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Rocky Flats Environmental Technology Site

Monthly Environmental Monitoring Report

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Rocky Flats Environmental Technology Site Monthly Environmental Monitoring Report

November Highlights

Summarized below are highlights for the major data categories presented in this report.

Airborne Effluent Calculations - Effluent air sampling results are provided in Tables 1, 2, and 3. All reported data are within expected ranges.

Ambient Air Sampling Results - Ambient air sampling results are provided in Tables 4, 5, and 6. All reported data are within expected ranges.

Onsite Surface Water Sample Results - Onsite surface water sample results are presented in Tables 7, 8, and 9. All reported data are within expected ranges.

NPDES Sampling - Water sampling results associated with the NPDES/FFCA permit are presented in Tables 10, 11, and 12. No NPDES/FFCA permit exceedances were reported during the month and all results are within expected ranges.

Daily Flow Data - Tables 13 through 15 present surface water flow data for the two onsite drainage systems, Walnut Creek and Woman Creek.

Groundwater Monitoring - Boundary well monitoring results for the second quarter of 1994 were presented in the October edition of the Monthly Envireonmental Monitoring Report. Third quarter data are scheduled to be presented in the January 1995 report.

Wind Direction Frequency - Table 16 presents wind direction data for the month of November.

Climatic Summary - Table 17 summarizes the climatic data for the month of November.

1. Introduction

The Rocky Flats Environmental Technology Site (RFETS) 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. RFETS no longer produces weapons components, and is now in a transition phase into decontamination and decommissioning (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 RFETS 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 RFETS for November 1994. Data presented herein reflect the best information available to the RFETS at this time. If subsequent analysis indicate that any data presented herein are inaccurate or misleading, revisions will be issued promptly.

The Highlights section summarizes 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 RFETS operations are typically well below any regulatory limit and far less than doses 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 (CWQCC) standards for the Walnut Creek and Woman Creek drainages downstream of RFETS.

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 analysis 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 analysis. 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 analysis, 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

BOD_5	Biochemical Oxygen Demand, 5 day test
C Average	Average concentration
$CBOD_5$	Carbonaceous Biochemical Oxygen Demand, 5 day test
C Maximum	Maximum concentration
C Minimum	Minimum concentration
EFF	Efficiency
LC_{50}	Lethal concentration to 50 percent of the organisms
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
$\mu g/l$	Micrograms per liter

2. Air

2.1 Airborne Effluent

RFETS 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 RFETS.

For immediate detection of abnormal conditions, RFETS 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 RFETS 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. Analysis 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 RFETS.

Processes ventilated from several exhaust systems potentially exhibit trace quantities of tritium contamination. Impinger-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.

The calibration methodology for the beryllium analysis 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 Environmental Protection Agency (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 ensure absence of equipment contamination and matrix effects during the analysis.

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

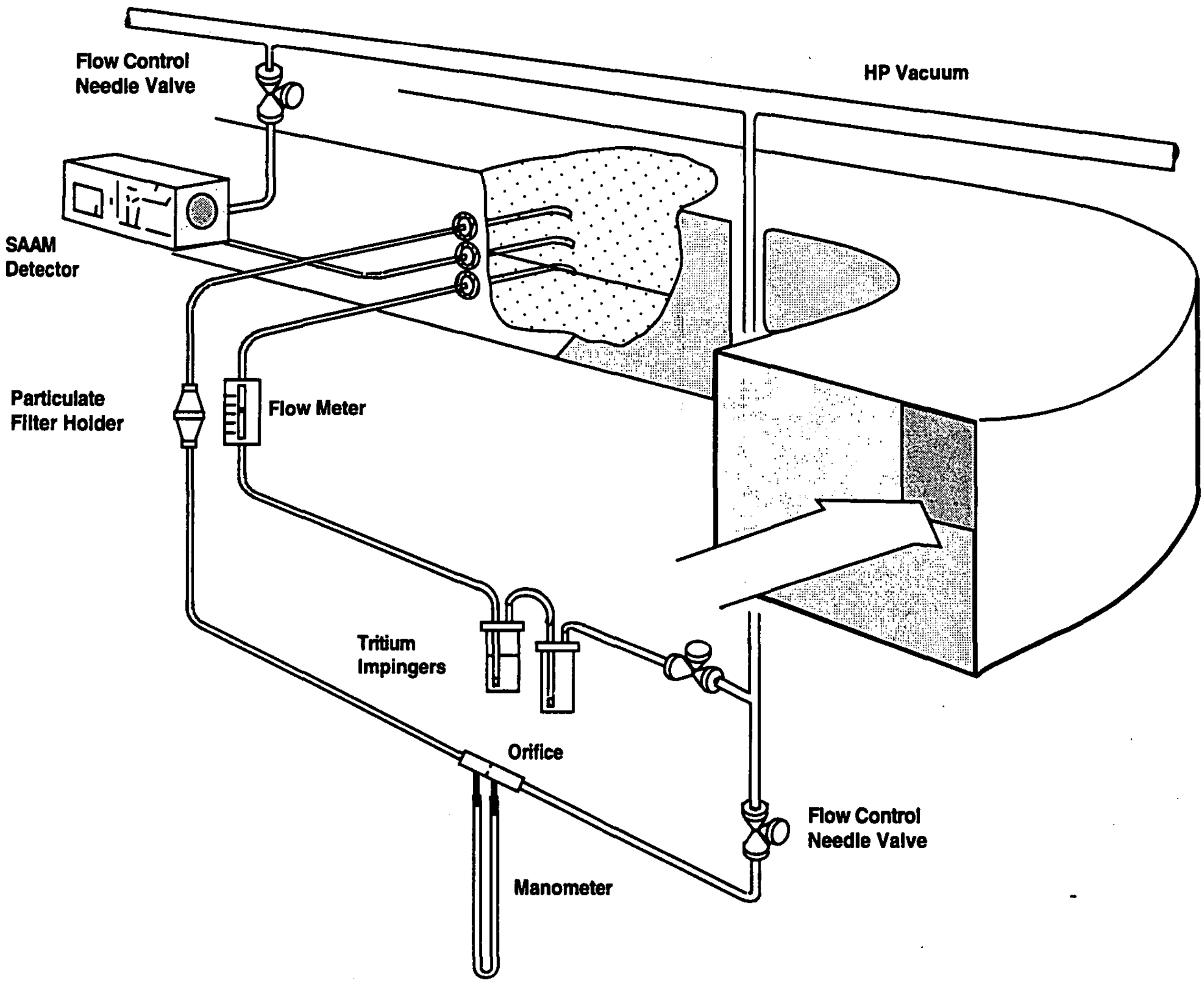


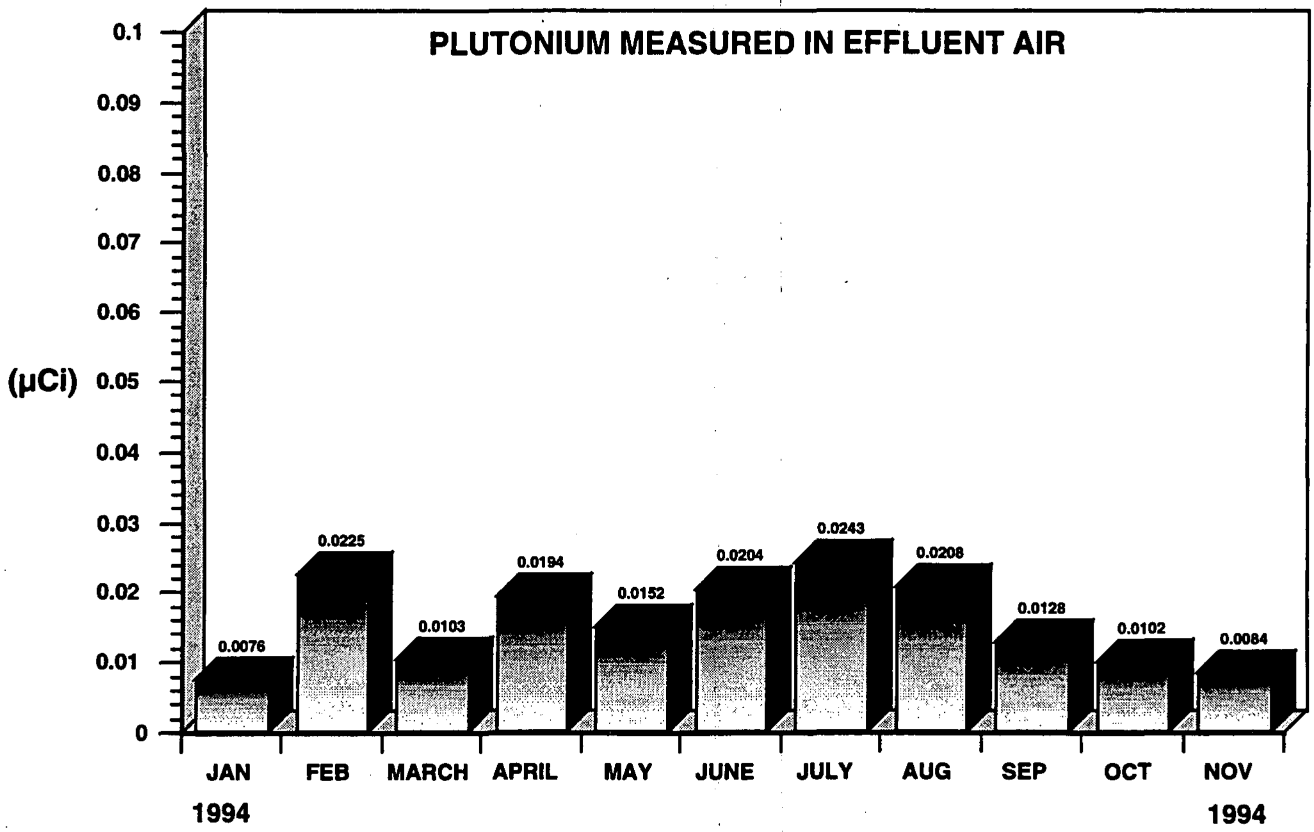
Figure 1: Radiological Effluent Air Sampling System

Table 1

Plutonium and Americium Airborne Effluent Data

Month	Plutonium-239, -240 (10/13/94 - 11/15/94) Release (µCi)			C Maximum (pCi/m^3)			Americium-241 (9/12/94 - 10/14/94) Release (µCi)			C Maximum (pCi/m^3)		
CY1993	0.1492	±	0.0299	0.0006	±	0.0001	0.1575	±	0.0407	0.0001	±	0.0000
1994												
January	0.0076	±	0.0016[a]	0.0001	±	0.0000	-0.0002	±	0.0017	0.0001	±	0.0000
February	0.0225	±	0.0019	0.0001	±	0.0000	0.0093	±	0.0029	0.0001	±	0.0000
March	0.0103	±	0.0015	0.0001	±	0.0000	0.0143	±	0.0039	0.0000	±	0.0000
April	0.0194	±	0.0019[a]	0.0001	±	0.0000	0.0085	±	0.0025[a]	0.0002	±	0.0001
May	0.0152	±	0.0015	0.0001	±	0.0000	0.0067	±	0.0023	0.0000	±	0.0000
June	0.0204	±	0.0019	0.0002	±	0.0000	0.0054	±	0.0020	0.0000	±	0.0000
July	0.0243	±	0.0031	0.0005	±	0.0001	0.0041	±	0.0031	0.0001	±	0.0000
August	0.0208	±	0.0034	0.0000	±	0.0000	0.0102	±	0.0045[a]	0.0001	±	0.0000
September	0.0128	±	0.0019	0.0002	±	0.0000	0.0084	±	0.0026[b]	0.0000	±	0.0000
October	0.0102	±	0.0017	0.0001	±	0.0000	0.0261	±	0.0030	0.0001	±	0.0000
November	0.0084	±	0.0017[c]	0.0001	±	0.0000	0.0041	±	0.0028[d]	0.0001	±	0.0000
Year to Date	0.1718	±	0.0221	0.0005	±	0.0001	0.0969	±	0.0313	0.0002	±	0.0001

a The data for some locations were missing because of failure of quality assurance criteria and no additional sample remained for analysis. This figure represents a "best estimate" of the release activity for this location.
b The data for one Americium location are missing due to failure of Quality Assurance Criteria. The sample is being rerun.
c The data for one Plutonium location are missing due to failure of Quality Assurance Criteria. The sample is being rerun.
d The November Americium data are being reported one month in arears.


PLUTONIUM MEASURED IN EFFLUENT AIR
(µCi)
0.1
0.09
0.08
0.07
0.06
0.05
0.04
0.03
0.02
0.01
0
0.0076
0.0225
0.0103
0.0194
0.0152
0.0204
0.0243
0.0208
0.0128
0.0102
0.0084
JAN
FEB
MARCH
APRIL
MAY
JUNE
JULY
AUG
SEP
OCT
NOV
1994
1994

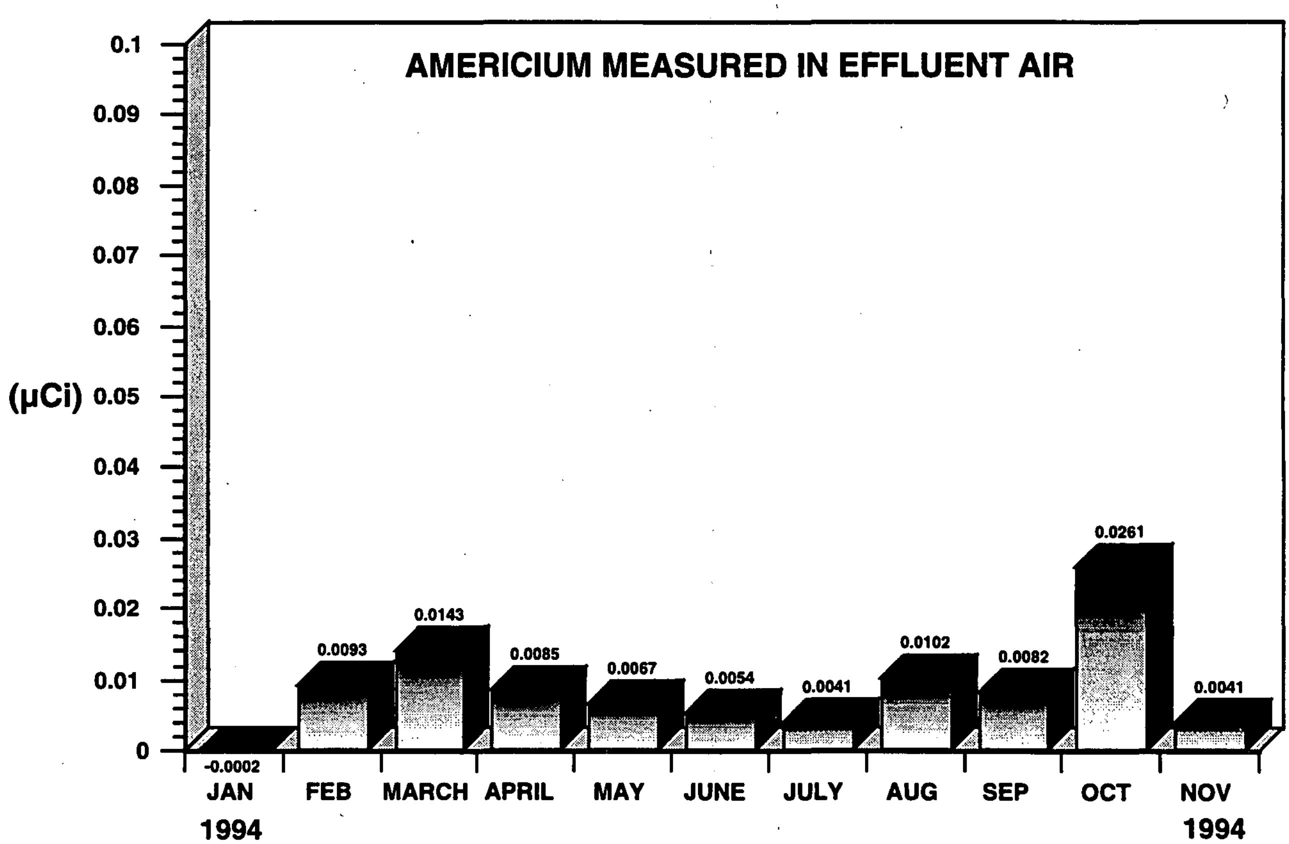

AMERICIUM MEASURED IN EFFLUENT AIR
(µCi)
0.1
0.09
0.08
0.07
0.06
0.05
0.04
0.03
0.02
0.01
0
-0.0002
0.0093
0.0143
0.0085
0.0067
0.0054
0.0041
0.0102
0.0082
0.0261
0.0041
JAN
FEB
MARCH
APRIL
MAY
JUNE
JULY
AUG
SEP
OCT
NOV
1994
1994

