/07/92 | | |
| 09/08/92 | | |
| 09/09/92 | | |
| 09/10/92 | | |
| 09/11/92 | | |
| 09/12/92 | | |
| 09/13/92 | | |
| 09/14/92 | | |
| 09/15/92 | | |
| 09/16/92 | | |
| 09/17/92 | | |
| 09/18/92 | | |
| 09/19/92 | | |
| 09/20/92 | | |
| 09/21/92 | | |
| 09/22/92 | | |
| 09/23/92 | | |
| 09/24/92 | | |
| 09/25/92 | | |
| 09/26/92 | | |
| 09/27/92 | | |
| 09/28/92 | | |
| 09/29/92 | | |
| 09/30/92 | Low flow | No discharge |
| Total | Low flow[a] | No discharge |

[a] Intermittant low flow was observed at Pond C-1 during September 1992. Flow was too low to accurately quantify. Samples were collected from 09/05/92 - 09/17/92, 09/22/92 - 09/25/92, and 09/27/92 - 09/30/92. Corresponding data reported in Tables 7, 8, and 11 of this report.

## *Table 18*

## *Daily Transfer Flow Data Recorded for Pond B-5 to Pond A-4*

| Date | Pond B-5 to Pond A-4 (Gallons) |
|---|---|
| 09/01/92 | No transfer |
| 09/02/92 | |
| 09/03/92 | |
| 09/04/92 | No transfer |
| 09/05/92 | 638,000 |
| 09/06/92 | 695,000 |
| 09/07/92 | 1,295,000 |
| 09/08/92 | 1,192,000 |
| 09/09/92 | 1,158,000 |
| 09/10/92 | 1,174,000 |
| 09/11/92 | 1,140,000 |
| 09/12/92 | 965,000 |
| 09/13/92 | 962,000 |
| 09/14/92 | 922,000 |
| 09/15/92 | No transfer |
| 09/16/92 | |
| 09/17/92 | |
| 09/18/92 | |
| 09/19/92 | |
| 09/20/92 | |
| 09/21/92 | No transfer |
| 09/22/92 | 995,000 |
| 09/23/92 | 948,000 |
| 09/24/92 | 809,000 |
| 09/25/92 | 229,000 |
| 09/26/92 | 131,000 |
| 09/27/92 | 450,000 |
| 09/28/92 | 264,000 |
| 09/29/92 | No transfer |
| 09/30/92 | No transfer |
| Total | 14,237,000 |

# 4. Meteorology and Climatology

Meteorological data are routinely collected on the plantsite from instrumentation installed on a 61-meter (200-foot) tower located in the west buffer zone. Meteorological data recovery was nearly 100 percent for September. Table 19 is the September 1992 summary of the percent frequency of wind directions (16 compass points) divided into four wind-speed categories. The compass point designations indicate the true bearing when facing against the wind. These frequency values are represented graphically in the accompanying wind rose. The wind rose vectors also represent the bearing against the wind (i.e., wind along each vector blows toward the center).

Winds at RFP generally occur from the west through north-west, especially when speeds are greater than 3 m/s (6.7 mph). At lighter wind speeds less than 3 m/s (6.7 mph), the distribution of wind direction is more even. Wind speeds greater than 7 m/s (15.7 mph) from the east-southeast through south occur infrequently. The distribution of winds during September shows more frequent southeasterly winds, probably indicating thermally driven, daytime winds flowing up the South Platte River Basin and the Rocky Flats slope. Up-valley and up-slope winds are especially common during summer months when solar heating is strong.

September was warmer than normal with no recorded precipitation. Unlike the previous months, September experienced infrequent and relatively weak outbreaks of Canadian air masses. The storm track remained far to the north near the Canadian border during the month resulting in mild and dry weather. The high temperature reached 27 degrees centigrade (27 °C) (80 degrees Fahrenheit [80 °F]) or greater on 6 separate days, with the maximum of 29 °C (84 °F) occurring on September 12. Overnight lows were also mild, with the lowest temperature of 3 °C (37 °F) occurring on September 18.

