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INEL SITE ENVIRONMENTAL SURVEILLANCE DATA FOR THE FOURTH QUARTER 1992

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INEL SITE ENVIRONMENTAL SURVEILLANCE DATA - FOURTH QUARTER 1992

General Information

This report summarizes data from analyses of samples collected at INEL Site locations by the Environmental Sciences Branch (ESB) of the Radiological and Environmental Sciences Laboratory (RESL), U.S. Department of Energy Idaho Field Office during the fourth quarter of calendar year 1992. Data from analyses of some water samples collected by the INEL Project Office of the U.S. Geological Survey (USGS) are also included. Data were obtained from analyses of air, well and surface water samples, and from direct radiation measurements. Table I summarizes the onsite radiological sampling program. The approximate minimum detectable concentrations (~MDC) shown in Table I and the results of the air and water radiological surveillance program are compared to the derived concentration guides (DCG) listed in DOE Order 5400.5 dated February 8, 1990. Nonradiological pollutants are compared to appropriate EPA standards.

The RESL Analytical Chemistry Branch (ACB) and Laboratory Quality Branch (LQB) report analytical results with the estimated analytical uncertainty "1s" where all analytical uncertainties have been propagated. RESL has adopted the following interpretation of results near the minimum detectable concentration (MDC). If the result is less than or equal to twice the estimated analytical uncertainty, the material is not considered to be detected by the analysis. If the result lies in the range of two to three times its estimated analytical uncertainty, detection of the material by the analysis may be questionable because of statistical fluctuations. Due to the questionable nature of results between "2s" and "3s", they will be reported but generally not discussed. If the result exceeds three times its estimated analytical uncertainty, there is confidence that the material was detected by the analysis, and the data will be discussed.

TABLE I

ON-SITE RADIOLOGICAL ENVIRONMENTAL SURVEILLANCE PROGRAM SUMMARY

<u>AIR</u>						
Type of Analysis	Frequency of Analysis	Number of Samples	Sample Size	Count Time	-MDC ^a	% DCG
<u>Low-Volume Samplers</u>						
Gross Beta	Weekly	12	330 m ³	20 min.	8 E-15 μ Ci/mL	0.3 ^b
Am	Quarterly	6	4000	1000	8 E-18	0.04
Pu	Quarterly	6	4000	1000	6 E-18	≤ 0.03
Specific gamma	Quarterly	12	4000	60	1-10 E-15	≤ 0.01
Sr-90	Quarterly	2	4000	50	1 E-16	0.001
<u>High-Volume Samplers</u>						
Gross Gamma	Daily	2	2000	10	N/A ^c	N/A
Specific gamma	Monthly	2	56000	60	1-10 E-16	≤ 0.001 ^d
<u>Other Sampler</u>						
H-3 as HTO	3 to 7 weeks	2	10-20	20	1 E-11	0.01
<u>WATER</u>						
<u>Production Wells</u>						
Gross Beta	Monthly	26	250 mL	20	5 E-9 μ Ci/mL	5 ^b
Gross Alpha	Monthly	26	100	60	3 E-9	10 ^b
Sr-90	Monthly	2	4000	20	0.5 E-9	0.05
H-3 as HTO	Monthly	26	10	20	0.4 E-6	0.02
<u>Observation Wells</u>						
Gamma Scans:	Quarterly	6	400	60	10-100 E-9	≤ 6 ^d
	Semiannually	12	400	60	10-100 E-9	≤ 6 ^d
	Annually	18	400	60	10-100 E-9	≤ 6 ^d
Sr-90	Quarterly	14	400	20	5 E-9	0.5 ^d
	Semiannually	39	400	20	5 E-9	0.5
Am	Semiannually	6	500	1000	0.05 E-9	0.2
Pu	Semiannually	7	500	1000	0.04 E-9	0.1
	Annually	3	500	1000	0.04 E-9	0.1
H-3 as HTO	Quarterly	28	10	20	0.4 E-6	0.02
	Semiannually	82	10	20	0.4 E-6	0.02
<u>SOIL</u>						
Specific gamma	Annually	Varies	400 g	1000	4 E-8 μ Ci/g	N/A
Pu	Annually	Varies	10	1000	2 E-9	N/A
Am	Annually	Varies	10	1000	3 E-7	N/A
Sr-90	Annually	Varies	10	50	9 E-8	N/A

ENVIRONMENTAL RADIATION

Thermoluminescent Dosimeters	Semiannually	135	5 TLDs per dosimeter	N/A	5 mR	N/A
Gamma Radiation Surveys	Annually ^g	N/A	N/A	N/A	N/A	N/A

- Approximate minimum detectable concentration.
- DCG based on the most restrictive beta emitter (Ra-228).
- Not applicable.
- For principle gamma-emitting radionuclides.
- DCG based on Am-241, Pu-239 and Pu-240.
- Onsite soil sampling is performed each year at a different facility. Facilities are sampled on a rotating seven-year schedule.
- Surveys performed each year at different facilities on a rotating 3-year schedule.

ATMOSPHERIC SAMPLING

Low-Volume Samplers

Atmospheric low-volume samplers are in operation at 12 onsite locations just outside facility security fences, seven INEL perimeter (boundary) locations, and four distant (background) locations (Figure A-1). Each low-volume air sampler contains two filters: a membrane prefilter for measurement of airborne particulates and a charcoal cartridge for collection of iodine. ESB personnel change the filters weekly and submit them to the ACB for analysis.

The gross alpha activity is determined weekly for particulate filters from eight selected locations--four offsite and four onsite--as a nonspecific screening technique for alpha-emitting radionuclides. Results are tabulated and inspected each week for anomalies.

Gross gamma activity is determined weekly for the charcoal cartridges to screen for gamma-emitters such as radioiodines. If activity greater than a specified level is detected, the cartridges are analyzed by gamma spectrometry for I-131 and any other gamma-emitters present.