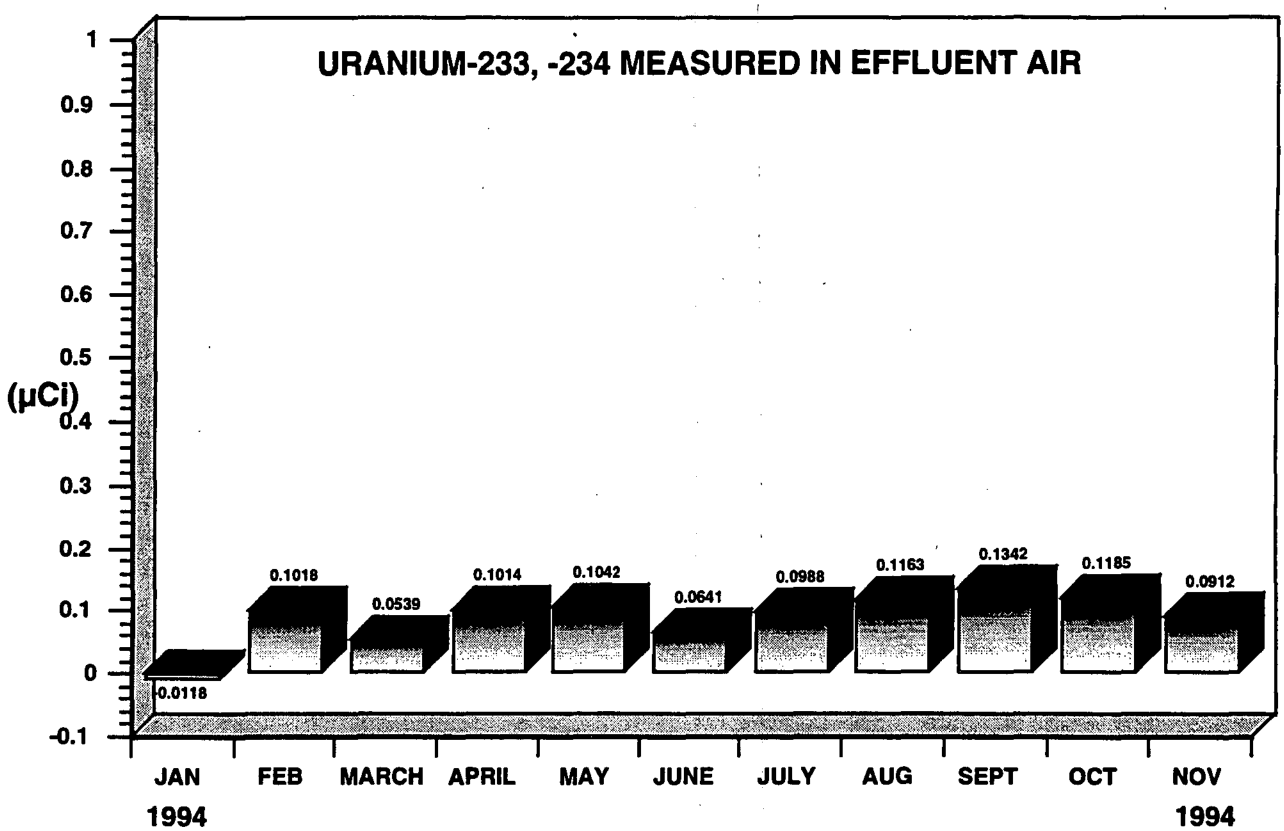
Table 2

Uranium Airborne Effluent Data

Month	Uranium-233, -234 (10/13/94 - 11/15/94) Release (µCi)			C Maximum (pCi/m^3)			Uranium-238 (10/13/94 - 11/15/94) Release (µCi)			C Maximum (pCi/m^3)		
CY1993	0.7029	±	0.1200	0.0004	±	0.0004	0.8940	±	0.1257	0.0005	±	0.0004
1994												
January	-0.0118	±	0.0074	0.0000	±	0.0000	-0.0107	±	0.0075	0.0001	±	0.0000
February	0.1018	±	0.0106	0.0001	±	0.0000	0.1267	±	0.0111	0.0002	±	0.0000
March	0.0539	±	0.0092	0.0001	±	0.0000	0.0638	±	0.0093	0.0001	±	0.0001
April	0.1014	±	0.0090[a]	0.0001	±	0.0000	0.1274	±	0.0089[a]	0.0003	±	0.0001
May	0.1042	±	0.0102	0.0001	±	0.0000	0.1205	±	0.0089	0.0002	±	0.0000
June	0.0641	±	0.0099	0.0001	±	0.0000	0.1000	±	0.0100	0.0003	±	0.0001
July	0.0988	±	0.0119[a]	0.0002	±	0.0001	0.1493	±	0.0132[a]	0.0003	±	0.0001
August	0.1163	±	0.0124	0.0002	±	0.0001	0.1456	±	0.0124	0.0004	±	0.0001
September	0.1342	±	0.0113	0.0003	±	0.0001	0.1598	±	0.0118	0.0003	±	0.0001
October	0.1185	±	0.0107	0.0004	±	0.0001	0.1267	±	0.0110	0.0005	±	0.0001
November	0.0912	±	0.0110[b]	0.0006	±	0.0001	0.0983	±	0.0111[b]	0.0006	±	0.0001
Year to Date	0.9724	±	0.1136	0.0006	±	0.0001	1.1090	±	0.1064	0.0006	±	0.0001

a The data for some locations were missing because of failure of quality assurance criteria and no additional sample remained for analysis. This figure represents a "best estimate" of the release activity at this location.

b The data for two Uranium locations are missing due to failure of Quality Assurance Criteria. The samples are being rerun.


URANIUM-233, -234 MEASURED IN EFFLUENT AIR
(µCi)
1
0.9
0.8
0.7
0.6
0.5
0.4
0.3
0.2
0.1
0
-0.1
-0.0118
0.1018
0.0539
0.1014
0.1042
0.0641
0.0988
0.1163
0.1342
0.1185
0.0912
JAN
FEB
MARCH
APRIL
MAY
JUNE
JULY
AUG
SEPT
OCT
NOV
1994
1994

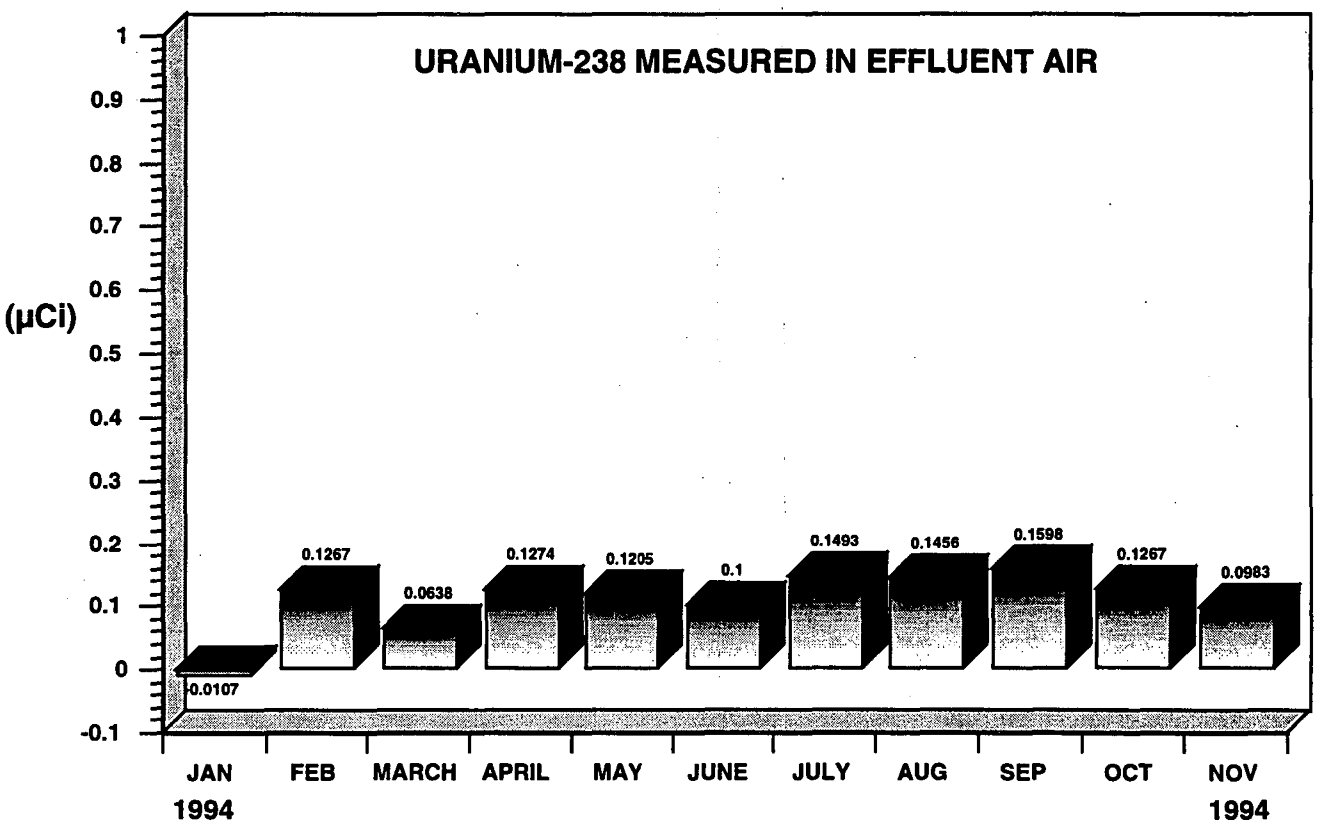

URANIUM-238 MEASURED IN EFFLUENT AIR
(µCi)
1
0.9
0.8
0.7
0.6
0.5
0.4
0.3
0.2
0.1
0
-0.1
-0.0107
0.1267
0.0638
0.1274
0.1205
0.1
0.1493
0.1456
0.1598
0.1267
0.0983
JAN
FEB
MARCH
APRIL
MAY
JUNE
JULY
AUG
SEP
OCT
NOV
1994
1994

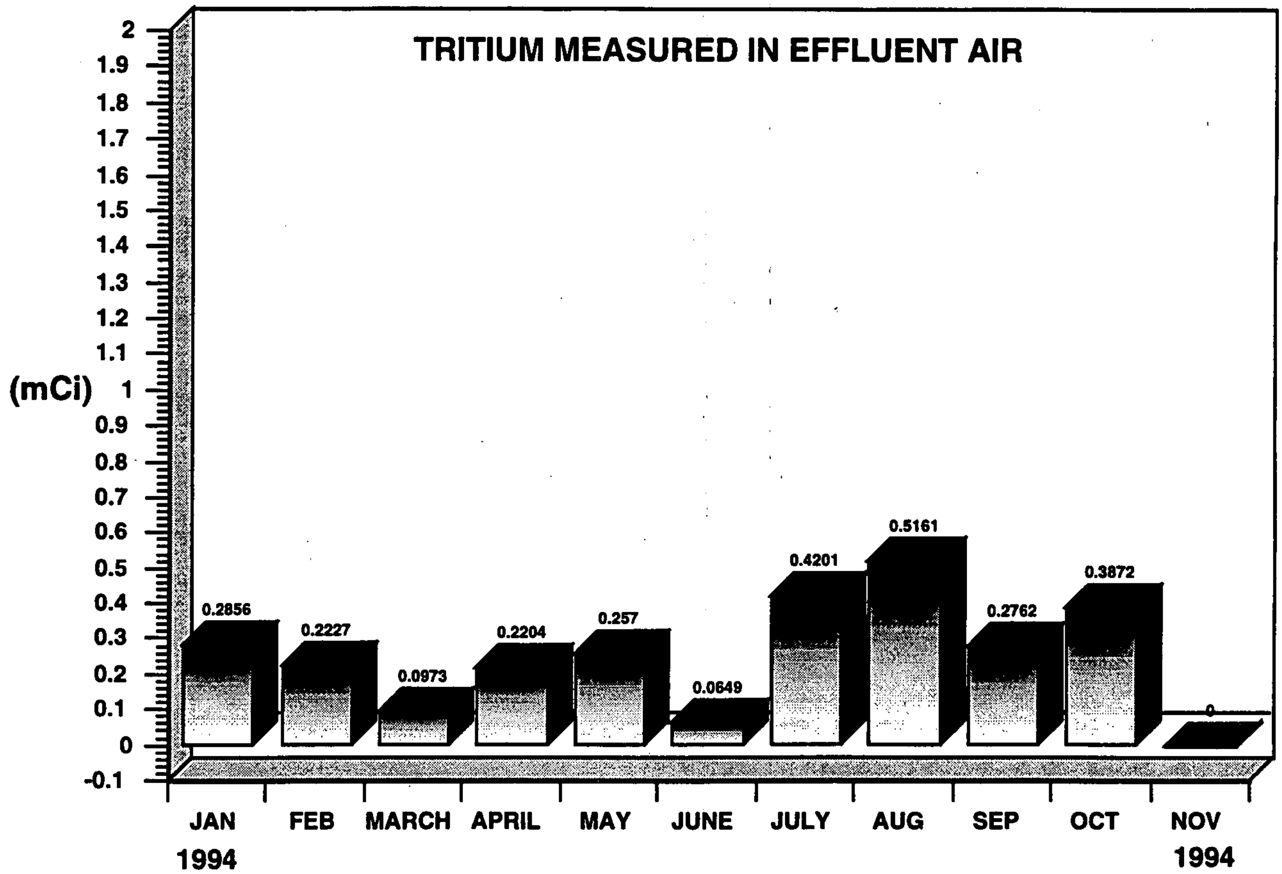
Table 3

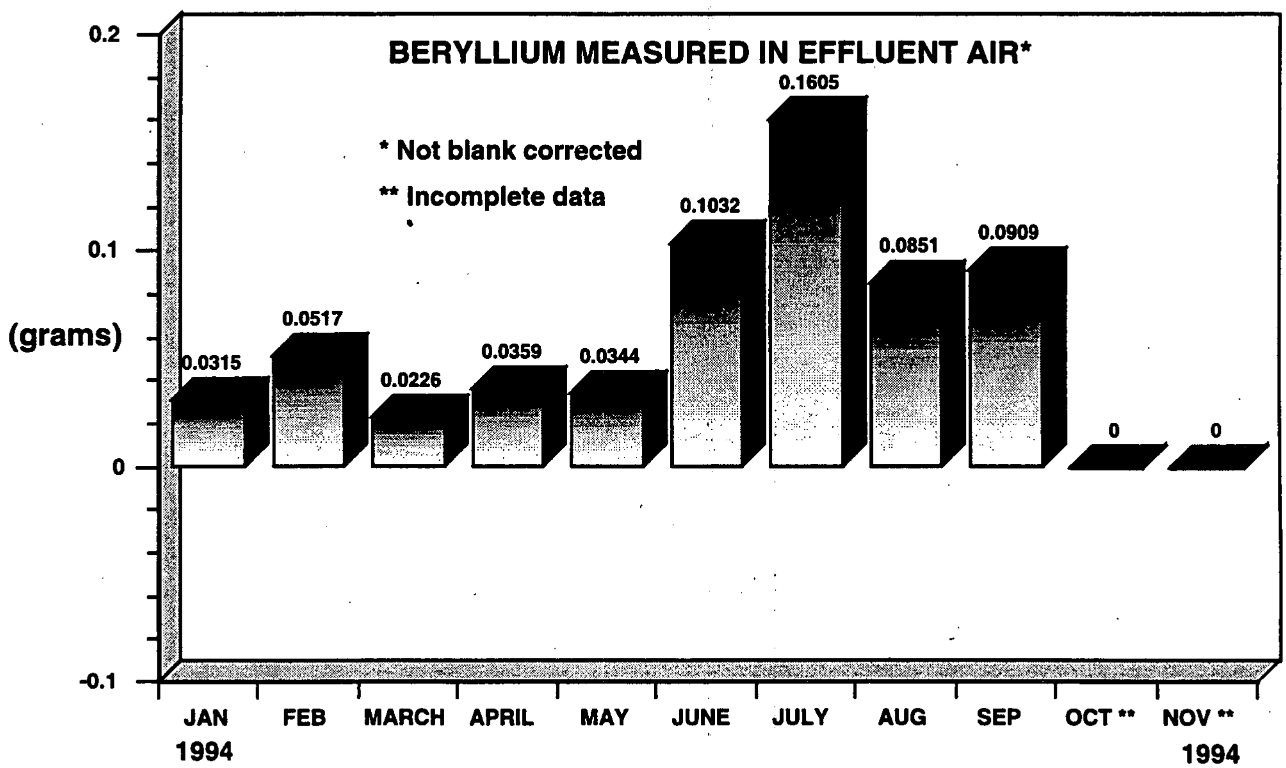
Tritium and Beryllium Airborne Effluent Data

	Tritium (H-3) (10/31/94 - 11/30/94)		Beryllium (10/13/94 - 11/15/94)	
Month	**Release (mCi)**	**C Maximum (pCi/m^3)**	**Release (grams)**	**C Maximum ($\mu g/m^3$)**
CY1993	3.7266	3135 ± 38	0.5789 ± 0.0481	0.00043
1994				
January	0.2490	823 ± 11	0.0315 ± 0.0019	0.00047
February	0.2392	15 ± 5	0.0517 ± 0.0041	0.00018
March	0.0973	14 ± 6	0.0226 ± 0.0021	0.00016
April	0.2204	39 ± 6	0.0359 ± 0.0030	0.00018
May	0.2570	40 ± 12	0.0344 ± 0.0033	0.00019
June	0.0649	18 ± 12	0.1032 ± 0.0067	0.00058
July	0.4201	32 ± 11	0.1605 ± 0.0067	0.00060
August	0.5161	22 ± 11	0.0851 ± 0.0062	0.00054
September	0.2762	27 ± 12	0.0909 ± 0.0059[a]	0.00050
October	0.3872	24 ± 11	b	b
November	b	b	b	b
Year to Date	2.7273	823 ± 11	0.6158 ± 0.0443	0.00060

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. No blank corrections are made to any beryllium data.

a The data for one Beryllium location are missing due to incomplete laboratory analysis.
b Incomplete laboratory analysis.