The mean wind speed during September was 4.0 m/s (9.0 mph). The peak gust during the month was 25 m/s (56 mph), which occurred on September 5. The mean temperature recorded for September was 17.1 °C (62.8 °F), or about 0.8 centigrade degrees (1.5 Fahrenheit degrees) below normal.

No precipitation was recorded during September. The month became the second September (also 1956) with no measurable precipitation since RFP records begin in 1953. The normal September precipitation is about 3.18 cm (1.25 in.). Annual precipitation has now fallen to nearly 3.8 cm (1.5 in.) below normal, equalling 31.0 cm (12.21 in.).

## *Table 19*

## *Rocky Flats Plant Wind Direction Frequency (Percent) by Four Wind-Speed Classes*

**(Fifteen-Minute Averages - September 1992)**

| | Calm | 1-3 (m/s) | 3-7 (m/s) | 7-15 (m/s) | >15 (m/s) | Total |
|---|---|---|---|---|---|---|
| N | - | 1.67 | 1.49 | 0.31 | 0.00 | 3.47 |
| NNE | - | 1.08 | 0.80 | 0.10 | 0.00 | 1.98 |
| NE | - | 1.49 | 0.90 | 0.00 | 0.00 | 2.39 |
| ENE | - | 1.25 | 0.56 | 0.00 | 0.00 | 1.81 |
| E | - | 2.40 | 0.59 | 0.00 | 0.00 | 2.99 |
| ESE | - | 3.75 | 1.91 | 0.00 | 0.00 | 5.66 |
| SE | - | 4.20 | 4.48 | 0.14 | 0.00 | 8.82 |
| SSE | - | 2.64 | 4.13 | 0.17 | 0.00 | 6.94 |
| S | - | 2.78 | 1.81 | 0.00 | 0.00 | 4.59 |
| SSW | - | 2.40 | 2.08 | 0.03 | 0.00 | 4.48 |
| SW | - | 2.01 | 3.54 | 0.14 | 0.00 | 5.69 |
| WSW | - | 2.60 | 7.36 | 0.80 | 0.00 | 10.76 |
| W | - | 3.61 | 5.73 | 3.02 | 0.00 | 12.36 |
| WNW | - | 2.95 | 5.28 | 5.80 | 0.07 | 14.10 |
| NW | - | 2.92 | 3.68 | 0.87 | 0.00 | 7.47 |
| NNW | - | 1.35 | 3.61 | 0.03 | 0.00 | 5.00 |
| TOTAL | 1.49 | 39.10 | 47.95 | 11.41 | 0.07 | 100.00 |