The gross beta activity is determined weekly for the particulate filters from each location as a screening technique to give timely information in the event of INEL releases, worldwide fallout, etc. This information may be difficult to interpret due to local variations in gross beta levels at any given time or location. Any of several factors may be responsible for the variations observed, including: loading of dust or soot on certain individual filters and varying concentrations of natural or fallout radioactivity as a result of diverse local meteorological conditions. If unusually high gross

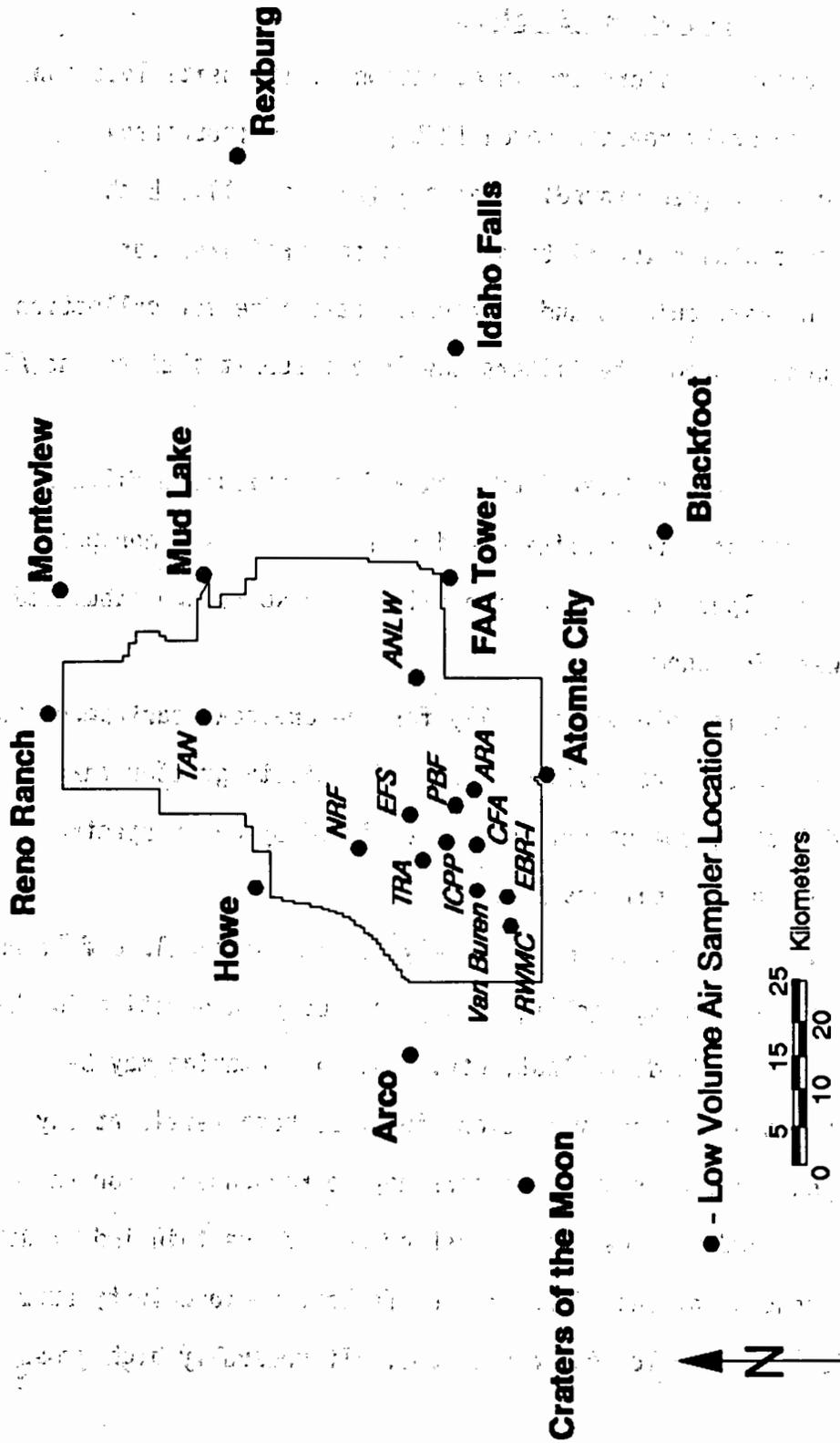


Figure A-1. Low-volume Air Sampling Locations

beta activity is detected on the filters, they may be submitted for gamma spectrometry for more information.

At the end of each quarter, composites of the particulate filters for each location are submitted to ACB and to the Laboratory Quality Branch (LQB) for specific nuclide analyses. When interpreting air sampling data to assess possible INEL impact, more reliance is placed upon results from analyses for specific man-made radionuclides than upon gross alpha or gross beta concentrations. Gross alpha and gross beta analyses are used primarily as screening techniques to detect sudden increases over natural background radioactivity.

Gross Alpha

Gross alpha concentrations were, in general, typical of those normally measured. Gross alpha activity is generally higher at Blackfoot than at boundary or onsite locations due to contributions from non-INEL sources. During the fourth quarter, the mean gross alpha concentration at Blackfoot was 1.6×10^{-15} $\mu\text{Ci/mL}$ (8% DCG), compared to an onsite location mean of 1.2×10^{-15} $\mu\text{Ci/mL}$ (6% DCG).

Gross Beta

Results from analyses of particulate filters for all locations are interpreted with the help of statistical comparisons as described in the following sections.

Weekly Comparisons. The gross beta activities for all sampling locations are analyzed each week using an analysis-of-variance test, a lognormal plot,

and comparisons between individual locations and the distant community group mean.

Weekly gross beta concentrations ranged from $9.0 \pm 1.3 \times 10^{-15}$ to $6.0 \pm 0.4 \times 10^{-14}$ $\mu\text{Ci}/\text{mL}$. There were six weeks when one or more individual location gross beta concentrations were statistically greater than the distant group mean concentration:

1) The gross beta concentrations at Howe, FAA Tower, CFA, TAN, EFS, and Van Buren were statistically greater than the background mean during the week of October 2 through October 9. The lognormal plot appears to show a typical population distribution. The highest gross beta concentration during this week was 2.8×10^{-14} $\mu\text{Ci}/\text{mL}$.

2) The gross beta concentration was also statistically significant at FAA Tower, TAN, and Van Buren during the week of October 16 to October 23, but the lognormal plot again appeared to show a typical population distribution. The highest gross beta concentration during this week was 4.4×10^{-14} $\mu\text{Ci}/\text{mL}$.

3) During the week of October 23 to October 30, the gross beta concentration was statistically greater than the background mean (3.1×10^{-14} $\mu\text{Ci}/\text{mL}$) at PBF (5.1×10^{-14} $\mu\text{Ci}/\text{mL}$). This location also appeared to be an outlier on the lognormal plot. No likely origin for this statistical difference has been located.

4) There were three locations--Howe, TAN, and Van Buren--whose gross beta concentrations were statistically above background from October 30 to November 6. The lognormal plot appeared normal, however, and gross beta concentrations were lower than average at all locations, the highest being 1.9×10^{-14} $\mu\text{Ci}/\text{mL}$.

5) Twelve widely separated locations, three offsite and nine onsite, were statistically above background during the week of November 6 to November 13.

The lognormal plot showed a typical population; the highest gross beta concentration this week was Howe at 3.7×10^{-14} $\mu\text{Ci/mL}$.