TRITIUM MEASURED IN EFFLUENT AIR
(mCi)
2
1.9
1.8
1.7
1.6
1.5
1.4
1.3
1.2
1.1
1
0.9
0.8
0.7
0.6
0.5
0.4
0.3
0.2
0.1
0
-0.1
0.2856
0.2227
0.0973
0.2204
0.257
0.0649
0.4201
0.5161
0.2762
0.3872
0
JAN
FEB
MARCH
APRIL
MAY
JUNE
JULY
AUG
SEP
OCT
NOV
1994
1994


BERYLLIUM MEASURED IN EFFLUENT AIR*
* Not blank corrected
** Incomplete data
(grams)
0.2
0.1
0
-0.1
0.0315
0.0517
0.0226
0.0359
0.0344
0.1032
0.1605
0.0851
0.0909
0
0
JAN
FEB
MARCH
APRIL
MAY
JUNE
JULY
AUG
SEP
OCT **
NOV **
1994
1994

2.2 Ambient

The Radioactive Ambient Air Monitoring Program (RAAMP) is responsible for monitoring radioactive particles at near-background concentrations. This monitoring is performed in accordance with DOE Order 5400.1. The data are used to estimate the air-inhalation dose to the public for comparison with the DOE standard of 100 millirem per year EDE from all modes of exposure that result from routine site operations.

To replace the aging RAAMP samplers, EG&G RFETS developed a new sampler that incorporates improvements suggested by external oversight recommendations and provides the ability to separate radioactive particles into two size ranges, one coarse, the other fine and respirable, and retain them for analysis. These new samplers are being installed in the network and are expected to be fully operational before December.

The sampling network is located on and around the Site in a number of locations. Samplers can be designated in four categories by their proximity to the main facilities area.

1. Onsite samplers - Twenty-two onsite samplers are located within RFETS, generally downwind of RFETS production facilities areas and near areas of known plutonium contamination. Of the 22 samplers, eight new locations were added to support the Operable Units that require monitoring for suspended particles (Figure 1).

2. Perimeter Samplers - Eleven perimeter samplers border RFETS along highways on the north (Highway 128), east (Indiana Street), south (Highway 72), and west (Highway 93) (Figure 2).

3. Community Samplers - Four community samplers are located in metropolitan areas adjacent to RFETS (Figure 3). These samplers are supplemented by five additional samplers in the Community Radiation Monitoring Program (ComRad).

4. Collocated Samplers - Four existing samplers (pre-1994 sample upgrades) will remain collocated with new RAAMP samplers (Figure 1) for at least one year.

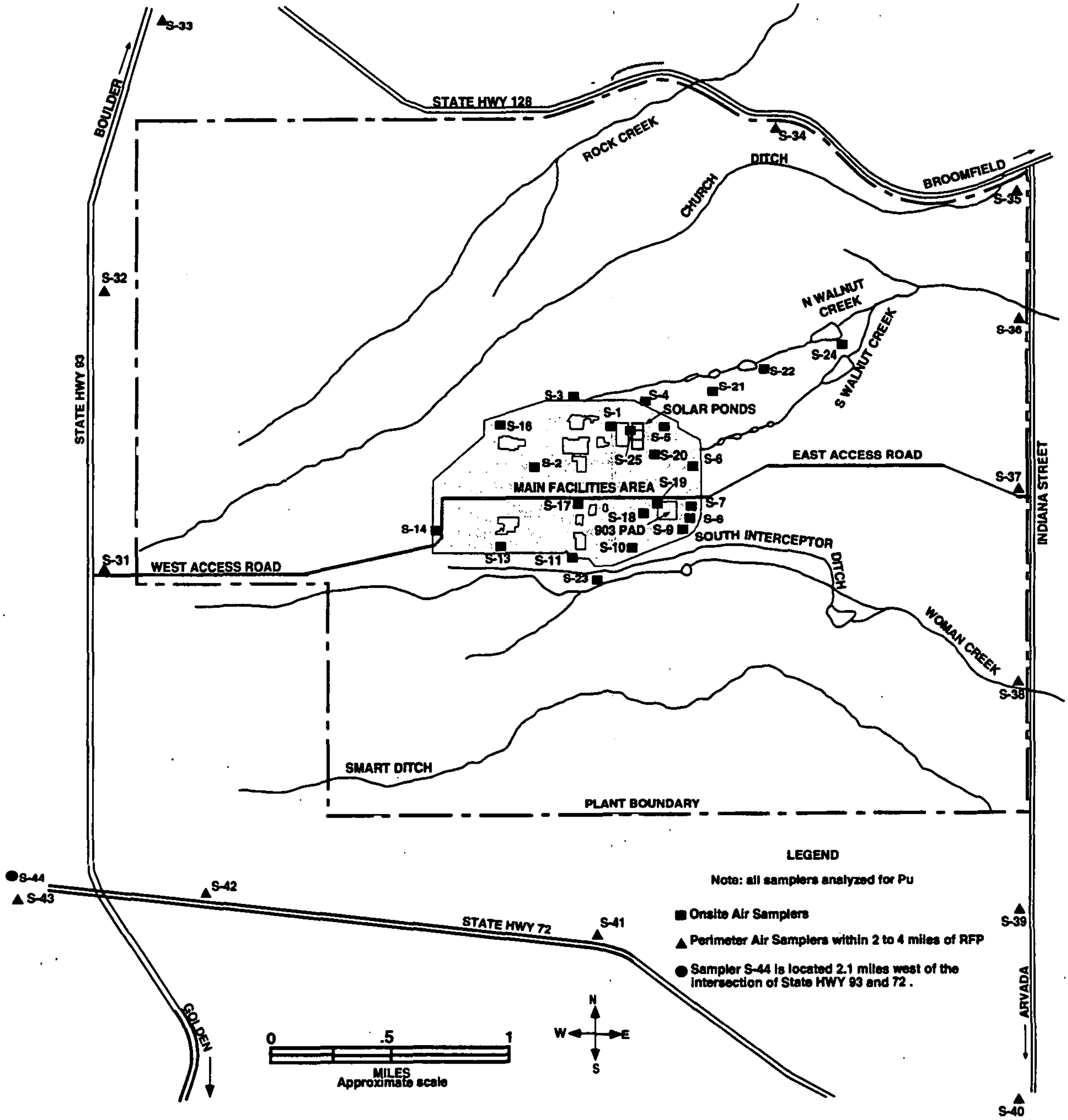


Figure 2: Location of Onsite and Perimeter Air Samplers

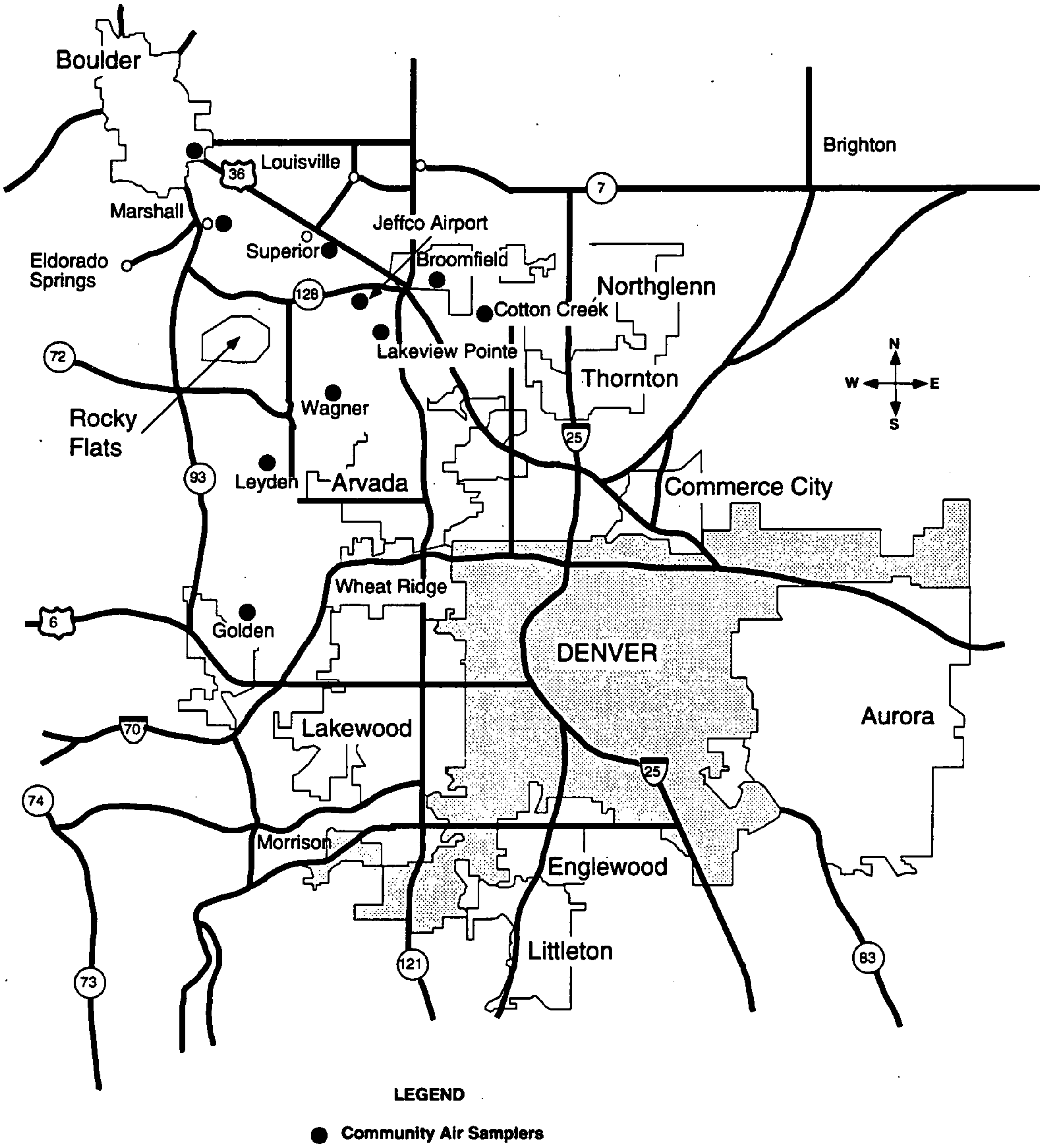


Figure 3: Location of Community Air Samplers

The new RFETS RAAMP air sampler operates at a volumetric flow rate of 40 actual cubic feet per minute (acfm), plus or minus ten percent. This flow rate is controlled by a volumetric flow controller. The flow controller is a venturi device that accelerates the air until the air velocity equals the speed of sound in the throat of the device, resulting in critical flow. This "critical flow" is necessary to maintain a constant velocity in the particle separator under varying conditions of atmospheric pressure and temperature.

This new sampler is designed to separate the respirable fraction from the larger particle fraction. The larger, coarse fraction will be collected on an oiled impaction substrate; the fine fraction will be collected on the same 20- by 25-centimeter fiberglass filters used on the pre-1994 samplers. Coarse and fine fractions will be analyzed separately for plutonium -239 and -240.

Ambient air filters will be collected monthly and composited every three months from each location before isotopic analysis. Data will be reported one month behind each sampling quarter. Both fractions will be reported.

Four pre-1994 samplers will be left in place collocated with the new samplers. The collocated samples will be analyzed monthly for comparison between results typical of the previous sampling device and the new one.

Tables 4 through 6 summarize environmental monitoring data from the RFETS ambient air sampling network for the month of November.

Table 4

Plutonium Concentrations in Ambient Air for Onsite Samplers

(10/03/94 - 11/14/94)

Location	Volume (m^3)	Plutonium Concentration (pCi/m^3)[c]	± 95 percent Confidence Interval (pCi/m^3)
S-03[a]	6847	.000000	.000000
S-04[a]	6308	.000000	.000000
S-05	50851	.000012	.000002
S-06	44830	.000121	.000012
S-07[a]	6245	.000398	.000045
S-08	46404	.000000	.000000
S-09[a]	9760	.000181	.000022
S-10[a]	7768	.000002	.000002
S-11	43856	.000013	.000002
S-13[b]			
S-14[b]			
S-16[b]			
S-17[b]			
S-18[b]			
S-19	5909	.000016	.000006
S-20	49660	.000000	.000000
S-21[b]			
S-22	37722	.000000	.000000
S-23[b]			
S-24	50533	.000000	.000000
S-25[c]			

a These samplers operated for a period of time before being removed from service due to the sampler upgrade project.
b These samplers were removed from service during the month due to the sampler upgrade project.
c Equipment failure.

Table 5

Plutonium Concentrations in Ambient Air for Perimeter Samplers

(10/04/94 - 11/16/94)

Location	Volume (m^3)	Plutonium Concentration (pCi/m^3)	± 95 percent Confidence Interval (pCi/m^3)
S-31[a]			
S-32[a]			
S-33[b]	16769	.000001	.000001
S-34[b]	18314	.000000	.000000
S-35[b]	16966	.000000	.000001
S-36[a]			
S-37[a]			
S-38[b]	17401	.000002	.000002
S-39[b]	17069	.000001	.000001
S-40[a]			
S-41[a]			
S-42[a]			
S-43[b]	15929	.000001	.000001

a These samplers were removed from service during the month due to the sampler upgrade project.

b These samplers were operated for a period of time before being removed from service due to the sampler upgrade project .