# Table 20

## Climatic Summary

| | TEMPERATURE AND DEWPOINT | | | | WIND SPEED | | PRECIPITATION | | PRESSURE | SOLAR |
|---|---|---|---|---|---|---|---|---|---|---|
| Date | High (°F) | Low | Mean | Dew-point | Mean (mph) | Maximum (1 sec) | Total Inches | Maximum (15 min) | Actual Mean (Millibars) | Total |
| 9/01/92 | 68.4 | 50.0 | 59.2 | 34.9 | 12.5 | 37.4 | 0.00 | 0.00 | 813 | -999 |
| 9/02/92 | 73.9 | 57.6 | 65.8 | 33.4 | 9.6 | 32.0 | 0.00 | 0.00 | 816 | -999 |
| 9/03/92 | 77.4 | 55.9 | 66.7 | 35.8 | 6.9 | 20.6 | 0.00 | 0.00 | 817 | -999 |
| 9/04/92 | 78.8 | 56.5 | 67.7 | 36.9 | 10.7 | 44.5 | 0.00 | 0.00 | 811 | -999 |
| 9/05/92 | 71.2 | 51.8 | 61.5 | 31.8 | 10.1 | 56.4 | 0.00 | 0.00 | 814 | -999 |
| 9/06/92 | 74.3 | 52.0 | 63.2 | 31.3 | 7.4 | 20.8 | 0.00 | 0.00 | 815 | -999 |
| 9/07/92 | 65.8 | 46.8 | 56.3 | 34.2 | 8.7 | 25.3 | 0.00 | 0.00 | 817 | -999 |
| 9/08/92 | 81.5 | 40.6 | 61.1 | 31.3 | 8.5 | 33.8 | 0.00 | 0.00 | 813 | -999 |
| 9/09/92 | 70.2 | 47.5 | 58.9 | 31.5 | 6.9 | 22.6 | 0.00 | 0.00 | 815 | -999 |
| 9/10/92 | 68.9 | 43.2 | 56.1 | 34.3 | 7.2 | 19.5 | 0.00 | 0.00 | 819 | -999 |
| 9/11/92 | 83.1 | 54.5 | 68.8 | 32.4 | 6.3 | 20.6 | 0.00 | 0.00 | 816 | -999 |
| 9/12/92 | 84.2 | 63.1 | 73.7 | 34.3 | 12.8 | 47.9 | 0.00 | 0.00 | 813 | 4.80 |
| 9/13/92 | 78.6 | 57.4 | 68.0 | 36.7 | 7.8 | 37.6 | 0.00 | 0.00 | 812 | 5.18 |
| 9/14/92 | 78.8 | 53.1 | 66.0 | 39.0 | 7.8 | 25.3 | 0.00 | 0.00 | 814 | 5.29 |
| 9/15/92 | 79.9 | 61.0 | 70.5 | 39.9 | 9.4 | 38.3 | 0.00 | 0.00 | 813 | 4.95 |
| 9/16/92 | 78.8 | 62.4 | 70.6 | 36.9 | 12.8 | 42.7 | 0.00 | 0.00 | 816 | 4.78 |
| 9/17/92 | 80.6 | 40.3 | 60.5 | 35.8 | 13.9 | 46.3 | 0.00 | 0.00 | 814 | 5.05 |
| 9/18/92 | 61.7 | 36.9 | 49.3 | 29.1 | 4.9 | 17.4 | 0.00 | 0.00 | 816 | 4.98 |
| 9/19/92 | 69.3 | 51.8 | 60.6 | 35.2 | 7.6 | 26.4 | 0.00 | 0.00 | 811 | 2.31 |
| 9/20/92 | 74.1 | 57.7 | 65.9 | 32.9 | 13.2 | 36.7 | 0.00 | 0.00 | 808 | 5.30 |
| 9/21/92 | 65.7 | 49.1 | 57.4 | 32.7 | 7.8 | 37.4 | 0.00 | 0.00 | 816 | 4.51 |
| 9/22/92 | 75.7 | 48.9 | 62.3 | 31.6 | 7.2 | 21.7 | 0.00 | 0.00 | 819 | 5.71 |
| 9/23/92 | 81.7 | 60.3 | 71.0 | 34.5 | 6.5 | 18.6 | 0.00 | 0.00 | 816 | 5.56 |
| 9/24/92 | 80.4 | 62.4 | 71.4 | 32.5 | 8.3 | 23.3 | 0.00 | 0.00 | 810 | 4.42 |
| 9/25/92 | 72.1 | 45.3 | 58.7 | 24.8 | 16.3 | 45.0 | 0.00 | 0.00 | 809 | 5.25 |
| 9/26/92 | 64.8 | 41.9 | 53.4 | 21.7 | 9.2 | 32.0 | 0.00 | 0.00 | 817 | 5.50 |
| 9/27/92 | 73.6 | 45.0 | 59.3 | 23.9 | 11.2 | 38.5 | 0.00 | 0.00 | 818 | 5.39 |
| 9/28/92 | 66.6 | 37.4 | 52.0 | 27.0 | 5.8 | 11.0 | 0.00 | 0.00 | 823 | 5.30 |
| 9/29/92 | 75.4 | 51.1 | 63.3 | 25.9 | 6.0 | 14.8 | 0.00 | 0.00 | 822 | 5.21 |
| 9/30/92 | 76.5 | 56.3 | 66.4 | 23.9 | 5.8 | 14.5 | 0.00 | 0.00 | 822 | 5.22 |

| | MONTHLY TEMPERATURES | | | | WIND SPEED | | PRECIPITATION | | PRESSURE | |
|---|---|---|---|---|---|---|---|---|---|---|
| Mean High (°F) | Mean Low | Mean | Mean Dew-point | Mean Monthly (mph) | Maximum | Monthly Total | Monthly Maximum | Monthly Average | Total |
| 74.4 | 51.3 | 62.8 | 32.2 | 9.0 | 56.4 | 0.00 | 0.00 | 815.2 | -999 |