6) During the week of December 18 through December 24, gross beta concentrations at 11 locations, three offsite and eight onsite, were statistically significant. Concentrations this week ranged from 1.6×10^{-14} $\mu\text{Ci/mL}$ to 5.0×10^{-14} $\mu\text{Ci/mL}$ at TAN.

Monthly Comparisons. Figures A-2 through A-13 graphically illustrate monthly gross beta mean concentrations of onsite and distant groups.

Each month, the weekly data for each onsite location are grouped and statistically compared to the corresponding set of data from the distant community locations using an unpaired t-test ($\alpha=0.05$).

The mean gross beta concentrations at the following locations were statistically greater than the background group mean gross beta concentration during the month of October: FAA Tower, TAN, PBF, and Van Buren. In addition, the onsite group mean gross beta concentration was statistically greater than the distant group mean gross beta concentration in October. There were no statistical differences noted during November and December. Review of the specific nuclide results discussed below, as well as the release information reported in the Radioactive Waste Management Information System (RWMIS) report did not indicate any likely origin for the statistical differences.

Quarterly Comparisons. Each quarter, the weekly gross beta concentration data for each onsite location are grouped and compared to the corresponding data from the distant community group using an unpaired t-test ($\alpha=0.05$).

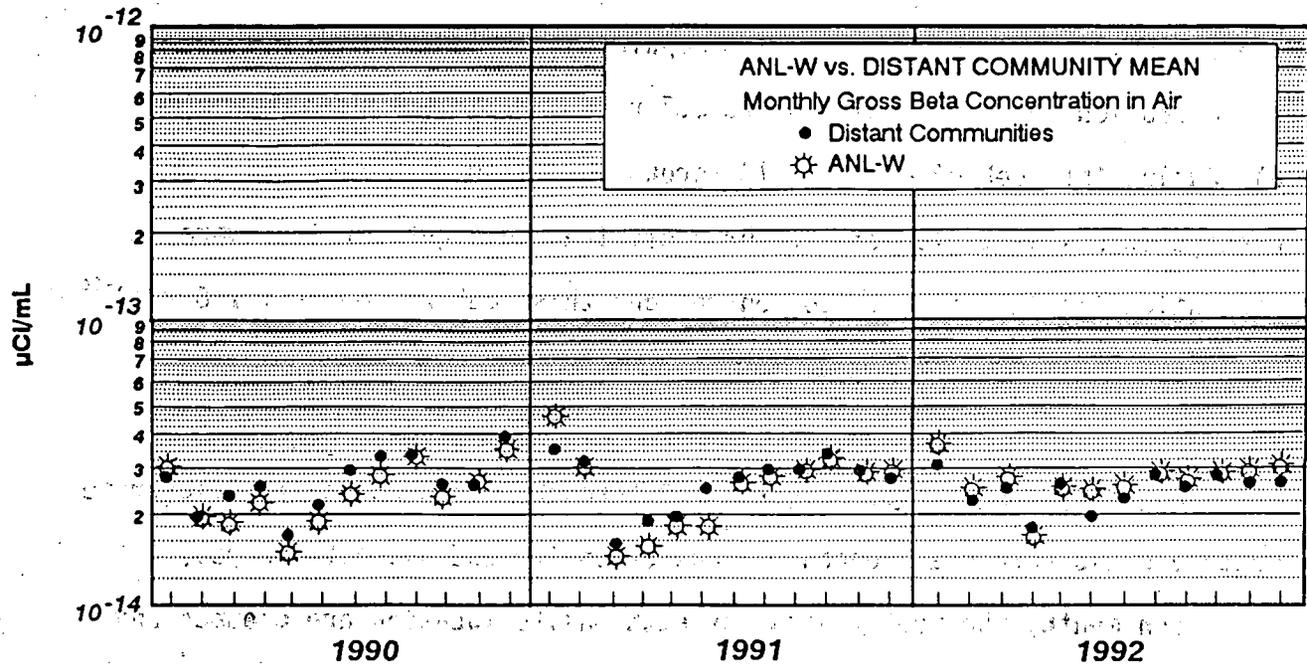


Figure A-2. ANL-W vs. Distant Community Mean Gross Beta Concentration

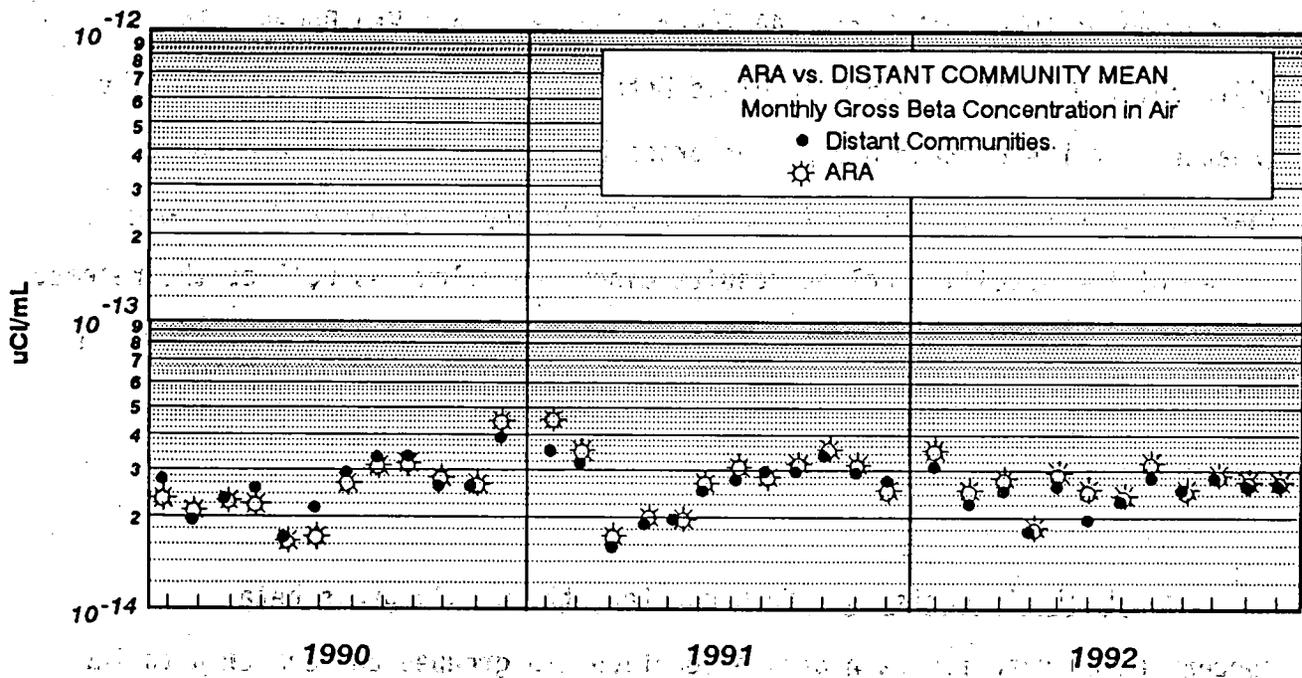


Figure A-3. ARA vs. Distant Community Mean Gross Beta Concentration

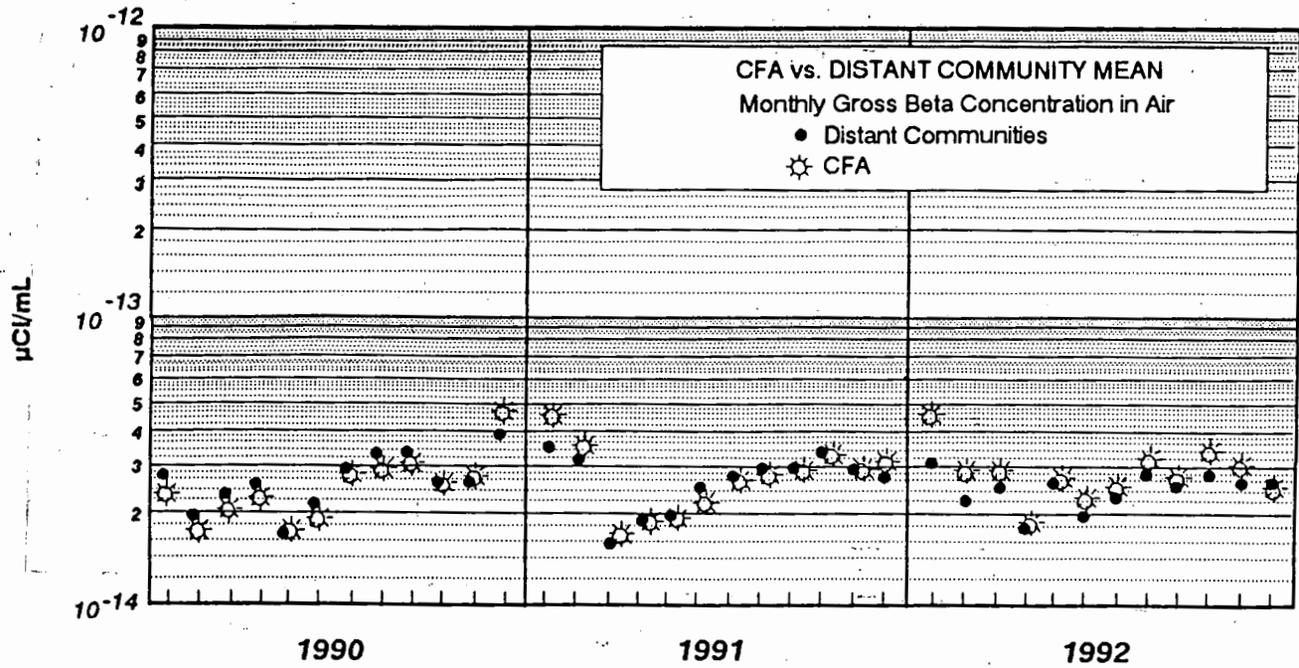


Figure A-4. CFA vs. Distant Community Mean Gross Beta Concentration

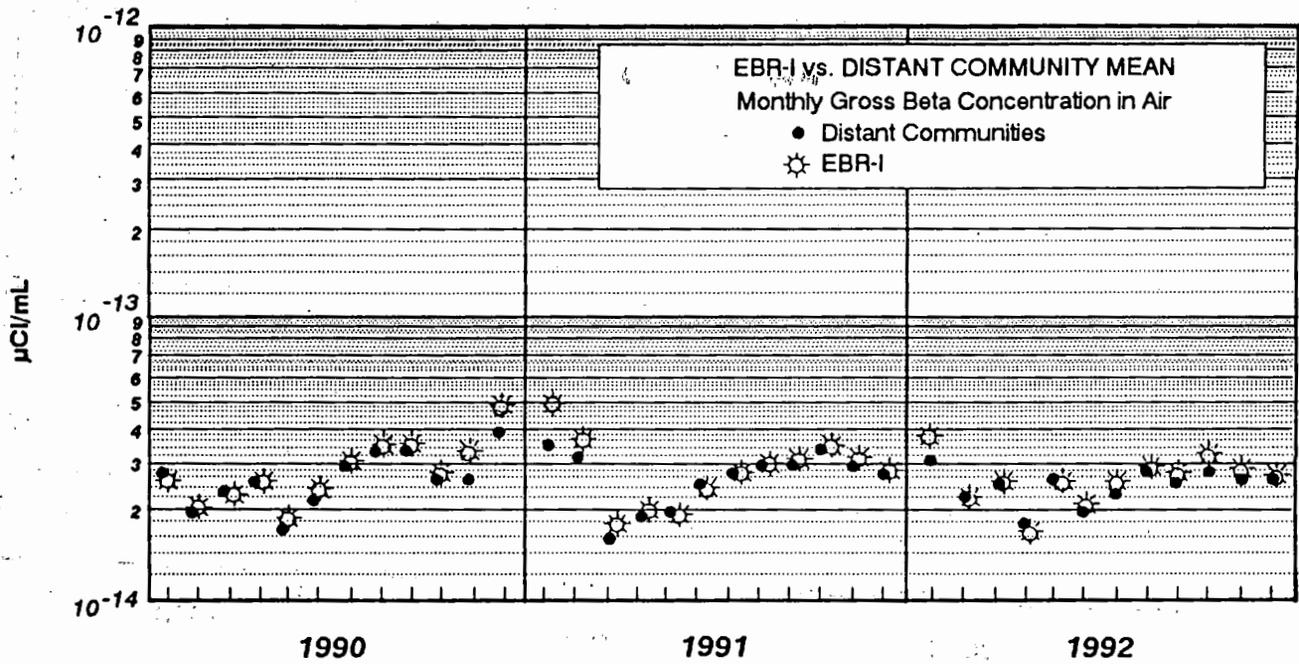


Figure A-5. EBR-I vs. Distant Community Mean Gross Beta Concentration

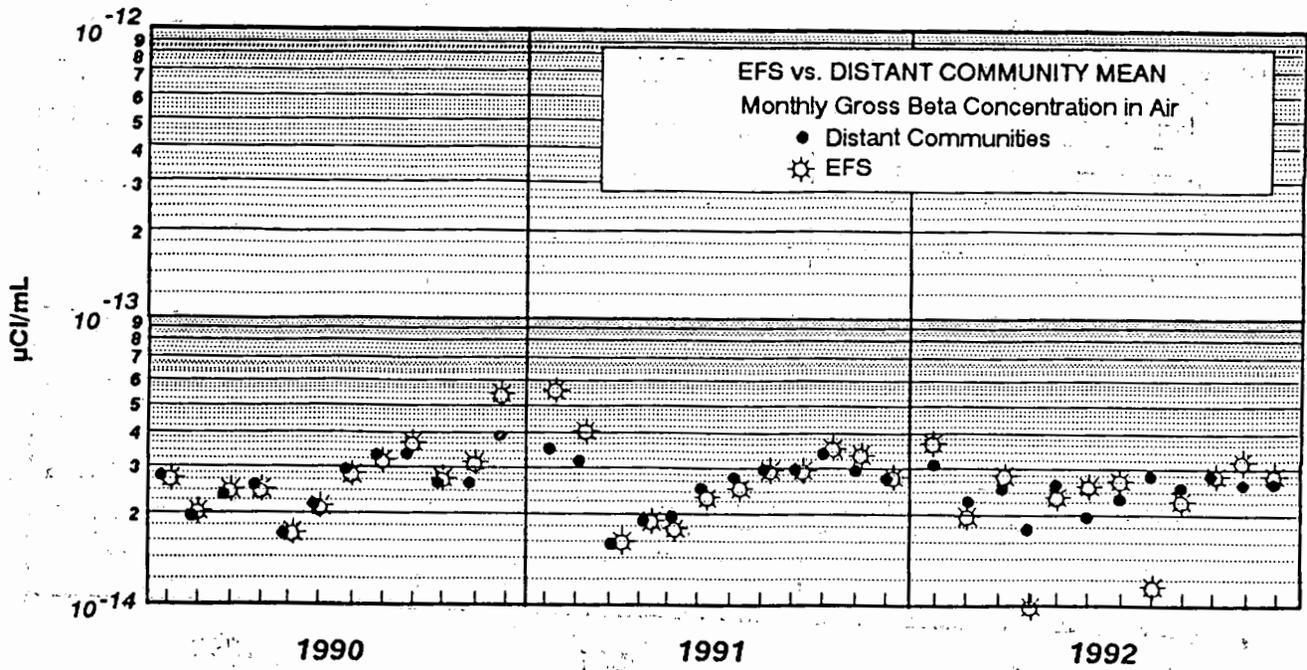


Figure A-6. EFS vs. Distant Community Mean Gross Beta Concentration

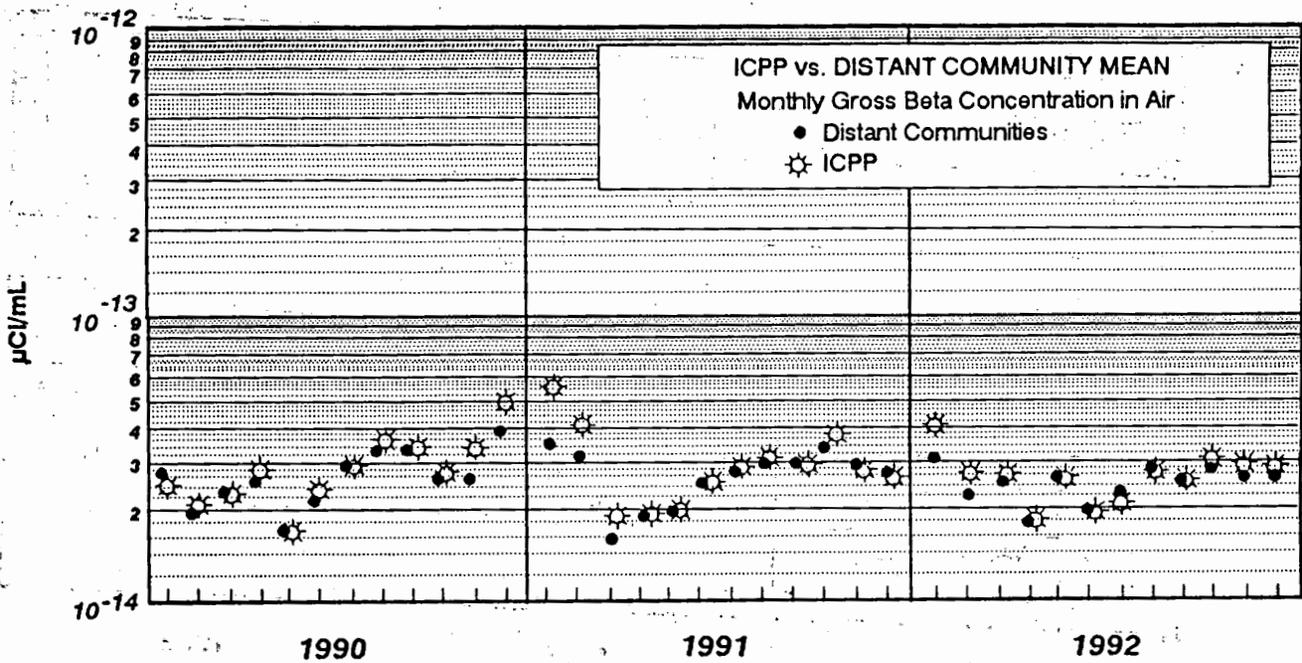