Table 6

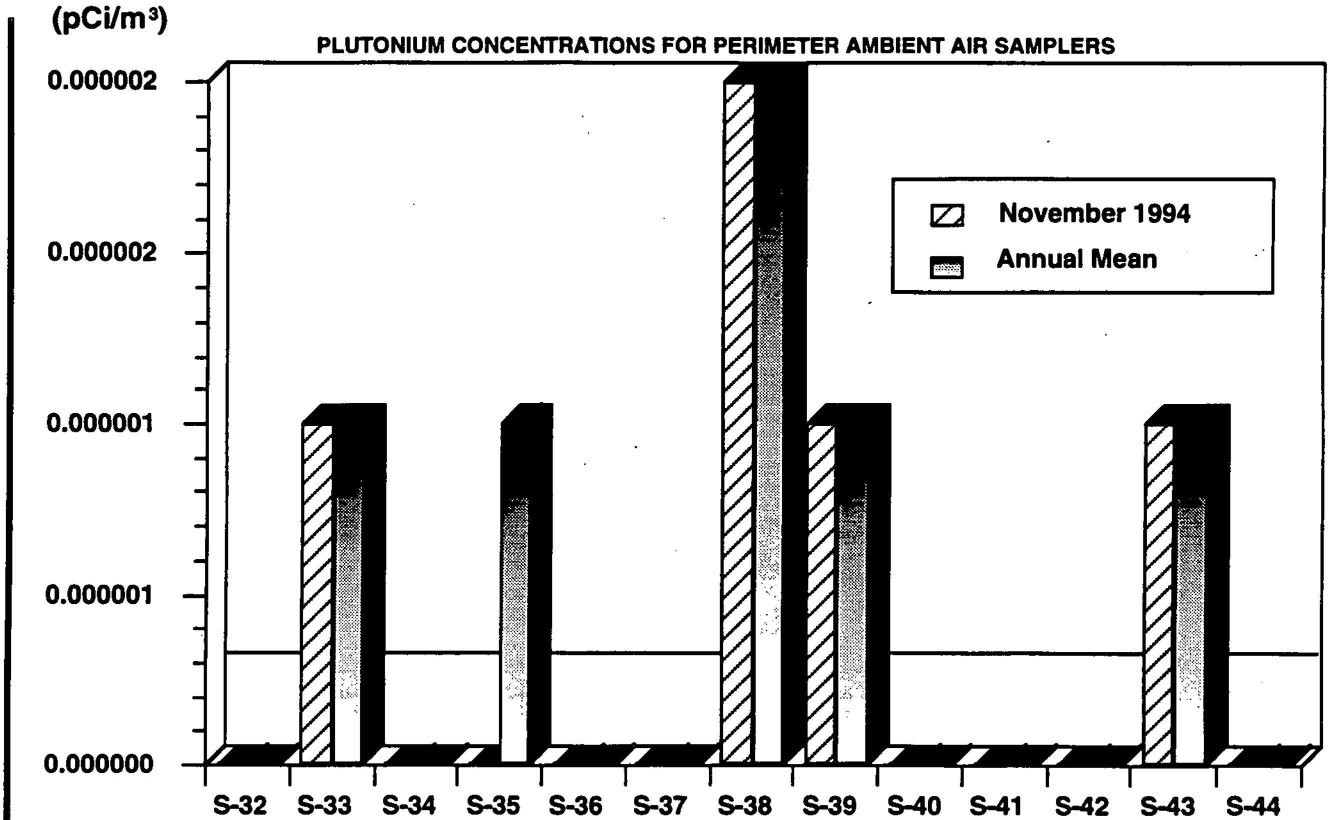
Plutonium Concentrations in Ambient Air for Community Samplers

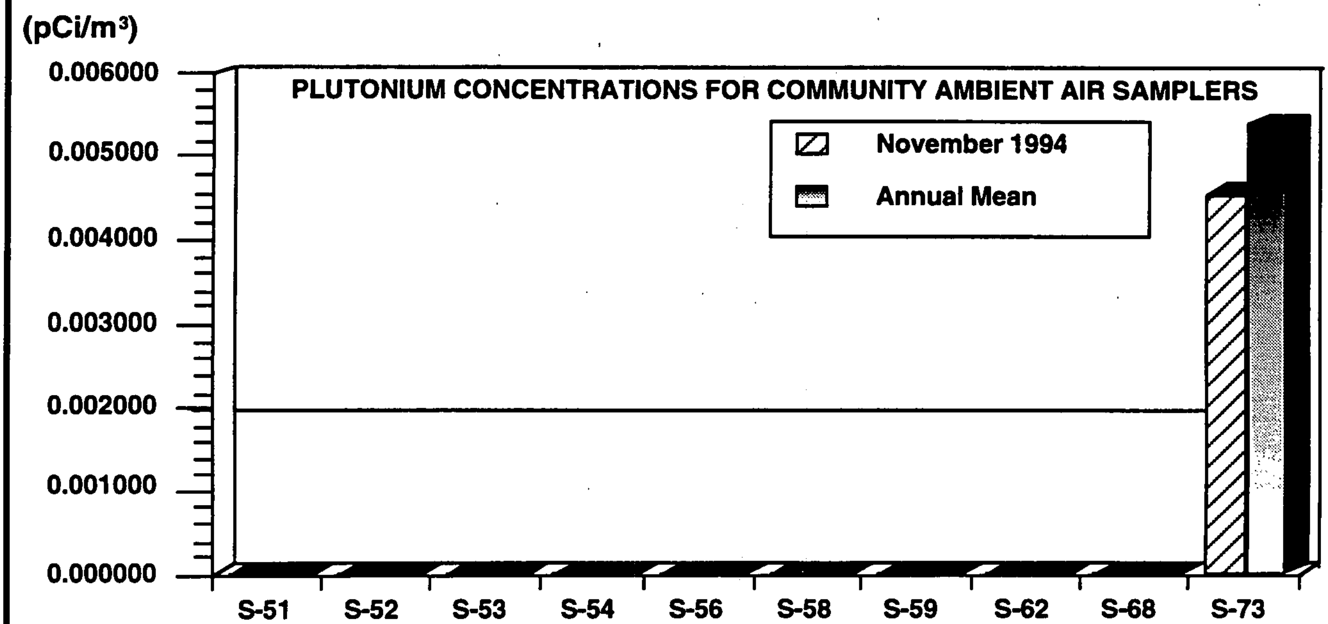
(10/05/94 - 11/16/94)

Location	Community Name	Volume (m^3)	Plutonium Concentration (pCi/m^3)	± 95 percent Confidence Interval (pCi/m^3)
S-51	Marshall	28362	.000000	.000001
S-52	Jeffco Airport	21060	.000000	.000001
S-53	Superior	31447	.000000	.000001
S-54[a]	Boulder			
S-56	Broomfield	28694	.000000	.000000
S-58[a]	Wagner			
S-59	Leyden	30069	.000000	.000000
S-62	Golden	33360	.000000	.000000
S-68	Lakeview Pointe			
S-73[b]	Cotton Creek	4	.004551	.005425

a These samplers were removed from service during the month due to the sampler upgrade project.

b Equipment failure.


(pCi/m³)
PLUTONIUM CONCENTRATIONS FOR PERIMETER AMBIENT AIR SAMPLERS
0.000002
0.000002
0.000001
0.000001
0.000000
November 1994
Annual Mean
S-32
S-33
S-34
S-35
S-36
S-37
S-38
S-39
S-40
S-41
S-42
S-43
S-44


(pCi/m³)
PLUTONIUM CONCENTRATIONS FOR COMMUNITY AMBIENT AIR SAMPLERS
0.006000
0.005000
0.004000
0.003000
0.002000
0.001000
0.000000
November 1994
Annual Mean
S-51
S-52
S-53
S-54
S-56
S-58
S-59
S-62
S-68
S-73

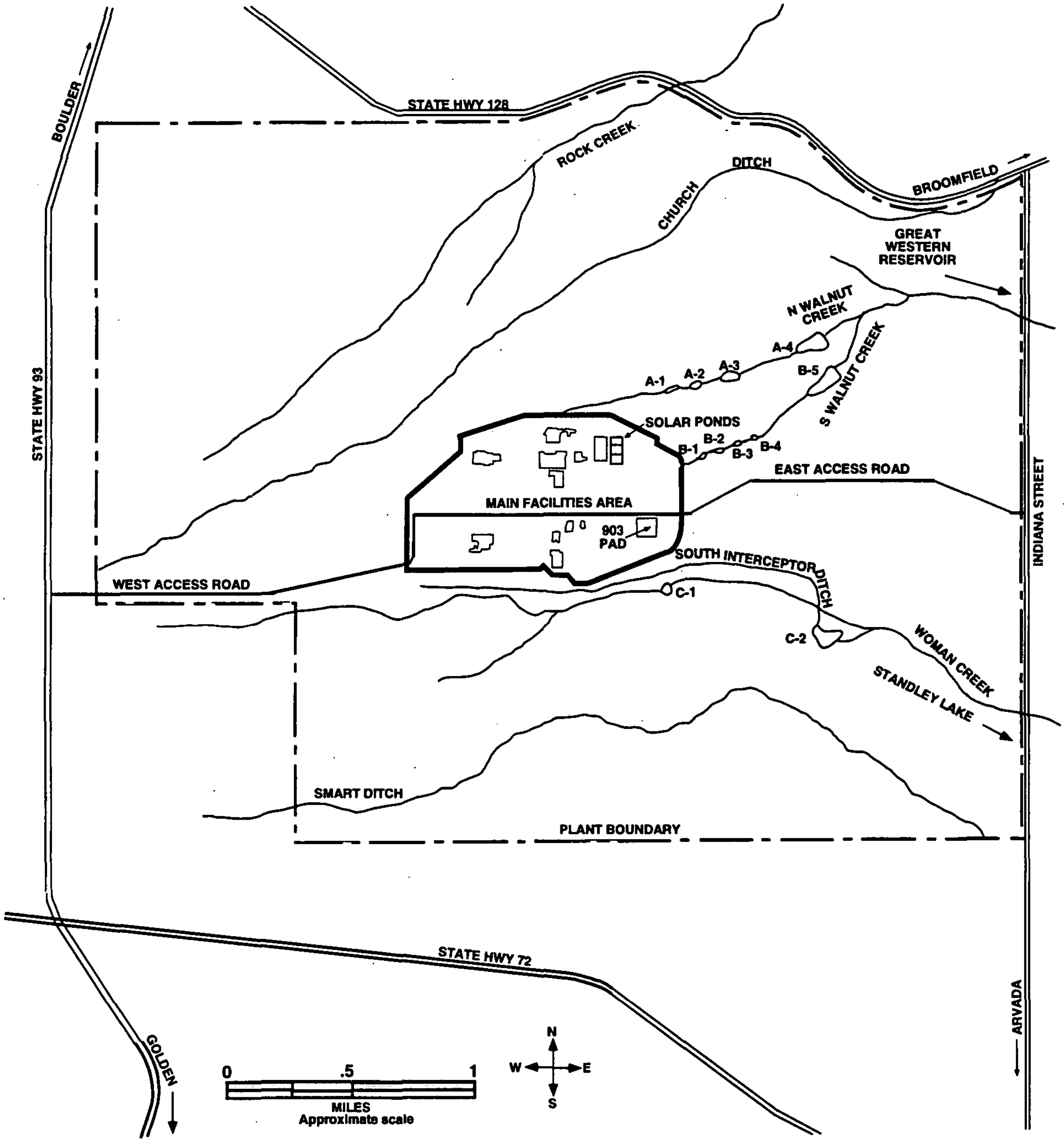
3. Surface Water

3.1 Radionuclide

RFETS samples for and analyzes radionuclides that may be present in the plant surface-water control ponds and drinking water reservoirs. 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 CWQCC has issued stream segment standards for drainages downstream of RFETS. These standards address both radioactive and nonradioactive parameters. Figure 4 shows the locations of holding ponds and liquid effluent water courses at RFETS.

Water sampling is performed at several locations at RFETS. 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. Analysis are then performed for plutonium, americium, and uranium isotopic concentrations.

Water sampling results for radioactive constituents are given in Tables 7 through 10.



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

Figure 4: Holding Pond and Liquid Effluent Water Courses

Table 7

Onsite Surface Water Sample Results - Plutonium and Americium

Holding Pond Outfall (pCi/l)

Location	Plutonium-239, -240			Americium-241		
Pond A-4 No discharge						
Volume weighted average concentration						
Pond B-5 - No discharge						
Pond C-1						
10/29/94 - 11/04/94	0.003	±	0.005	0.021	±	0.016
11/05/94 - 11/11/94	0.001	±	0.005	0.014	±	0.013
11/12/94 - 11/18/94		a			a	
11/19/94 - 11/25/94	-0.001	±	0.004	0.000	±	0.006
11/26/94 - 12/02/94	0.005	±	0.006		a	
Average concentration		a			a	
Pond C-2 - No discharge						
Volume weighted average concentration						
Walnut Creek at Indiana - No flow						
Volume weighted average concentration						

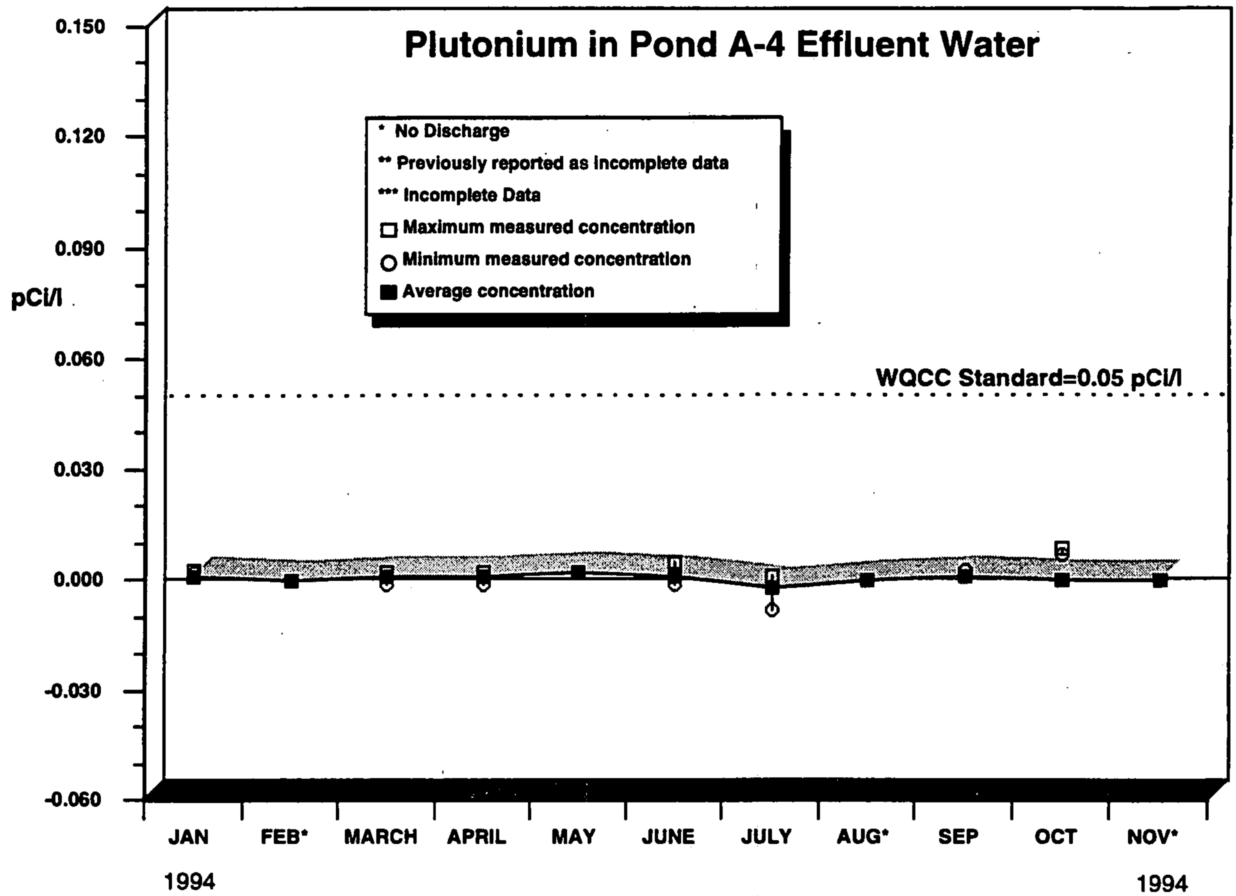
a Incomplete lab analysis.