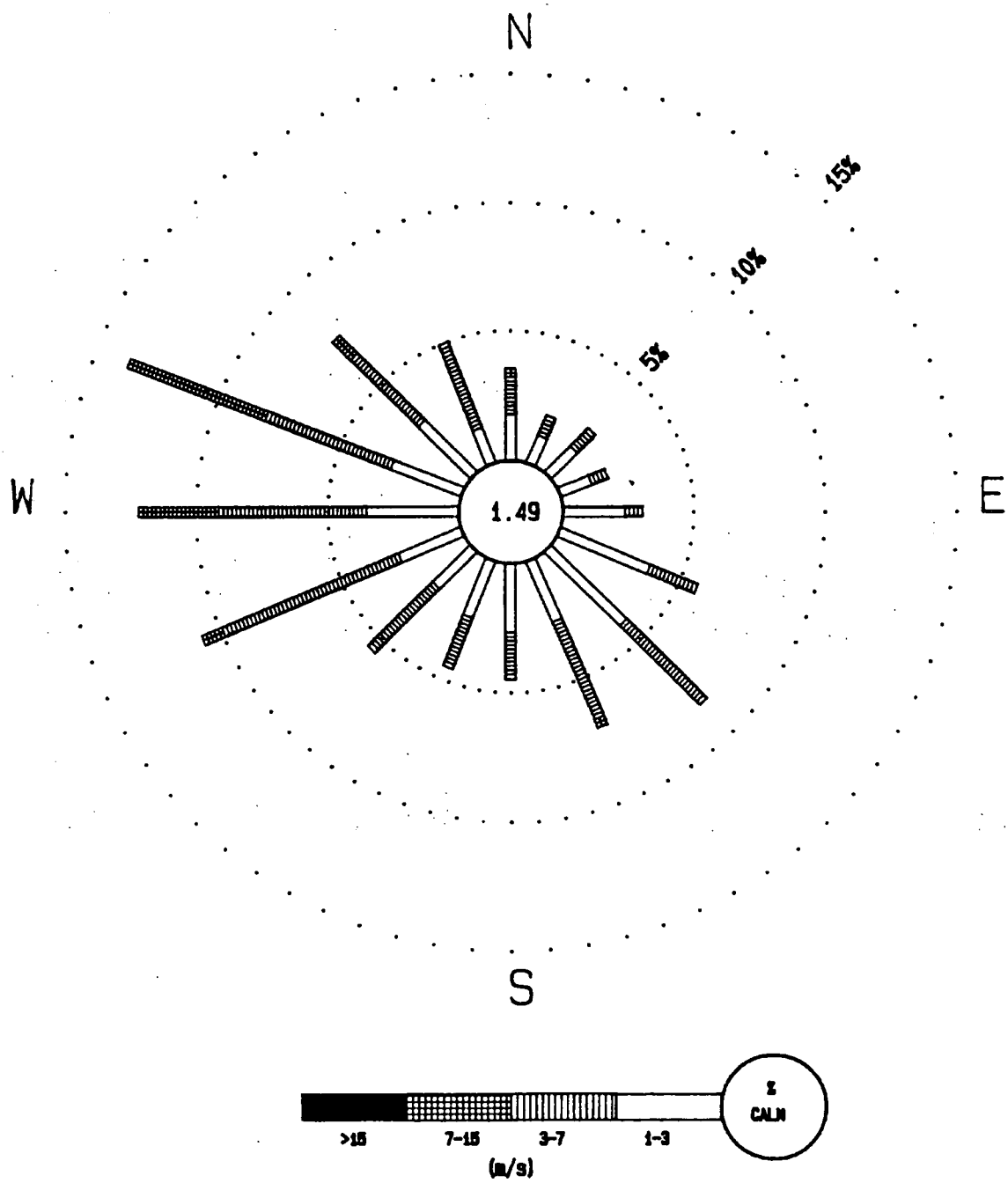



Figure 5: Wind Rose for the Rocky Flats Plant - September 1992

# Appendix A

## Radiation Standards for Protection of the Public

### Calculation of Potential Plant Contribution to Public Radiation Dose

The primary standards for protection of the public from radiation are based on radiation dose. Radiation dose is a means of quantifying the biological damage or risk of ionizing radiation. The unit of radiation dose is the rem or the millirem (1 rem = 1,000 mrem). Radiation protection standards for the public are annual standards, based on the projected radiation dose from a year's exposure to or intake of radioactive materials.