Figure A-7. ICPP vs. Distant Community Mean Gross Beta Concentration

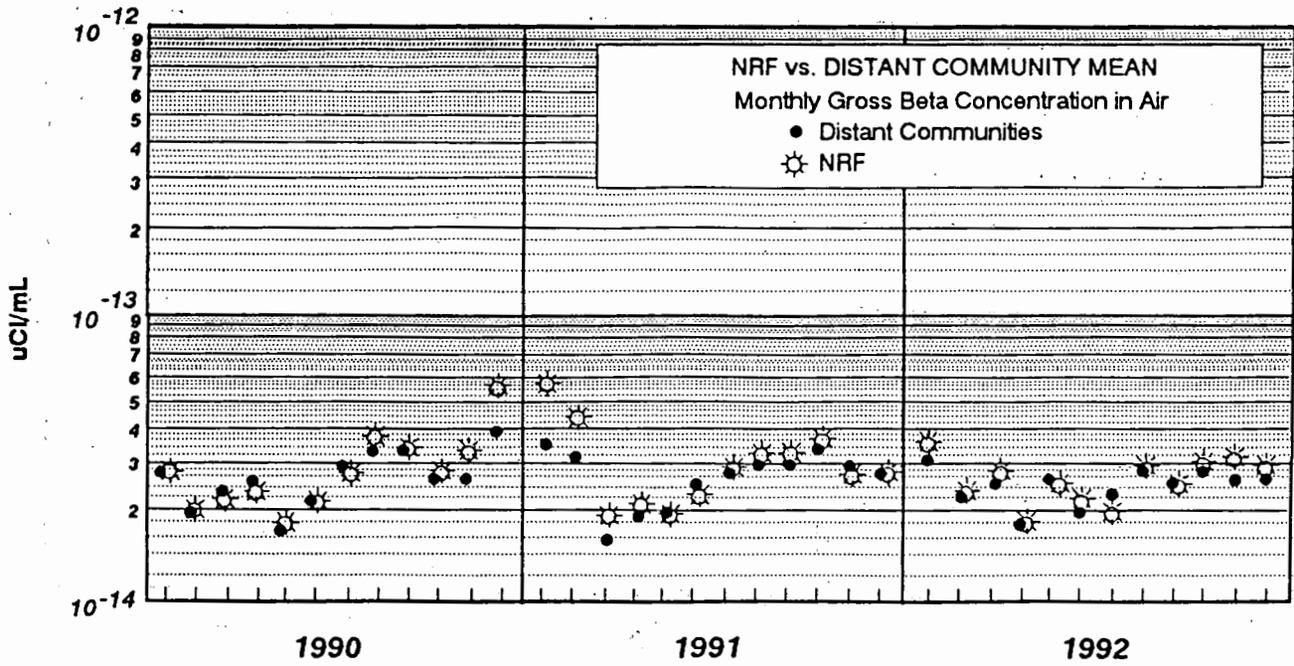


Figure A-8. NRF vs. Distant Community Mean Gross Beta Concentration

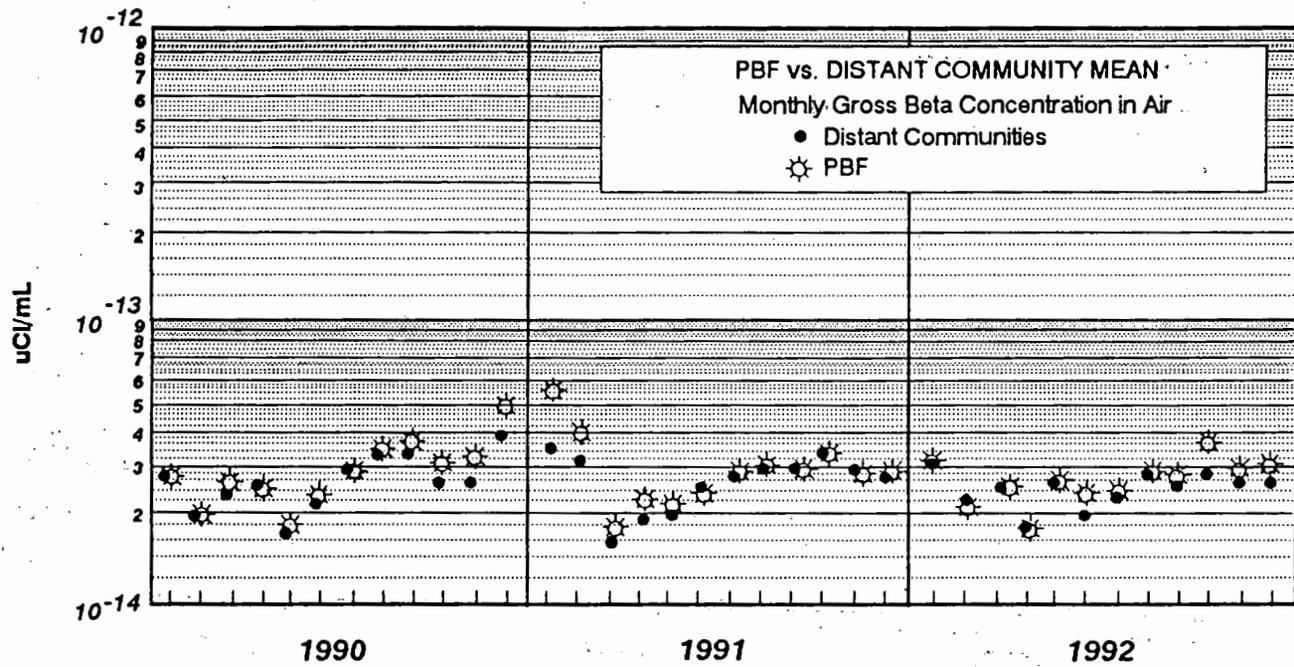


Figure A-9. PBF vs. Distant Community Mean Gross Beta Concentration

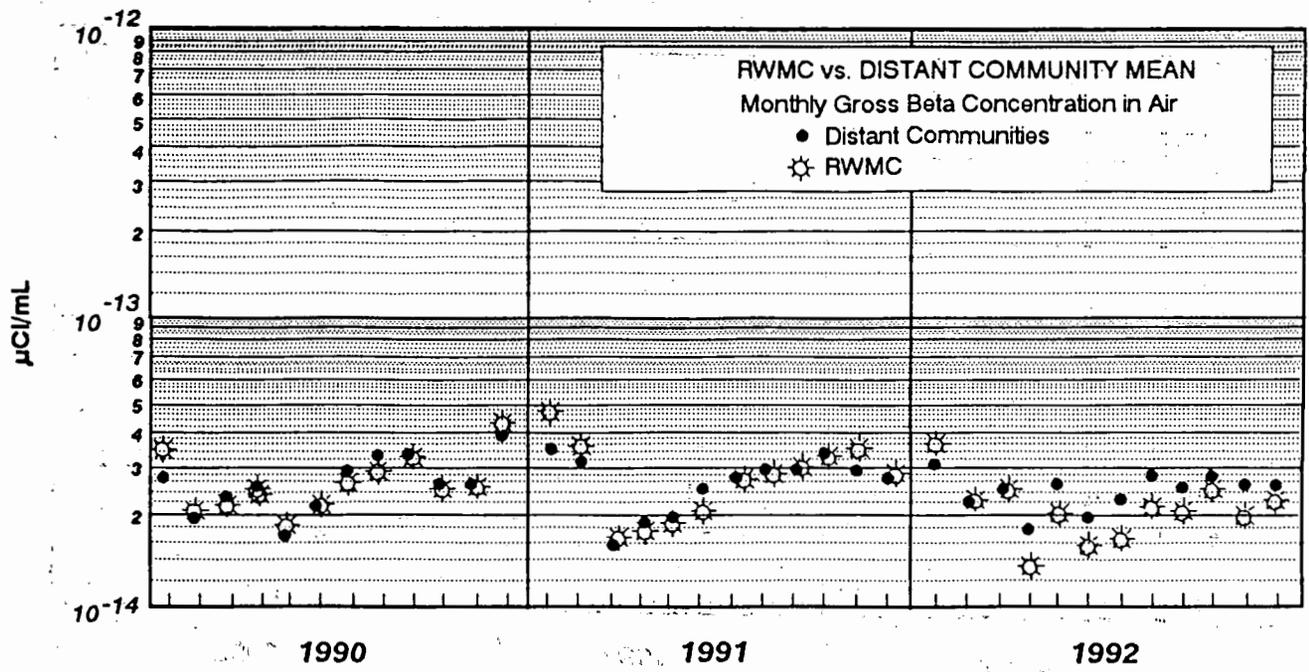


Figure A-10. RWMC vs. Distant Community Mean Gross Beta Concentration

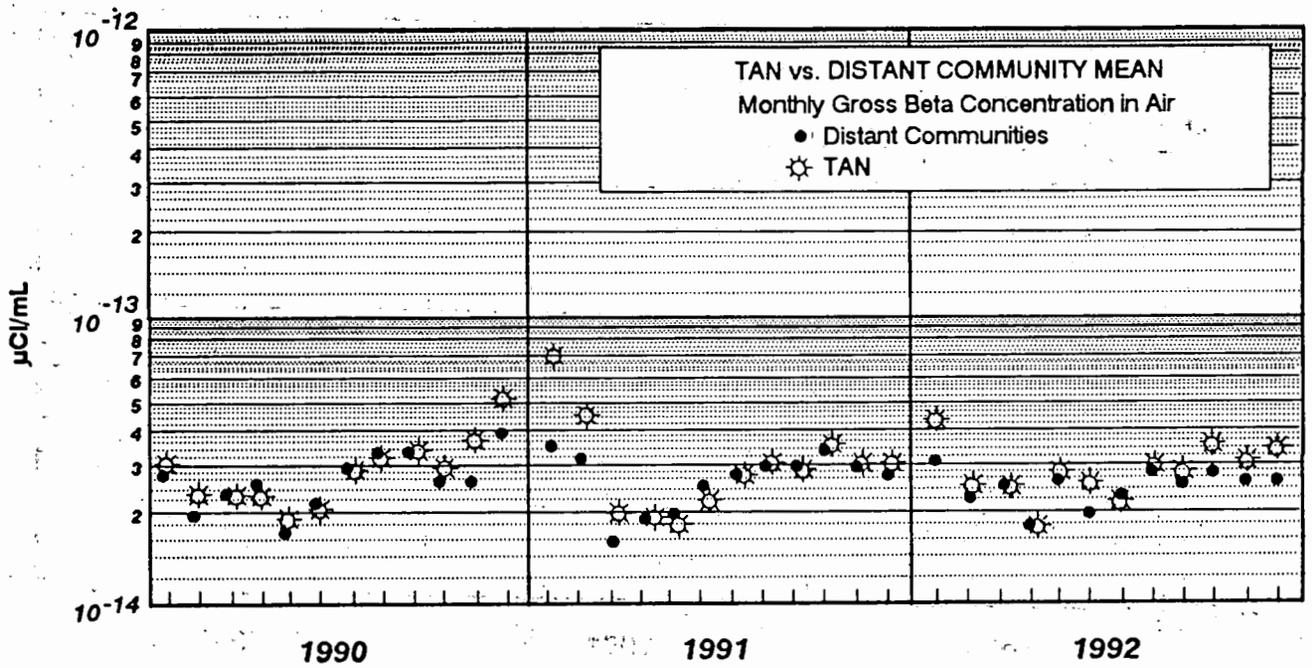


Figure A-11. TAN vs. Distant Community Mean Gross Beta Concentration

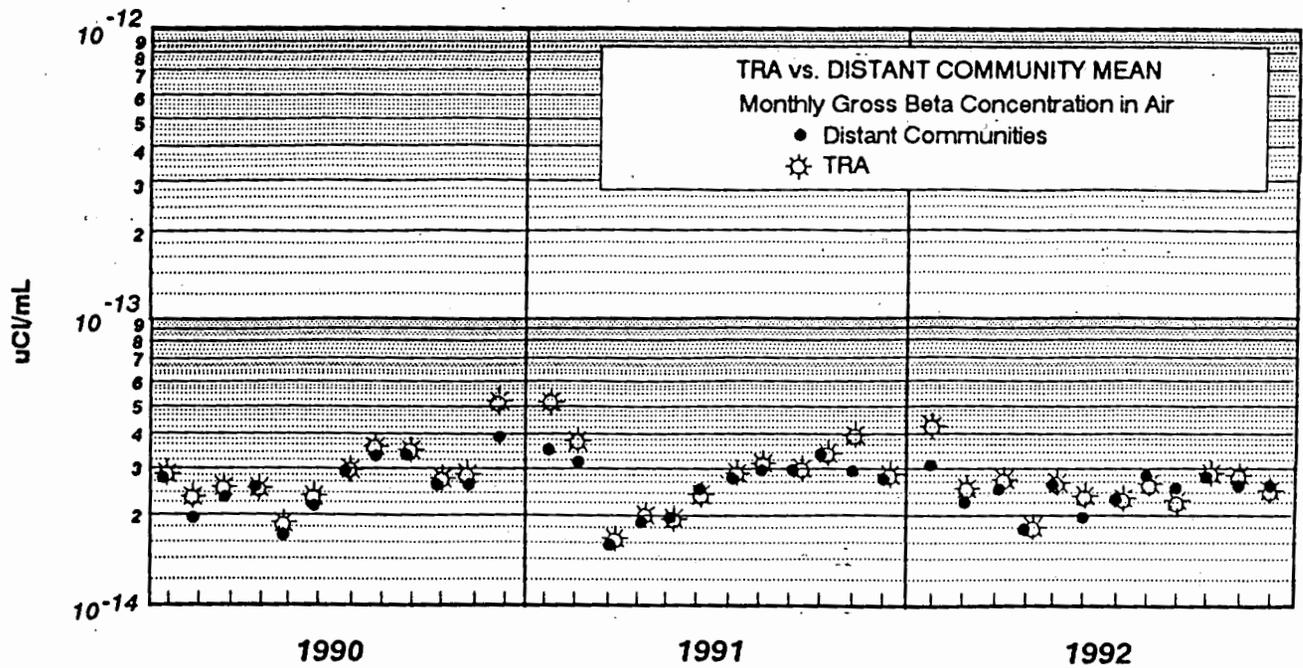


Figure A-12. TRA vs. Distant Community Mean Gross Beta Concentration

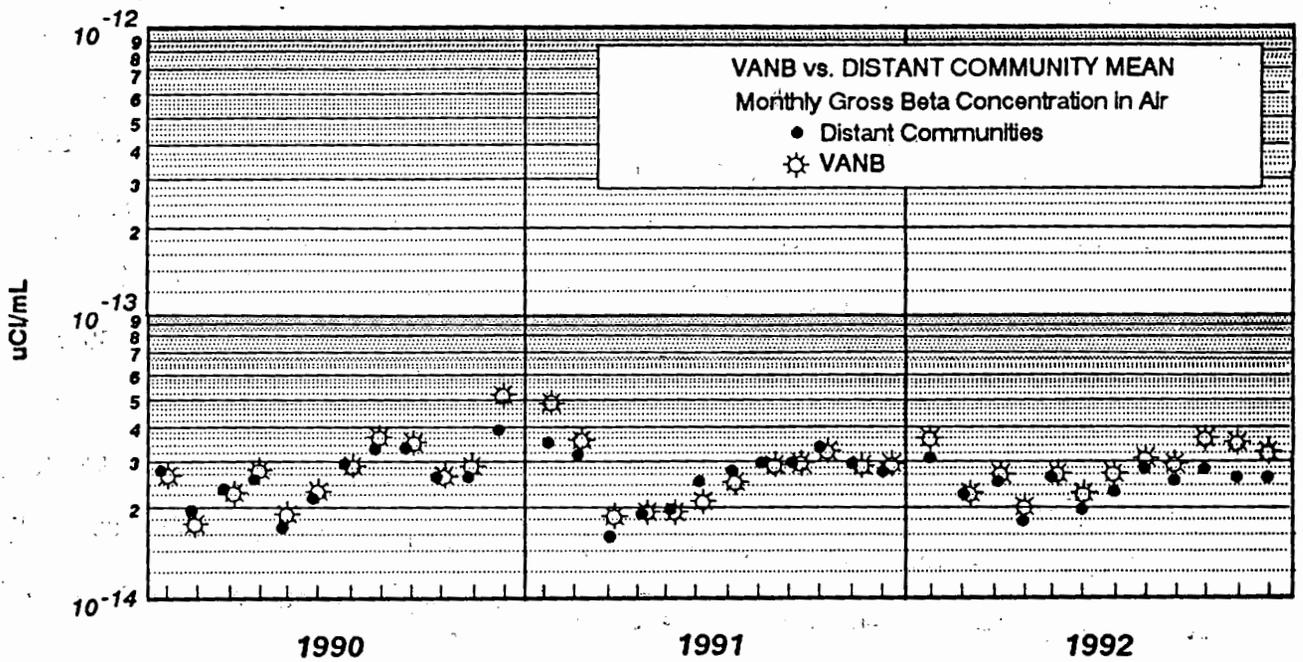


Figure A-13. VANB vs. Distant Community Mean Gross Beta Concentration

During the fourth quarter of 1992, the mean gross beta concentrations at TAN, PBF, and Van Buren were statistically greater than the background mean gross beta concentration. The onsite group mean gross beta concentration was also statistically above the background group mean gross beta concentration. As