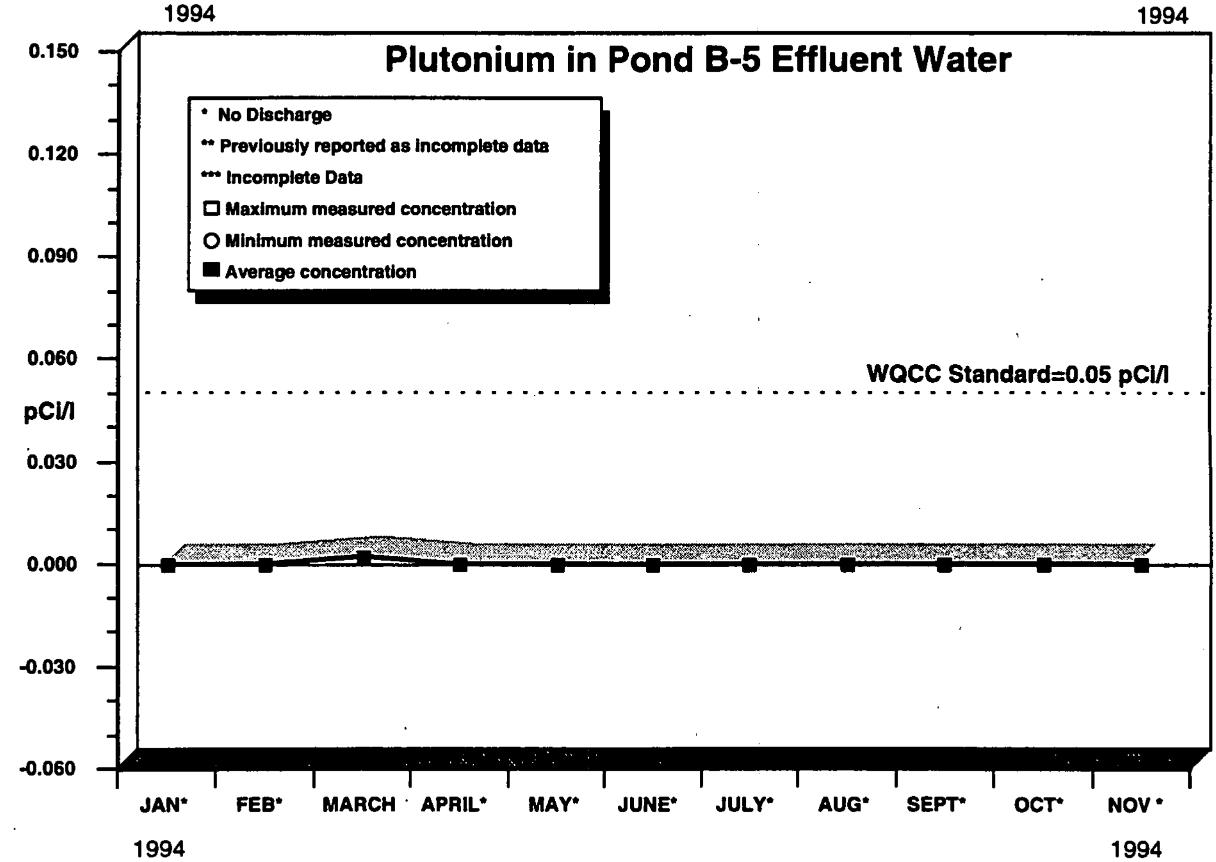
Table 8

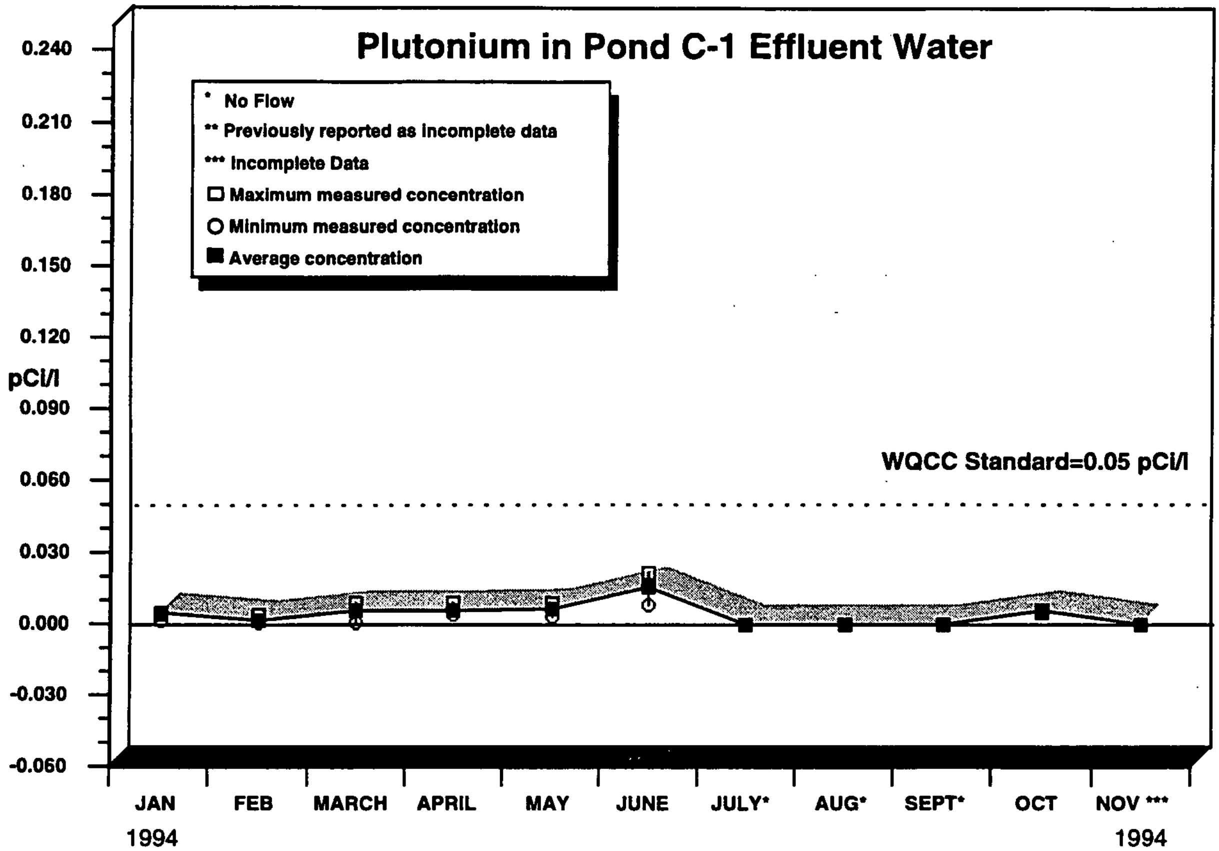
Onsite Surface Water Sample Results - Uranium

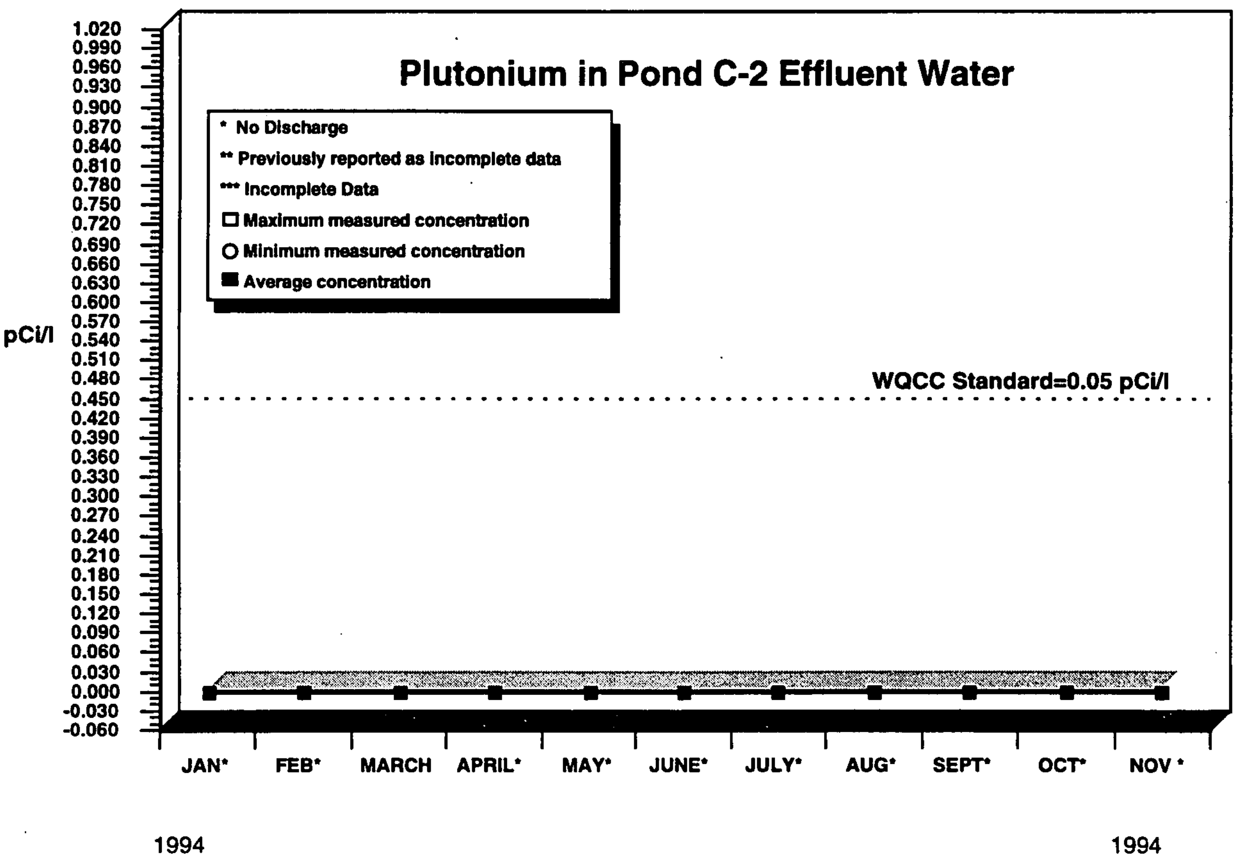
Holding Pond Outfall (pCi/l)

Location	Uranium-233, -234			Uranium-238		
Pond A-4 No discharge						
Volume weighted average concentration						
Pond B-5 - No discharge						
Pond C-1						
10/29/94 - 11/04/94	2.20	±	0.20	1.63	±	0.15
11/05/94 - 11/11/94	1.71	±	0.20	1.23	±	0.15
11/12/94 - 11/18/94	1.36	±	0.16	0.98	±	0.12
11/19/94 - 11/25/94	1.36	±	0.15	1.04	±	0.12
11/26/94 - 12/02/94	1.39	±	0.15	1.00	±	0.11
Average concentration	1.60	±	0.36	1.18	±	0.27
Pond C-2 - No discharge						
Volume weighted average concentration						
Walnut Creek at Indiana - No flow						
Volume weighted average concentration						


Plutonium in Pond A-4 Effluent Water
* No Discharge
** Previously reported as incomplete data
*** Incomplete Data
Maximum measured concentration
Minimum measured concentration
Average concentration
WQCC Standard=0.05 pCi/l
pCi/l
0.150
0.120
0.090
0.060
0.030
0.000
-0.030
-0.060
JAN
FEB*
MARCH
APRIL
MAY
JUNE
JULY
AUG*
SEP
OCT
NOV*
1994
1994


Plutonium in Pond B-5 Effluent Water
* No Discharge
** Previously reported as incomplete data
*** Incomplete Data
Maximum measured concentration
Minimum measured concentration
Average concentration
WQCC Standard=0.05 pCi/l
pCi/l
0.150
0.120
0.090
0.060
0.030
0.000
-0.030
-0.060
JAN*
FEB*
MARCH
APRIL*
MAY*
JUNE*
JULY*
AUG*
SEPT*
OCT*
NOV*
1994
1994


Plutonium in Pond C-1 Effluent Water
* No Flow
** Previously reported as incomplete data
*** Incomplete Data
Maximum measured concentration
Minimum measured concentration
Average concentration
WQCC Standard=0.05 pCi/l
pCi/l
0.240
0.210
0.180
0.150
0.120
0.090
0.060
0.030
0.000
-0.030
-0.060
JAN
FEB
MARCH
APRIL
MAY
JUNE
JULY*
AUG*
SEPT*
OCT
NOV ***
1994
1994


Plutonium in Pond C-2 Effluent Water
* No Discharge
** Previously reported as incomplete data
*** Incomplete Data
Maximum measured concentration
Minimum measured concentration
Average concentration
WQCC Standard=0.05 pCi/l
pCi/l
1.020
0.990
0.960
0.930
0.900
0.870
0.840
0.810
0.780
0.750
0.720
0.690
0.660
0.630
0.600
0.570
0.540
0.510
0.480
0.450
0.420
0.390
0.360
0.330
0.300
0.270
0.240
0.210
0.180
0.150
0.120
0.090
0.060
0.030
0.000
-0.030
-0.060
JAN*
FEB*
MARCH
APRIL*
MAY*
JUNE*
JULY*
AUG*
SEPT*
OCT*
NOV *
1994
1994

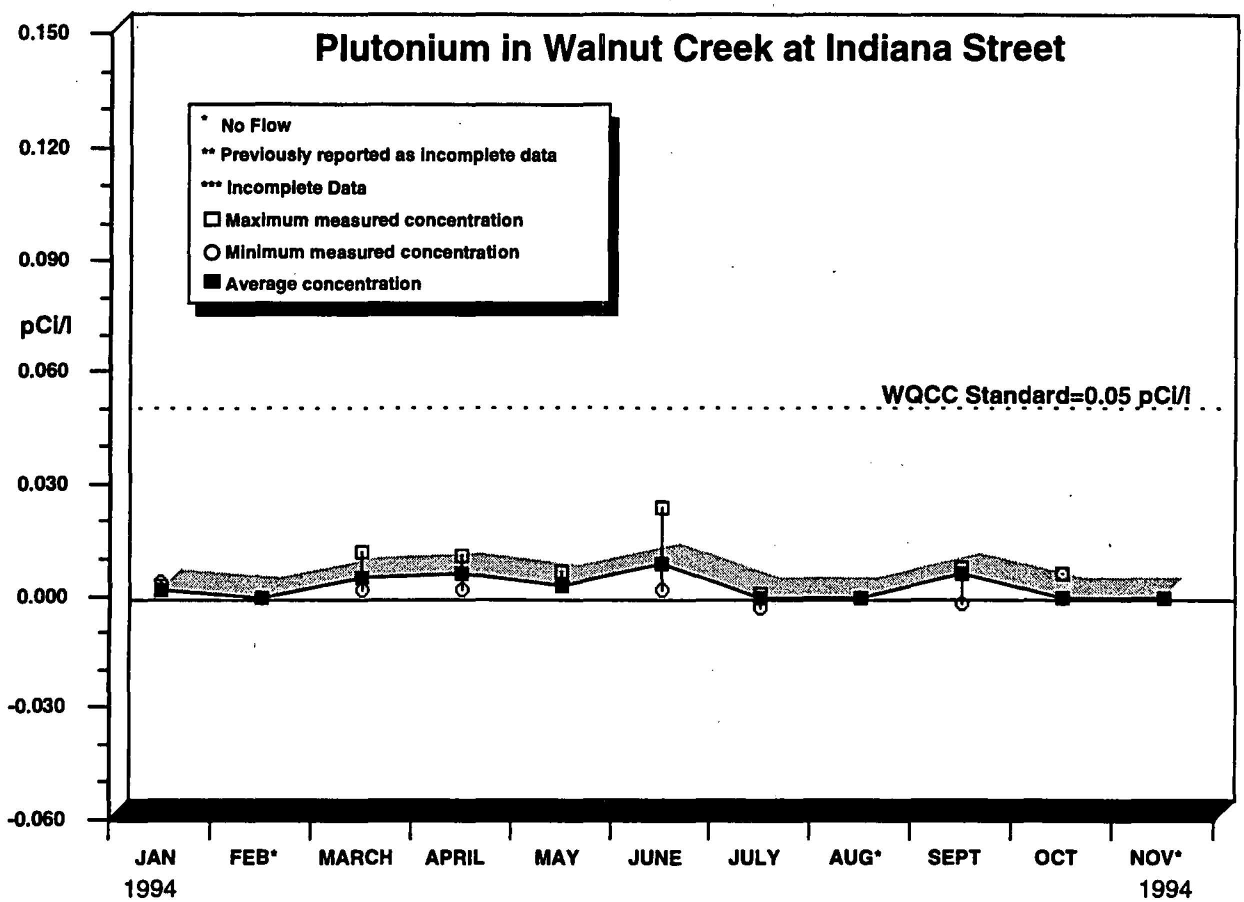

Plutonium in Walnut Creek at Indiana Street
* No Flow
** Previously reported as incomplete data
*** Incomplete Data
Maximum measured concentration
Minimum measured concentration
Average concentration
WQCC Standard=0.05 pCi/l
pCi/l
0.150
0.120
0.090
0.060
0.030
0.000
-0.030
-0.060
JAN 1994
FEB*
MARCH
APRIL
MAY
JUNE
JULY
AUG*
SEPT
OCT
NOV* 1994

Table 9

Onsite Surface Water Sample Results - Tritium

		Tritium (pCi/l)		
Location	Number of Samples	C Minimum	C Maximum	C Average
Pond C-1	4	60 ±180	210 ±170	110 ± 70

3.2 Nonradionuclide

RFETS conducts sitewide surface-water sampling programs to monitor discharges from detention ponds, evaluate potential contaminant releases, and characterize baseline water quality. Nonradioactive parameters requirements for this monitoring are derived from the NPDES permit as modified in March 1991 by an FFCA. The NPDES/FFCA permit sets limits for nonradioactive pollutants in effluent water from federal facilities.