Radiation dose is a calculated value. It is calculated by multiplying radioactivity concentrations in air and water or on contaminated surfaces by assumed intake rates (for internal exposures) or by exposure times (for external exposure to penetrating radiation), then by the appropriate radiation dose conversion factors. That is:

Radiation Dose = Radioactivity Concentration x Intake Rate/Exposure Time x Dose Conversion Factor

Radioactivity concentrations can be determined either by measurements in the environment or by calculations using computer models. These computer models perform airborne dispersion/dose modeling of measured building radioactivity effluents and estimated diffuse source term emissions (e.g., from resuspension from contaminated soil areas).

**DOE Radiation Protection Standards for the Public**

ICRP-Recommended Standards for all Pathways:

Temporary Increase - 500 mrem-year Effective Dose Equivalent (with prior approval of DOE EH-2)

Normal Operations - 100 mrem/year Effective Dose Equivalent

EPA Clean Air Act Standards for the Air Pathway Only:

10 mrem-year Effective Dose Equivalent

Assumed intake rates and dose conversion factors used are based on recommendations of national and international radiation protection advisory organizations, such as the National Council on Radiation Protection and Measurements (NCRP) and the International Commission on Radiological Protection (ICRP).

Radioactive materials of importance in calculating radiation dose to the public from Rocky Flats Plant (RFP) activities include plutonium, uranium, americium, and tritium. Alpha radiation emissions from plutonium, uranium, and americium are primary contributors to the projected radiation dose.

Potential public radiation dose commitments, which could have resulted from plant operations and from background (i.e., non-Plant) contributions, are calculated from average radionuclide concentrations measured at the Department of Energy (DOE) property boundary and in surrounding communities. Inhalation and water ingestion are the principal potential pathways of human exposure.

**DOE Derived Concentration Guides for Radionuclides of Interest at the Rocky Flats Plant**

**Air Inhalation:**

| Radionuclide | DCG (pCi/m3) |
|---|---|
| Plutonium-239, -240 | 0.02 |

**Water Ingestion:**

| Radionuclide | DCG (pCi/l) |
|---|---|
| Plutonium-239, -240 | 30 |
| Americium-241 | 30 |
| Uranium-233, -234 | 500 |
| Uranium-238 | 600 |

On February 8, 1990, DOE adopted DOE Order 5400.5, "Radiation Protection of the Public and the Environment," a radiation protection standard for DOE environmental activities (US 90). This standard incorporates guidance from the International Commission on Radiological Protection (ICRP), as well as from the Environmental Protection Agency Clean Air Act air emission standards (as implemented in 40 CFR 61, Subpart H). Included in DOE Order 5400.5 is a revision of the dose limits for members of the public. Tables of radiation dose conversion factors currently used for calculating dose from intakes of radioactive materials were issued in July 1988 (US88a, US88b). The dose factors are based on the ICRP Publications 30 and 48 methodology and biological models for radiation dosimetry. The DOE Order 5400.5 and the dose conversion factor tables are used for assessment of any potential RFP contribution to public radiation dose. On December 15, 1989, EPA published revised Clean Air Act air emission standards for DOE facilities (US89). DOE radiation standards for protection of the public are given in this Appendix and include the December 15, 1989, EPA Clean Air Act air pathway standards.

## DOE Derived Concentration Guides

Secondary radioactivity concentration guides can be calculated from the primary radiation dose standards and used as comparison values for measured radioactivity concentrations. DOE provides tables of these "Derived Concentration Guides" - in Order 5400.5. Derived Concentration Guides (DCGs) are the concentrations that would result in an effective dose equivalent of 100 mrem from one year's chronic exposure or intake. In calculating air inhalation DCGs, DOE assumes that the exposed individual inhales 8,400 cubic meters of air at the calculated DCG during the year. Ingestion DCGs assume a water intake of 730 liters at the calculated DCG for the year. The table on page 40 lists the most restrictive air and water DCGs for the principal radionuclides of interest at the RFP.

**Compliance with EPA Clean Air Act Standards**

To determine compliance with the EPA air emissions standards, measured airborne effluent radioactivity emissions are entered into the EPA-approved atmospheric dispersion/dose calculation computer model, AIRDOS-PC, for calculation of the maximum radiation dose that an individual in the public could receive from the air pathway only.

For comparison with the annual radiation dose standards for protection of the public, the maximum annual effective dose equivalent that a member of the public could receive as a result of RFP activities is typically less than 1 mrem, or less than 1 percent of the recommended annual standard for all pathways.

**Dose Equivalent and Effective Dose Equivalent (EDE)**

Dose equivalent is a calculated value used to quantify radiation dose; it reflects the degree of biological effect from ionizing radiation. Differences in the biological effect of different types of ionizing radiation (e.g., alpha, beta, gamma, or x-rays) are accounted for in the calculation of dose equivalent.

EDE is a calculated value used to allow comparisons of total health risk (based primarily on the risk of cancer mortality) from exposures of different types of ionizing radiation to different body organs. It is calculated by first calculating the dose equivalent to those organs receiving significant exposures, multiplying each organ dose equivalent by a health risk weighting factor, and then summing those products. One millirem EDE from natural background radiation would have the same health risk as one millirem EDE from an artificially produced source of radiation.

**US88a** DOE/EH-0070, "External Dose-Rate Conversion Factors for Calculation of Dose to the Public," United States Department of Energy, Asst. Secretary for Environment, Safety and Health, July 1988.

**US88b** DOE/EH-0071, "Internal Dose Conversion Factors for Calculation of Dose to the Public," United States Department of Energy, Asst. Secretary of Environment, Safety and Health, July 1988.

**US89** United States Environmental Protection Agency, Code of Federal Regulations 40 CFR 61, Subpart H, "National Emission Standards for Emissions of Radionuclides other than Radon from Department of Energy Facilities," Washington, D.C., December 15, 1989.

**US90** United States Department of Energy, DOE Order 5400.5, "Radiation Protection of the Public and the Environment," Washington, D.C., February 8, 1990.

# Appendix B

## National Pollutant Discharge Elimination System/Federal Facilities Compliance Agreement Volatile Organic Compounds

The following is a list of volatile organic compounds (VOCs) for which monitoring is required by the Environmental Protection Agency (EPA) National Pollutant Discharge Elimination System/Federal Facilities Compliance Agreement (NPDES/FFCA).

| Compound | PQL (µg/l) | Compound | PQL (µg/l) |
|---|---|---|---|
| Benzene | 5 | 1,3-dichloropropylene | 5 |
| Bromoform | 5 | Ethylbenzene | 5 |
| Methyl bromide | 10 | Methyl chloride | 10 |
| Carbon Tetrachloride | 5 | Methylene chloride | 5 |
| Chlorobenzene | 5 | 1,1,2,2-tetrachloroethane | 5 |
| Chlorodibromomethane | 5 | Tetrachloroethylene | 5 |
| Chloroethane | 10 | Toluene | 5 |
| Chloroform | 5 | 1,2-trans-dichloroethylene | 5 |
| Dichlorobromomethane | 5 | 1,1,1-trichloroethane | 5 |
| 1,1-dichloroethane | 5 | 1,1,2-trichloroethane | 5 |
| 1,2-dichloroethane | 5 | Trichloroethylene | 5 |
| 1,1-dichloroethylene | 5 | Vinyl chloride | 10 |
| 1,2-dichloropropane | 5 | | |

# Appendix C

## Colorado Water Quality Control Commission Standards

The Colorado Water Quality Control Commission has promulgated new standards for the Walnut Creek and Woman Creek drainages downstream from the Rocky Flats Plant. The EPA has not yet written a new NPDES permit that reflects these standards; however, in the spirit of the Agreement in Principle completed between the DOE and the State of Colorado, the plant is attempting to meet the standards at this time.