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

Water sampling results associated with the NPDES/FFCA permit are reported in Table 10. Applicable NPDES/FFCA limits are included in Table 10 for comparison. Monitoring results for which no limits have been established under the NPDES/FFCA are reported in Table 11. Analytical results for nonradioactive parameters in water at Walnut Creek at the Indiana Street location are summarized in Table 12.

Table 10

NPDES/FFCA Permit Surface Water Sample Results

Discharge 001-A (Pond B-3) - Continuous discharge 11/01/94 -11/30/94

Parameters		*Measured 30-Day Average*	*Limit 30-Day Average*	*Measured Max. 7-Day Average*	*Limit Max. 7-Day Average*
Nitrate	mg/l	4.4	10	5.9	20

		Measured Maximum	*Limit Maximum*
Total Residual Chlorine	mg/l	0.10	0.5

Discharge 001-B (Sewage Treatment Plant) - Continuous discharge 11/01/94 - 11/30/94

Parameters		*Measured 30-Day Average*	*Limit 30-Day Average*	*Measured Maximum*	*Limit Maximum*
CBOD5	mg/l	3.7	10	7.6	25
Total Phosphorus	mg/l	4.3	8	7.6	12
Total Chromium	mg/l	<0.005	0.05	<0.005	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)	<15 (Geometric)	400 (Geometric)
Total Suspended Solids	mg/l	<4	30	<4	45

		Measured Minimum	*Limit Minimum*	*Measured Maximum*	*Limit Maximum*
pH	SU	6.4	6.0	7.4	9.0

	Observed Sheen	*Limit Sheen*
Oil and Grease	No visual	No visual

Table 10

NPDES/FFCA Permit Surface Water Sample Results (Continued)

Discharge 002 (Pond A-3) - No discharge

Parameters		***Measured 30-Day Average***	***Limit 30-Day Average***	***Measured Maximum***	***Limit Maximum***
Nitrates as N	mg/l		10		20
		Measured Minimum	***Limit Minimum***	***Measured Maximum***	***Limit Maximum***
pH	SU		6.0		9.0

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)- No discharge

Parameters		***Measured Maximum***	***Limit Maximum***
Total Chromium	mg/l		0.05

Discharge 006 (Pond B-5) - No discharge

Measured Parameters	***Limit***	***Measured 30-Day Average***	***Limit 30-Day Average***	***Max. 7-Day Maximum***	***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 11

NPDES/FFCA Effluent Monitoring

Discharge 001-A (Pond B-3) - Pond discharged continuously 11/01/94 - 11/30/94

Parameters		Measured Maximum	Measured 30-Day Average
BOD5	mg/l	11.3	6.5
CBOD5	mg/l	7.3	4.4
Total Suspended Solids	mg/l	13	7.8

Discharge 001-B (Sewage Treatment Plant [STP]) - Discharged continuously 10/01/94 - 10/31/94

Parameters		Measured Maximum	Measured 30-Day Average
Total Residual Chlorine	mg/l	0.06	0.03
Whole Effluent Toxicity[a]		Sampled quarterly; data reported 9/94	
Ceriodaphnia		% Eff to LC50:	
Fathead Minnows		% EFF to LC50:	

			Measured Concentrations
Metals	μg/l		
Metals were sampled on 11/02/94			
Antimony			<27.0
Arsenic			1.0
Beryllium			<1.0
Cadmium			<0.1
Copper			6.0[b]
Iron			104
Lead			0.4[b]
Manganese			30.5
Mercury			<0.1
Nickel			<9.0
Silver			0.2[b]
Zinc			35.6

		PQL[c]	Concentrations that were above PQL	
Volatile Organic Compounds (VOCs)	μg/l			
Chloroform	5 ug/l	5 ug/l		Sampled 11/02/94

Table 11

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) No discharge

Whole Effluent Toxicity[a]

Ceriodaphnia	% EFF to LC50:
Fathead Minnows	% EFF to LC50:

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 Absolute value of the analyzed result is less than the Contract Required Detection Limit (CRDL).

c PQL (Practical Quantitation Limit) 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 12

Surface Water Sample Results, Nonradioactive Parameters

Walnut Creek at Indiana Street

Parameters		Number of Samples	C Minimum	C Maximum	C Average
pH	SU				N/A
Nitrates as N	mg/l				

No flow measured during November 1994.

3.3 Flow

Daily flow data for surface water from the two plant drainage systems (Walnut Creek and Woman Creek) are given in Tables 13 and 14. 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 15. Discharges from Pond A-4, which include transfers from Pond B-5, enter Walnut Creek and are diverted around Great Western Reservoir through the Broomfield Diversion Ditch. Discharges from Pond C-2 are pumped through a pipeline into the Broomfield Diversion Ditch, and also diverted around Great Western Reservoir.

Table 13

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)
11/01/94	No Flow	No Discharge	No Discharge
11/02/94			
11/03/94			
11/04/94			
11/05/94			
11/06/94			
11/07/94			
11/08/94			
11/09/94			
11/10/94			
11/11/94			
11/12/94			
11/13/94			
11/14/94			
11/15/94			
11/16/94			
11/17/94			
11/18/94			
11/19/94			
11/20/94			
11/21/94			
11/22/94			
11/23/94			
11/24/94			
11/25/94			
11/26/94			
11/27/94			
11/28/94			
11/29/94			
11/30/94	No Flow	No Discharge	No Discharge
Total	No Flow	No Discharge	No Discharge

Table 14

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

Date	Pond C-1 (Gallons)	Pond C-2 (Gallons)
11/01/94	28,000	No Discharge
11/02/94	26,000	
11/03/94	54,000	
11/04/94	91,000	
11/05/94	146,000	
11/06/94	153,000	
11/07/94	69,000	
11/08/94	79,000	
11/09/94	154,000	
11/10/94	177,000	
11/11/94	92,000	
11/12/94	76,000	
11/13/94	82,000	
11/14/94	165,000	
11/15/94	200,000	
11/16/94	273,000	
11/17/94	413,000	
11/18/94	412,000	
11/19/94	412,000	
11/20/94	360,000	
11/21/94	244,000	
11/22/94	163,000	
11/23/94	86.000	
11/24/94	127,000	
11/25/94	137,000	
11/26/94	133,000	
11/27/94	100,000	
11/28/94	58,000	
11/29/94	39,000	
11/30/94	70,000	No Discharge
Total	4,619,000	No Discharge

Table 15

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

Date	Pond B-5 to Pond A-4 (Gallons)
11/01/94	No Transfer
11/02/94	
11/03/94	
11/04/94	
11/05/94	
11/06/94	
11/07/94	
11/08/94	
11/09/94	
11/10/94	No Transfer
11/11/94	980,000
11/12/94	1,456,000
11/13/94	1,425,000
11/14/94	1,415,000
11/15/94	1,419,000
11/16/94	1,319,000
11/17/94	1,197,000
11/18/94	1,159,000
11/19/94	1,110,000
11/20/94	1,042,000
11/21/94	340,000
11/22/94	No Transfer
11/23/94	
11/24/94	
11/25/94	
11/26/94	
11/27/94	
11/28/94	
11/29/94	
11/30/94	No Transfer
Total	12,862,000

Errata

Table 7 - Errata October 1994

Onsite Surface Water Sample Results - Plutonium and Americium

Holding Pond Outfall (pCi/l)

Location	Plutonium-239, -240			Americium-241		
Pond A-4						
10/22/94 - 10/28/94	0.009	±	0.007	0.001	±	0.007[a]
10/29/94 - 10/31/94	-0.002	±	0.004[a]	-0.001	±	0.008[a]
Volume weighted average concentration	0.006	±	0.005[a]	0.000	±	0.005[a]
Pond B-5 - No discharge						
Pond C-1						
10/18/94 - 10/21/94	0.005	±	0.006	0.003	±	0.010
10/22/94 - 10/28/94	0.006	±	0.007	0.018	±	0.012[a]
Average concentration	0.006	±	0.001	0.011	±	0.011[a]
Pond C-2 - No discharge						
Volume weighted average concentration						
Walnut Creek at Indiana						
10/23/94 - 10/28/94	0.006	±	0.006	0.007	±	0.009[a]
10/22/94 - 10/28/94	0.001	±	0.005a	-0.008	±	0.008[a]
Volume weighted average concentration	0.004	±	0.004[a]	0.002	±	0.007[a]

a Previously reported as incomplete.

Table 8 - Errata October 1994

Onsite Surface Water Sample Results - Uranium

Holding Pond Outfall (pCi/l)

Location	Uranium-233 -234			Uranium-241		
Pond A-4						
10/22/94 - 10/28/94	0.70	±	0.08	0.71	±	0.08
10/29/94 - 10/31/94	0.95	±	0.10[a]	0.91	±	0.10[a]
Volume weighted average concentration	0.77	±	0.06[a]	0.77	±	0.06[a]
Pond B-5 - No discharge						
Pond C-1						
10/18/94 - 10/21/94	1.87	±	0.17	1.49	±	0.14
10/22/94 - 10/28/94	2.35	±	0.26	1.55	±	0.18
Average concentration	2.11	±	0.34	1.52	±	0.04
Pond C-2 - No discharge						
Volume weighted average concentration						
Walnut Creek at Indiana						
10/23/94 - 10/28/94	0.91	±	0.10	0.93	±	0.11
10/22/94 - 10/28/94	0.83	±	0.09a	0.84	±	0.09[a]
Volume weighted average concentration	0.89	±	0.08[a]	0.90	±	0.08[a]

a Previously reported as incomplete.

Table 9 - Errata October 1994

Onsite Surface Water Sample Results - Tritium

Location	Number of Samples	C Minimum	C Maximum	C Average
		Tritium (pCi/l)		
Pond A-4[b]	10	-110 ±150	80 ±150	0 ± 50
Pond C-1	2	-90 ±190	60 ±154	-20 ±100
Walnut at Indiana[b]	9	-70 ±150	90 ±160	0 ± 5

a Previously reported as incomplete.
b Volume weighted average concentration

4 . Groundwater Monitoring

Underlying RFETS is a series of stratigraphic units that include surface deposits (i.e., recent valley fill and loose rock debris), the Rocky Flats Alluvium, Arapahoe Formation, Laramie Formation, Fox Hills Sandstone, and the Pierre Shale (Figure 5).The Rocky Flats Alluvium and weathered portions of the Arapahoe Formation are in hydraulic connection, and together with colluvium and other alluvium, represent the uppermost aquifer in the area.

The Rocky Flats Alluvium is composed of cobbles, coarse gravel, sand, and gravely clay, varying in thickness across RFETS from approximately 103 feet on the west side, to less than 10 feet in the central area, and 45 feet on the east side of the plant. The Arapahoe Formation is approximately 102 feet thick in the area of RFETS and consists of fluvial claystone overbank deposits and lesser amounts of sandstone channel deposits. The sandstones range from very fine grained to conglomeratic.

In the spring and early summer, the Rocky Flats Alluvium and Arapahoe Formation are recharged by precipitation and groundwater lateral flow. In late summer and early fall, recharge is primarily by groundwater lateral flow. In the stream drainages, groundwater discharges at seeps located at the base of the Rocky Flats Alluvium and where individual sandstone lenses are exposed at the surface.

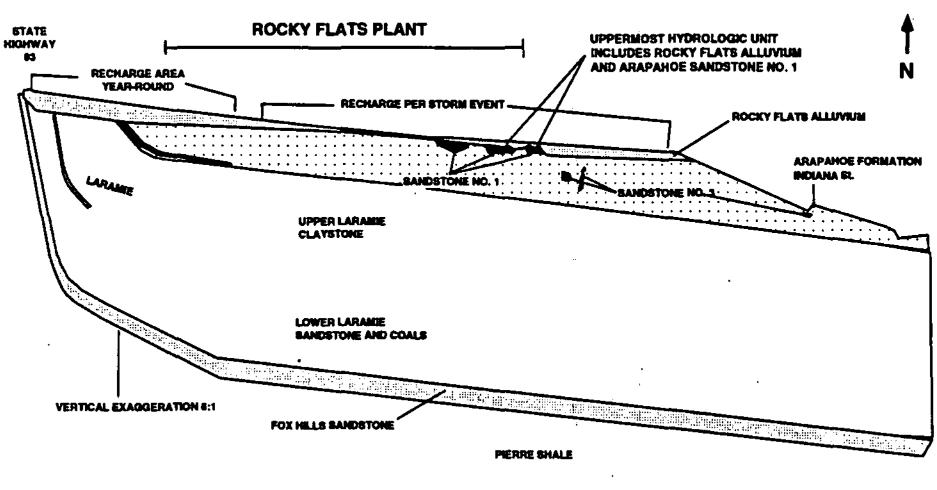


Figure 5: Generalized Cross Section of the Stratigraphy Underlying RFETS

Groundwater samples are collected quarterly from a network of more than 400 alluvial and bedrock wells located across the plantsite (Figure 6). Samples are analyzed at several offsite laboratories for a wide variety of parameters, including dissolved metals, total metals organics, dissolved radionuclides, total radionuclides, indicators (total dissolved solids and pH), several field parameters (including temperature, dissolved oxygen, alkalinity, and specific conductance), and anions (such as carbonate, bicarbonate, chloride, sulfate, etc.). Wells are spatially distributed to provide the coverage necessary to meet requirements of the Resource Conservation and Recovery Act (RCRA), the Comprehensive Environmental Response, Compensation and Liability Act (CERCLA), and plant protection guidelines for monitoring groundwater at hazardous waste sites. Some wells are used to help characterize hydrogeologic conditions at RFETS, whereas others are used to monitor background groundwater quality.

Wells are subdivided into six subsets, based on purpose and regulatory requirements:

- Background wells monitor the groundwater in areas upgradient of, or cogradient with, RFETS.
- RCRA regulatory wells characterize and/or monitor the uppermost aquifer for RCRA units.
- RCRA characterization wells characterize and/or monitor aquifers other than the uppermost aquifer at or near RCRA hazardous waste management units.
- CERCLA wells characterize and/or monitor the groundwater for CERCLA units.
- Boundary wells monitor the movement and quality of groundwater at the downgradient boundaries of RFETS.
- Special purpose wells include other wells installed to characterize groundwater and hydrogeology for a variety of other purposes.

Boundary well monitoring results for the second quarter of 1994 were presented in the October edition of the Monthly Environmental Monitoring Report. Third quarter data are scheduled to be reported in January 1995.

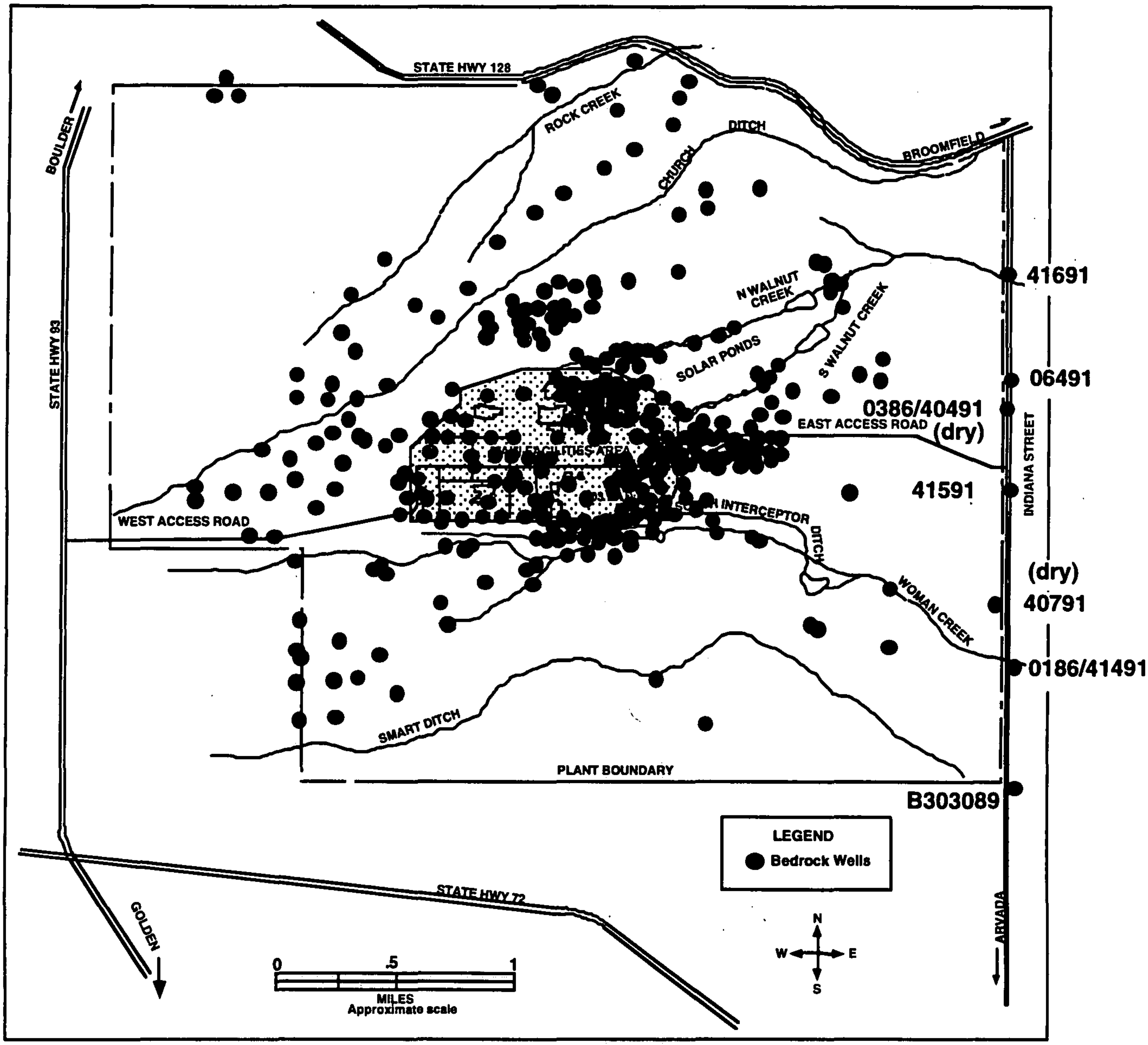


Figure 6: Location of Groundwater Monitoring Wells

5. Meteorology and Climatology

Meteorological data are routinely measured at the plantsite from instrumentation on a 61-meter (200-foot) tower located in the west buffer zone at an elevation of 1,870 meters (6,140 feet) above sea level. The frequency of wind direction and speed during November 1994 are shown in Table 16. The compass points indicate the direction from which the wind blows. Day and night wind roses display these frequencies graphically in Figure 7 to illustrate the large diurnal wind changes. The wind rose sectors also represent the direction from which the wind blows (i.e., wind blows toward the center):

Due to meteorological tower maintenance work, auditing and periodic failures during this month, meteorological parameter averages, some maximums and minimums, frequencies, and totals will be biased and/or erroneous.

The distribution of winds at the Rocky Flats Environmental Technology Site (RFETS), during November 1994, indicates predominant large-scale wind direction from the westerly sector. The most frequent wind direction was west-northwest. The westerly sector was also responsible for the most frequent occurrence of highest sustained wind velocities. Over 6% of November experienced speeds over 8.0 m/s (17.7 mph) from west-northwest. At speeds less than 4 m/s (9 mph), the distribution of wind direction was more even. Wind speeds of 5 m/s (11 mph) or greater from the east sector are common during daytime hours. Moderate northeast or southeast breezes occur when strong diurnal heating of the foothills generates an upslope circulation. Light or moderate thermally driven winds, which flow up the slope east of RFETS, are the most common daytime wind during the warm season. During fall, winter, and early spring, however, westerly winds are usually the most common wind during both day and night. The frequency and strength of westerly winds increase during the colder months because the polar jet stream is much stronger and lies close to, if not over, Colorado. Low level drainage wind down the Rocky Flats slope produces predominantly northwesterly breezes at night. This was the case for November.

Like October, November 1994 was cooler than average. Precipitation for November was slightly above normal for the month. This was due to the seasonably frequent passage of disturbances in the westerlies and associated cold fronts. Strong downslope west winds become more common during the fall months. With a mean wind speed of 10.2 mph (4.5m/s), November was close to the average monthly mean of 9.8 mph (4.4m/s). The peak gust 75.5 mph (33.7m/s) was also higher than average 1-second maximum of 66 mph (29.5m/s).

High temperatures reached at least 50.0°F (10.0°C) on 14 days and rose to above 60.0°F (15.5°C) on 5 days. The monthly maximum of 68.7°F (20.4°C) was reached on the 7th. A Canadian airmass associated with surface high pressure allowed the monthly minimum of 8.7°F (-12.9°C) to be reached on the morning of the 17th. A series of Pacific cold fronts and associated upper level disturbances during the first half of the month, resulted in a few significant snow events. The largest snowfall totaled 7 inches (17.8 cm) on the 3rd.

The mean temperature was 34.6°F (1.4°C), or about 2.4°F (1.3°C) below normal. The high temperature averaged 46.6°F (8.1°C), about 1.4°F (0.7°C) below normal. Overnight low temperatures averaged 22.4°F (-5.3°C), or 3.6°F (2.0°C) below normal. Precipitation totaled 1.08 in. (2.7cm). Normal for November is 0.82 in. (2.1cm). Nearly all of this precipitation fell as snow with 18 inches (45.7 cm) measured for the month. This is slightly above the average for November.

Table 16

Rocky Flats Environmental Technology Site Wind Direction Frequency (Percent) by Four Wind-Speed Classes

(Fifteen-Minute Averages - November 1994)

	Calm	1-2 (m/s)	2.5-4 (m/s)	4-8 (m/s)	>8 (m/s)	Total (m/s)
N	-	2.11	1.16	0.79	0.00	4.06
NNE	-	2.14	2.05	0.94	0.00	5.13
NE	-	2.27	1.92	0.69	0.03	4.91
ENE	-	2.58	1.04	0.22	0.03	3.87
E	-	1.83	1.10	0.16	0.13	3.22
ESE	-	2.96	0.76	0.35	0.06	4.13
SE	-	2.49	1.26	0.25	0.00	4.00
SSE	-	2.01	2.20	1.10	0.00	5.31
S	-	2.42	2.11	1.23	0.22	5.98
SSW	-	2.76	1.85	0.10	0.00	4.71
SW	-	3.34	1.86	1.92	0.47	7.59
WSW	-	3.40	1.98	1.26	1.70	8.34
W	-	2.27	1.92	0.69	0.03	4.91
WNW	-	2.23	1.64	2.55	6.10	12.52
NW	-	1.73	1.83	1.42	1.01	5.99
NNW	-	2.11	2.05	1.60	0.06	5.82
TOTAL		38.65	26.73	15.27	9.84	90.49

Table 17

Climatic Summary

Date	TEMPERATURE (deg. F) High	Low	Mean	DEW-POINT (deg. F) Mean	REL HUM (%) Mean	WIND SPEED (mph) Mean	Peak gust (1 sec)	PRESS. (mb) Mean	SOLAR (kW-h/m2) Total	WATER-EQUIV.-PRECIP. (inches) Total	Peak (15 min)	SNOW (inches) Total
11/01/94	33.26	12.31	22.78	12.88	61.96	8.39	64.00	801.16	5.73	0.00	0.16	0.00
11/02/94	51.08	30.30	41.98	19.72	36.44	5.77	28.00	801.16	5.73	0.20	0.16	0.00
11/03/94	32.88	21.92	27.40	27.00	98.18	5.88	14.70	806.12	0.46	0.10	0.04	7.00
11/04/94	34.20	19.13	26.66	25.36	94.15	5.77	19.84	801.16	5.73	0.00	0.16	0.00
11/05/94	55.81	21.51	38.66	27.95	62.02	8.39	36.35	808.75	3.49	0.00	0.00	0.00
11/06/94	64.76	30.16	47.46	32.88	53.29	5.53	17.74	811.66	3.78	0.00	0.00	0.00
11/07/94	68.77	39.96	54.37	29.66	34.61	7.69	18.05	808.66	3.60	0.00	0.00	0.00
11/08/94	46.63	23.70	35.17	30.22	80.18	5.93	18.25	811.46	0.45	0.35	0.03	5.00
11/09/94	42.08	23.25	32.67	29.61	87.16	3.74	13.22	812.87	2.67	0.00	0.00	0.00
11/10/94	55.72	25.25	40.49	32.36	70.01	4.36	13.11	809.62	2.95	0.00	0.00	0.00
11/11/94	65.80	32.95	49.38	23.50	31.90	6.20	21.21	808.64	3.21	0.00	0.00	0.00
11/12/94	65.44	32.00	48.72	29.64	43.64	10.38	49.06	798.74	2.34	0.00	0.00	0.00
11/13/94	50.83	26.58	38.71	19.17	40.91	9.64	42.75	805.63	2.42	0.35	0.04	3.00
11/14/94	32.00	11.17	21.59	20.88	96.72	3.80	10.80	815.91	0.92	0.08	0.02	3.00
11/15/94	34.05	9.09	21.57	12.74	65.16	4.47	11.86	814.34	3.94	0.00	0.00	0.00
11/16/94	50.67	22.51	36.59	19.80	46.28	7.31	35.50	801.07	2.52	0.00	0.00	0.00
11/17/94	39.87	23.92	31.90	8.91	33.23	18.48	63.04	799.29	3.30	0.00	0.00	0.00
11/18/94	30.34	13.66	22.00	12.70	63.72	6.73	18.36	809.71	3.06	0.00	0.00	0.00
11/19/94	35.94	8.73	22.34	16.54	75.78	4.81	10.80	808.74	3.48	0.00	0.00	0.00
11/20/94	47.19	24.13	35.66	16.14	40.36	19.35	72.50	803.89	3.49	0.00	0.00	0.00
11/21/94	39.24	17.42	28.33	17.65	60.51	8.61	34.34	812.19	2.42	0.00	0.00	0.00
11/22/94	36.48	14.79	25.64	14.43	58.53	7.18	21.41	818.00	3.32	0.00	0.00	0.00
11/23/94	58.26	20.35	39.31	-7.40	9.80	12.39	41.92	816.88	3.50	0.00	0.00	0.00
11/24/94	58.21	28.24	43.23	-1.79	11.33	9.01	32.88	813.54	3.09	0.00	0.00	0.00
11/25/94	52.95	24.58	38.77	11.41	27.77	6.38	20.27	808.31	3.34	0.00	0.00	0.00
11/26/94	50.47	23.94	37.21	10.83	28.89	11.63	39.70	799.32	1.90	0.00	0.00	0.00
11/27/94	29.98	17.35	23.67	-6.05	21.77	27.72	67.87	802.28	3.09	0.00	0.00	0.00
11/28/94	32.70	18.57	25.64	-3.46	22.93	23.00	75.54	806.27	3.46	0.00	0.00	0.00
11/29/94	43.57	15.37	29.47	-0.44	22.64	25.01	74.71	811.95	2.58	0.00	0.00	0.00
11/30/94	61.36	40.51	50.94	20.46	25.84	17.05	74.71	814.23	3.04	0.00	0.00	0.00

MONTHLY TEMPERATURES Mean High	Mean Low	Mean	Dew-point	Relative Humidity	WIND SPEED Mean (mph)	Monthly Max.	PRESS. Monthly Avg.	SOLAR Monthly Total	PRECIPITATION Total	Monthly Max.	SNOW Total
46.68	22.44	34.61	16.78	50.19	10.02	75.54	808.05	93.00	1.08	0.16	18.00

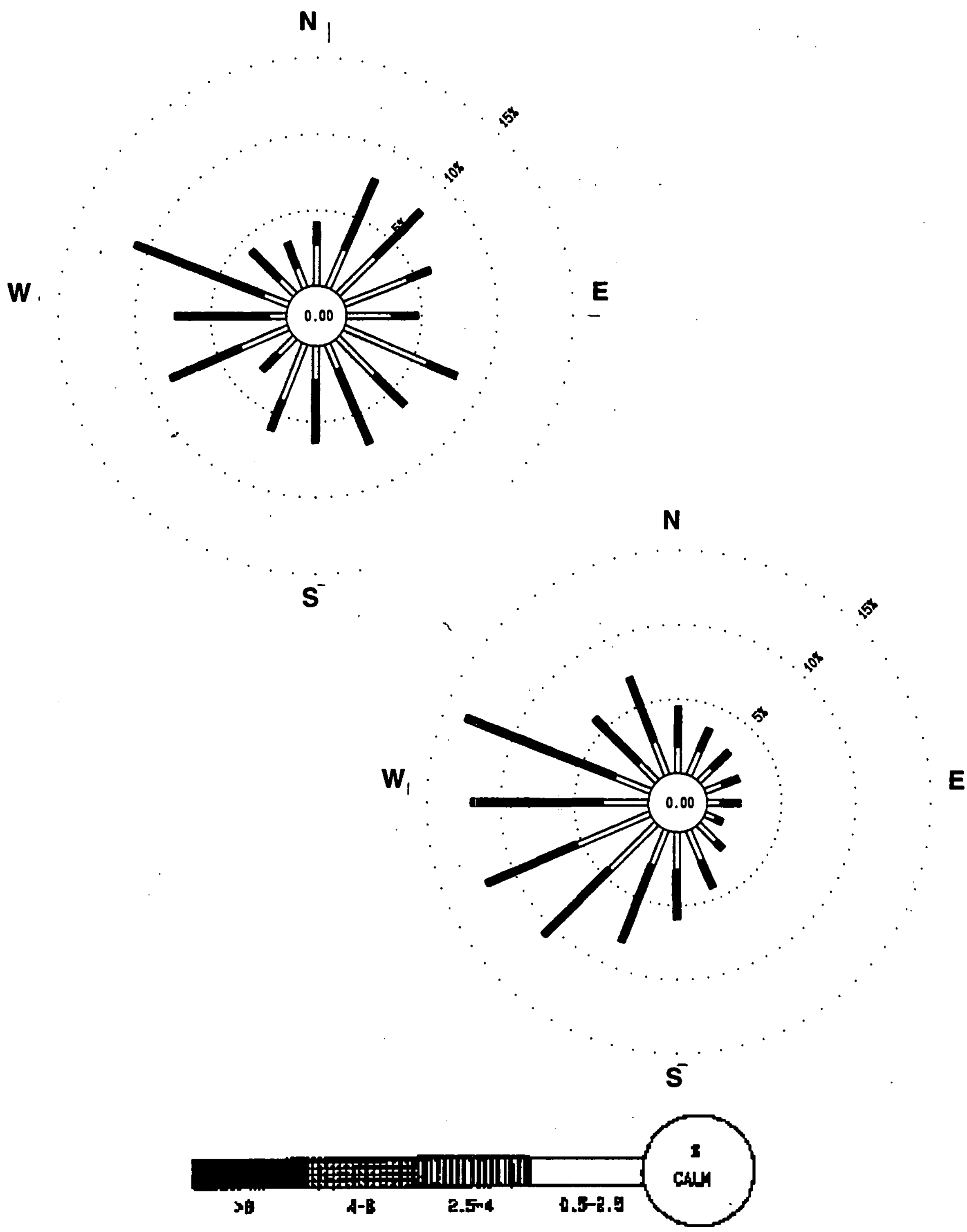


Figure 7: Daytime (top) and Nighttime (bottom) Wind Rose for the Rocky Flats Environmental Technology Site- November 1994

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 RFETS 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 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 Environmental Technology Site

Air Inhalation:

Radionuclide	DCG (pCi/m^3)
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
Hydrogen-3 (Tritium)	2,000,000

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 ICRP, as well as from the EPA Clean Air Act (CAA) 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 RFETS contribution to public radiation dose. On December 15, 1989, EPA published revised CAA 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 CAA 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 DCGs in DOE Order 5400.5. DCGs are the concentrations that would result in an EDE of 100 mrem from 1 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 this page lists the most restrictive air and water DCGs for the principal radionuclides of interest at the RFETS.

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 code, CAP88-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 EDE that a member of the public could receive as a result of RFETS 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

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 weighing 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.

References

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 finalized new standards for the Walnut Creek and Woman Creek drainages. The EPA has not yet written a new NPDES permit that reflects these standards; however, in the spirit of the Agreement in Principle (AIP) completed between the DOE and the State of Colorado, the RFETS is attempting to meet the standards at this time (Figure 8).

Standards for CWQCC are summarized in Table 18.