# Appendix D

## Distribution

### Federal Agencies

US DOE, RFO
Attn: R.M. Nelson, Jr.
Bldg. 115

US EPA
Attn: Dr. M. Lammering,
R. Rutherford
One Denver Place - Suite 1300
999 18th Street
Denver, CO 80202-2413

US EPA
Attn: B. Lavelle
999 18th Street, Suite 500
8 HWM-FF
Denver, CO 80202-2405

### State Government Agencies

Colorado Water Conservation Board
Attn: N.C. Ioannides
823 State Centennial Building
1313 Sherman Street
Denver, CO 80203

Denver Regional Council of Governments
Attn: L. Mugler
2480 W. 27th Avenue, #200B
Denver, CO 80211

Department of Natural Resources
Attn: B. Hamlett III
1313 Sherman Street
Denver, CO 80203

Rocky Flats Environmental Monitoring Council
Attn: G. Swartz
1536 Cole Blvd., Suite 325
Denver West Office Park #4
Golden, CO 80401

### City Governments

City of Arvada
Utilities Division
Attn: M. Mauro
8101 Ralston Road
Arvada, CO 80002

City of Boulder
Office of the City Manager
Attn: J. Piper, A. Struthers
P.O. Box 791
Boulder, CO 80302

City of Broomfield
Attn: H. Mahan, K. Schnoor
#6 Garden Office Center
P.O. Box 1415
Broomfield, CO 80038-1415

City of Fort Collins
Office of the City Manager
Attn: S. Burkett
300 La Porte
Fort Collins, CO 80525

City of Northglenn
Attn: T. Ambalam
11701 Community Center Drive
Northglenn, CO 80233-1099

City of Thornton
Attn: J. Ethredge, City Manager
9500 Civic Center Drive
Thornton, CO 80229-1120

City of Westminster Steve
Attn: W. Christopher, S. Ramer
4800 W. 92nd Avenue x2447
Westminster, CO 80030

Denver Water Department
Quality Control
Attn: J. Dice
1600 W. 12th Avenue
Denver, CO 80254

### Health Departments

Boulder City/County Health Department - Division of Environmental Health
Attn: T. Douville, V. Harris
3450 Broadway
Boulder, CO 80020

Colorado Department of Health
4300 Cherry Creek Drive South
Denver, CO 80222-1530
Attn: J. Berardini, J. Bruch, R. Fox,
P. Frohardt, D. Holme, J. Jacobi,
E. Kray, A. Lockhart, P. Nolan
R. Quillin, J. Sowinski, R. Terry,

Jefferson County Health Department
Attn: Dr. M. Johnson, C. Sanders
260 South Kipling
Lakewood, CO 80226

Tri County District Health
Attn: S. Salyards
4301 E. 72nd Avenue
Commerce City, CO 80022

### Environmental

Advance Sciences, Inc.
Attn: D. Kaskie, M.G. Waltermire
405 Urban Street, Suite 401
Lakewood, CO 80228

American Friends Service Co.
Attn: T. Rauch
1535 High Street, 3rd Floor
Denver, CO 80218

Doty and Associates
F.H. Blaha
2303 Table Heights Drive
Golden, CO 80401

Environmental Information Network
Attn: P. Elofson-Gardine
8470 W. 52nd Place, Suite 9
Arvada, CO 80002-3447

IT Corporation
Attn: C. Rayburn
5600 S. Quebec, Suite 280D
Englewood, CO 80111

L.C. Holdings
Attn: M. Jones
18300 Hwy 72
Golden, CO 80403-8222

Margie Reynolds
8882 Comanche Drivet
Longmont, CO 80503-8657

National Renewable Energy Laboratory
Attn: R. Noun
1617 Cole Blvd.
Golden, CO 80402

PRC Environmental Management, Inc.
Attn: R.J. Fox
1099 18th Street, Suite 1960
Denver, CO 80202

Peak Rock Spring Water
Attn: S. Dolson
4615 Broadway Street
Boulder, CO 80304-0509

Rocky Flats Cleanup Commission
Attn: K. Korkia
1738 Wynkoop, Suite 302
Denver, CO 80202

Sierra Club - Rocky Mountain Chapter
Attn: Dr. E. DeMayo
11684 Ranch Elsie Road
Golden, CO 80203

W. Gale Biggs Associates
Attn: Dr. W. Gale Biggs
P.O. Box 3344
Boulder, CO 80307

Woodward Clyde/ERCE
Attn: W. Glasgow
Stanford Place 3, Suite 415
4582 S. Ulster Street Pkwy.
Denver, CO 80237

Wright Water Engineers
Attn: J. Jones, S. Kribs
2490 W. 26th Avenue, Suite 100A
Denver, CO 80211

## Other

National Center for Atmospheric Research
Attn: S. Sadler
P.O. Box 3000
Boulder, CO 80307-3000

Physicians for Social Responsibility
Attn: T. Perry
1000 16th NW, Suite 810
Washington, D.C. 20036

R.M. Borinsky
13004 Lowell Court
Broomfield, CO 80020

W.J. Jones
10986 W. 77th Avenue
Arvada, CO 80005

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11746 W. 74th Way
Arvada, CO 80005

R.D. Morgenstern
3213 W. 133rd Avenue
Broomfield, CO 80020

J.K. Natale
11767 W. 74th Way
Arvada, CO 80005

L.S. Newton
5993 W. 75th Avenue
Arvada, CO 80003

F.H. Shoemaker
13631 W. 54th Avenue
Arvada, CO 80002

D.S. Smith
11122 Seton Place
Westminster, CO 80030

D.L. Weiland
7648 Owens Court
Arvada, CO 80005

S.M. Yasutake
6381 West 74th Place
Arvada, CO 80003

## EG&G Rocky Flats

Rocky Flats Plant Public Reading Room
c/o Front Range Community College
3645 W. 112th Avenue
Westminster, CO 80037

R.L. Benedetti, Acting Associate General Manager Environmental Restoration Management

B.M. Bowen, EPM/Air Quality Division

E.A. Brovsky, General Chemistry

M.S. Brugh, Gen. Spect. Laboratory

S.A. Buckie, Op. Health Physics

D.A. Cirrincione, EPM/ Environmental Protection and Waste Reporting

J.A. Cuicci, Liquid Waste

S.L. Cunningham, Info. Security

N.M. Daugherty, EPM/Air Quality Division

N.S. Demos, ERM/Facility Operations

J.R. Dick, Analytical Labs

L.A. Doerr, Op. Health Physics

G.D. Elliott, FPM Program Management

E.W. Ellis, Technical Development

N.L. Erdmann, EPM/Environmental Protection and Waste Reporting

G.R. Euler, EPM/Air Quality Division

V.T. Guettlein, EPM/Surface Water

D.I. Hunter, General Laboratory

J.E. Janke, ERM/Remediation Reporting Management

H. Jordan, Safety Analysis & Risk Assessment

T.G. Kalivas, EPM/Air Quality Division

J.M. Kersh, Associate General Manager Environmental & Waste Management

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R.D. Lindberg, ERM/Env. Science and Technology

F.G. McKenna, Chief Counsel

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J.G. Paukert, Media Relations

B.J. Pauley, EPM/Air Quality Division

V.L. Peterson, Safety Analysis & Risk Assessment

D.R. Pierson, Pondrete Ops.

F. Primozic Waste Quality Engineering

A.J. Read, Analytical Labs

R.S. Roberts, Remediation Programs Division

C.M. Sanda, Community Relations

J.K. Schwartz, Media Communications

C.A. Sedlmayr, Administration

G.H. Setlock, Acting Director Environmental Protection Management

T.A. Smith, Community Relations

N.R. Stallcup, EPM/Environmental Protection and Waste Reporting

D. Stein, Mechanical Utilities

M.T. Sullivan, Radiation Protection

C. Trice, Analytical Labs

J.M. Wilson, Director, Communications

K.T. Wanebo, EPM/Environmental Protection and Waste Reporting

J.O. Zane, General Manager

J. Zarret, Analytical Labs

K. Zbryk, Analytical Labs