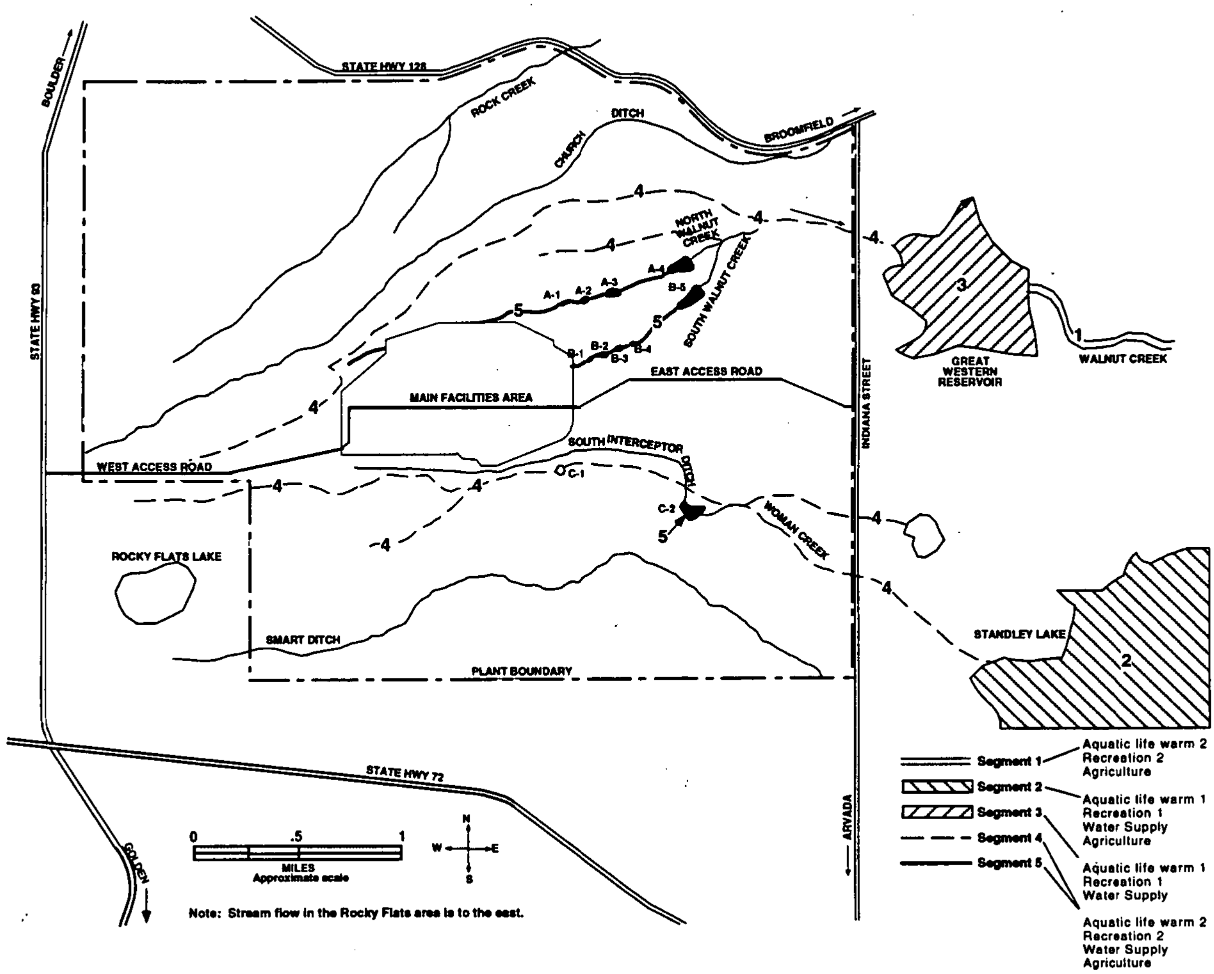


Figure 8: Stream Segmentation and Classification

Table 18

Water Quality Standards Comparison

Parameter Organics	CURRENT Segment 5 Standard µg/l	CURRENT Segment 4 Standard µg/l	footnotes
4-Chloro-3-methylphenol	30	30	f
Acenaphthene	520	520	f
Acenaphthylene	0.0028	0.0028	c
Acrolein	21	21	f
Acrylonitrile	0.058	0.058	c
Aldicarb	10	10	b
Aldrin	0.00013	0.00013	c,d
Anthracene	0.0028	0.0028	c
Atrazine	3	3	c
Benzene	1	1	b
Benzidine	0.00012	0.00012	b
Benzo(a)anthracene	0.0028	0.0028	c
Benzo(a)pyrene	0.0028	0.0028	c
Benzo(b)fluoranthene	0.0028	0.0028	c
Benzo(ghi)perylene	0.0028	0.0028	c
Benzo(k)fluoranthene	0.0028	0.0028	c
Bromodichloromethane	0.3	0.3	c
Bromoform	4	4	c
Butyl benzyl phthalate	3000	3000	f
Carbofuran	36	36	b
Carbon tetrachloride	18	0.25	b,e
Chlordane	0.00058	0.00058	c,d
Chlorobenzene	100	100	b
Chloroethyl ether (bis-2)	0.03	0.03	b,c
Chloroform	6.0	6.0	c
Chloromethyl ether (bis)	0.0000037	0.0000037	c
Chlorophenol	2000	2000	f
Chloropyrifos	0.041	0.041	f
Chrysene	0.0028	0.0028	c
DDD 4'4	0.00083	0.00083	f
DDE 4'4	0.001	0.001	b
DDT 4'4	0.00059	0.00059	c,d
Demeton	0.1	0.1	c
Di-n-butyl phthalate	2700	2700	f
Dibenzo(a,h)anthracene	0.0028	0.0028	c
Dibromochloromethane	6	6	c
Dichlorobenzene 1,2	620	620	b
Dichlorobenzene 1,3	400	400	b
Dichlorobenzene 1,4	75	75	b
Dichlorobenzidine	0.039	0.039	c
Dichloroethane 1,2	0.4	0.4	b
Dichloroethylene 1,1	0.057	0.057	b
Dichloroethylene 1,2-cis	70	70	b
Dichloroethylene 1,2-trans	100	100	b
Dichlorophenol 2,4	21	21	f
Dichlorophenoxyacetic acid (2,4-D)	70	70	c,d

Parameter **Organics**	CURRENT Segment 5 Standard µg/l	CURRENT Segment 4 Standard µg/l	footnotes
Dichloropropane 1,2	0.56	0.56	b
Dieldrin	0.00014	0.00014	c,d
Diethyl phthalate	23000	23000	f
Dimethylphenol 2,4	2120	2120	f
Dinitro-o-cresole	13	13	f
Dinitrophenol 2,4	14	14	b
Dinitrotoluene 2,4	0.11	0.11	f
Dinitrotoluene 2,6	230	230	f
Dioxin (2,3,7,8-TCDD)	0.000000013	1.3E-08	c,d
Diphenylhydrazine 1,2	0.04	0.04	b
Endosulfan	0.056	0.056	c
Endrin	0.0023	0.0023	c,d
Endrin aldehyde	0.2	0.2	f
Ethylbenzene	680	680	b
Ethylhexyl phthalate (bis-2)	1.8	1.8	f
Fluoranthene	42	42	c
Fluorene	0.0028	0.0028	c
Guthion	0.01	0.01	c
Heptachlor	0.00021	0.00021	c,d
Heptachlor epoxide	0.0001	0.0001	b
Hexachlorobenzene	0.00072	0.00072	c,d
Hexachlorobutadiene	0.45	0.45	c,d
Hexachlorocyclohexane, alpha (BHC)	0.0039	0.0039	c
Hexachlorocyclohexane, beta (BHC)	0.014	0.014	c
Hexachlorocyclohexane, gamma (BHC)	0.019	0.019	c,d
Hexachlorocyclohexane, technical (BHC)	0.012	0.012	c
Hexachloroethane	1.9	1.9	c
Hexachlororocyclopentadiene	5	5	b
Indeno(1,2,3-cd)pyrene	0.0028	0.0028	c
Isophorone	8.4	8.4	b
Malathion	0.1	0.1	c
Methoxychlor	0.03	0.03	c,d
Methyl bromide	48	48	c
Methyl chloride	5.7	5.7	c
Methylene chloride	4.7	4.7	c
Mirex	0.001	0.001	c
Naphthalene	0.0028	0.0028	c
Nitrobenzene	3.5	3.5	b
Nitroso-di-n-propylamine-n	0.005	0.005	f
Nitrosodi-n-butylamine-n	0.0064	0.0064	c
Nitrosodiethylamine-n	0.0008	0.0008	c
Nitrosodimethylamine-n	0.00069	0.00069	c
Nitrosodiphenylamine-n	4.9	4.9	c
Nitrosopyrrolidine-n	0.016	0.016	c
Parathion	0.4	0.4	c
PCBs	0.000044	0.000044	c,d
Pentachlorobenzene	6	6	b
Pentachlorophenol	5.7	5.7	b
Phenanthrene	0.0028	0.0028	c
Pyrene	0.0028	0.0028	c
Simazine	4	4	c
Tetrachlorobenzene 1,2,4,5	2	2	b

Parameter	CURRENT Segment 5 Standard µg/l	CURRENT Segment 4 Standard µg/l	footnotes
Organics			
Tetrachloroethane 1,1,2,2	0.17	0.17	f
Tetrachloroethylene	76	0.8	c,d,e
Toluene	1000	1000	b
Toxaphene	0.0002	0.0002	b
Trichloroethane 1,1,1	200	200	b
Trichloroethane 1,1,2	0.6	0.6	b
Trichloroethylene	66	2.7	b,e
Trichlorophenol 2,4,5	700	700	b
Trichlorophenol 2,4,6	2.0	2.0	b
Trichlorophenoxypropionic (2,4,5-tp)	50.0	50.0	c
Vinyl Chloride	2	2	b
Metals			
Aluminum	150	150	f
Arsenic	50	50	b
Barium	1000	1000	b
Beryllium	4	4	a
Cadmium	TVS = 1.50	TVS=1.50	a,b
Chromium III	50	50	b
Chromium VI	11	11	b
Copper	23	TVS=16	a,d
Iron (d)	300	300	b
Iron	13200	1000	e,f
Lead	28	TVS=6.5	b
Manganese (d)	560	50	b
Manganese	1000	1000	a
Mercury	0.01	0.01	b
Nickel	TVS=125	TVS=125	a
Selenium	10	10	b
Silver	TVS=0.59	TVS=0.59	b
Thallium	0.012	0.012	b
Zinc	350	TVS=45	a,d

TVS = TABLE VALUE STANDARD - TVSs, promulgated by the Colorado Water Quality Control Commission, are variable standards subject to the measured values for other parameters, such as total hardness.
(d) = DISSOLVED METAL

Parameter **Physical & Biological**	**CURRENT** **Segment 5 Standard µg/l**	**CURRENT** **Segment 4 Standard µg/l**	**footnotes**
Minimum Dissolved Oxygen (mg/l)	5.0	5.0	a,b
pH (s.u.)	6.5-9.0	6.5-9.0	b
Fecal Coliforms per 100 ml	2000	2000	b
Inorganics			
Unionized Ammonia - March Through June	1800	calculated	a,b,g
Unionized Ammonia - July Through February	700	calculated	b,g
Ammonia	100	100	
Boron	750	750	a
Chloride	250000	250000	b
Chlorine (Acute)	19	19	f
Chlorine (Chronic)	11	11	f
Cyanide (Free)	5	5	a,b
Fluoride	2000		b
Nitrate	10000	10000	b
Nitrite	500	500	b
Sulfate	250000	250000	b
Sulfide (as H_2S)	2	2	b

Parameter **Radionuclides**	**CURRENT** **Segment 5 Standard Woman Creek pCi/l**	**CURRENT** **Segment 4 Standard Walnut Creek pCi/l**
Gross alpha	7	11
Gross beta	5	19
Americium-241	0.05	0.05
Curium-244	60	60
Neptunium-237	30	30
Plutonium-239, -240	0.05	0.05
Uranium	5	10
Uranium-233, -234		
Uranium-238		
Cesium-134	80	80
Radium-226, -228	5	5
Strontium-90	8	8
Thorium-230, -232	60	60
Tritium	500	500

a Statewide agricultural standard.
b Statewide water supply standard.
c Site specific standard.
d This standard is more restrictive than the sitewide water supply standard.
e Segment 5 standard is a temporary modification, established 3/93.
f Statewide aquatic standard.
g Statewide water supply unionized ammonia standard of 0.5 µg/l applied at water supply intake.

Appendix D

Distribution

Federal Agencies

US DOE, RFO
Attn: Shirley Olinger
Safety and Health Division
Acting Manager
Bldg. 116

US EPA
Attn: Dr. M. Lammering,
R. Rutherford
8 ART-RP
999 18th Street, Suite 500
Denver, CO 80202-2466

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: R.W. Cattony
1313 Sherman Street
Denver, CO 80203

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: N. Renfroe
11701 Community Center Drive
Northglenn, CO 80233-1099

City of Thornton
Attn: Joel Meggers
9500 Civic Center Drive
Thornton, CO 80229-1120

City of Westminster
Attn: D. Cross, T. Settle
4800 W. 92nd Avenue
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 80302

Colorado Department of Health
4300 Cherry Creek Drive South
Denver, CO 80222-1530
Attn: J. Bruch, R. Fox, D. Holm,
E. Kray, R. Quillin,
J. Sowinski

Colorado Department of Health
Office of Environmental Multimedia
Focal Group
4300 Cherry Creek Drive South
Denver, CO 80222-1530
Attn: S. Tarlton

Jefferson County Health Department
Attn: George Theophilos
260 South Kipling
Lakewood, CO 80226-1099

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

Environmental

Advance Sciences, Inc.
Attn: Jim Kunkel, L. Host
405 Urban Street, Suite 401
Lakewood, CO 80228

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

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

L.C. Holdings
Attn: M. Jones
5650 York Street
Commerce City, CO 80022

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

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

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

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

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, P. Pinson
2490 W. 26th Avenue, Suite 100A
Denver, CO 80211-4208

Other

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

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

T.T. Matsuo
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

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

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

M. Peceny
Fluor Daniels
1726 Cole Blvd., Suite 150
Golden, CO 80401

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

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

S.J. Bender
Measure & Analysis

M.C. Broussard, ERPD/EOM

E.A. Brovsky, General Chemistry

A.H. Burlingame, President

R.J. Crocker, Air Qaulity

J.A. Cuicci, Regulated Waste

S.L. Cunningham, Info. Security

N.S. Demos, ERM/Facility Operations

J.R. Dick, Analytical Labs

C.L. Dickerman, EPM/Air Quality Division

G.A. Dingman, Waste Quality Engineering

L.A. Doerr, Op. Health Physics

L.A. Dunstan, EPM/Surface Water Division

E.W. Ellis, Technical Development

M.J. Ely, Liquid Residue Management

Environmental Master File
c/o M. Paliani, EPM/Records and Reporting

P.J. Etchart, Residue Waste Programs

H.L. Gloe, EPM/Environmental Protection and Waste Reporting

G.R. Euler, EPM/Air Quality Division

B.Haynes Sample Management Division

T.G. Hedahl, Director Waste Management

M. Henry, Performance Meas. and Analysis

M.W. Hume, SIAM

D.I. Hunter, General Laboratory

H. Jordan, Nuclear Safety Engineering

M.R. Klueber, Ext. Dos.

E. Lee, Planning and Integration

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

F.G. McKenna, Chief Counsel

C.M. Madore, EPM/Environmental Protection and Waste Reporting

R.V. Morgan, Org. Effectiveness

R.C. Nininger, Air Quality

R.W. Norton, Rap. Engineering

J.B. Novy, EPM/Environmental Protection and Waste Reporting

J.G. Paukert, Director Communications

B.J. Pauley, EPM/Air Quality Division

L.C. Pauley, EPM/Air Quality Division

V.L. Peterson, Safety Analysis Engineering

D.R. Pierson, Pondrete Ops.

G.L. Potter, Regulatory Liaison

A.J. Read, Analytical Labs

C.D. Reno, EPM/Environmental Protection and Waste Reporting

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

R.S. Roberts, Group One Closures

C.M. Sanda, Community Relations

J.K. Schwartz, Media Communications

C.A. Sedlmayr, Administration

G.H. Setlock, Program Manager Environmental Protection Management

S. Schoeppe, Environmental Protection Management

T.A. Smith, Community Relations

D. Stein, Mechanical Utilities

M.T. Sullivan, Radiation Protection

P.V. Thomas, EPM/Environmental Protection and Waste Reporting

C. Trice, Analytical Labs

P.E. Wise, Project Development, Support, and Performance

J. Zarret, Analytical Labs