stated above, review of the specific nuclide results discussed below, information from the RWMIS report, and the geographic distribution of the results did not indicate a specific point of origin for the statistical differences. The highest quarterly gross beta concentration, at PBF, was 3.7×10^{-14} $\mu\text{Ci/mL}$ or 1.2% of the annual DCG.

Specific Nuclides

After gross beta analyses are completed each week, the particulate filters are retained to make up a quarterly composite of filters from each sampling location. At the end of the quarter, ACB and LQB analyze these composites for specific radionuclides.

Gamma-Emitting Nuclides. Each quarter the composited particulate filters for each location are submitted to LQB and analyzed by gamma spectrometry. Spectra are specifically examined for 11 gamma-emitting radionuclides (Be-7, Ce-141, Ce-144, Co-60, Cs-134, Cs-137, Mn-54, Ru-103, Ru-106, Sb-125, and Zr-95). Any other nuclides detected are also reported. The data for radionuclides detected at any location are then statistically examined using an analysis-of-variance test and unpaired t-test comparisons ($\alpha=0.05$) between the distant community and the onsite group means and between individual onsite location results and the distant group mean.

One gamma-emitting nuclide, other than naturally occurring Be-7, was detected on a fourth quarter particulate filter composite. Cerium-141 was

indicated at FAA Tower at a concentration of $6 \pm 3 \times 10^{-15}$ $\mu\text{Ci/mL}$ (0.0006% DCG).

Strontium-90. Selected composites of the fourth quarter filters were analyzed for Sr-90. This nuclide was detected on five of the seven sets of composites submitted for analysis at the following concentrations: Rexburg, $3.7 \pm 0.8 \times 10^{-16}$ $\mu\text{Ci/mL}$ (0.004 % DCG); Blackfoot, $2.5 \pm 0.7 \times 10^{-16}$ $\mu\text{Ci/mL}$ (0.003% DCG); Arco, $2.2 \pm 0.7 \times 10^{-16}$ $\mu\text{Ci/mL}$ (0.002% DCG); Montevieu, $1.7 \pm 0.6 \times 10^{-16}$ $\mu\text{Ci/mL}$ (0.0019% DCG); and CFA, $2.4 \pm 0.7 \times 10^{-16}$ $\mu\text{Ci/mL}$ (0.003% DCG). Sr-90 was not detected at the FAA Tower or NRF. The presence of this nuclide at approximately equal concentrations at distant, boundary, and onsite locations does not indicate a probable INEL origin.

Transuranic Nuclides. Selected composites of the fourth quarter filters were analyzed by alpha spectrometry for Pu-238, Pu-239/240, and Am-241. None of these radionuclides were detected on any of the 10 sets of composites submitted.

High-Volume Samplers

Two onsite high-volume air samplers (CFA and EFS) continuously sample air for particulate airborne radioactivity from any source: natural radioactivity, INEL releases, weapons testing, domestic or foreign reactor accidents, etc. Filters from these samplers are analyzed each workday for gross gamma activity and decay curves are plotted. When indicated by unusual decay curves (different from naturally-occurring radon daughters) or suspected nuclear incidents, individual filters may be submitted for gamma spectrometry. No unusual curves were noted and no individual filters were submitted for analysis during the fourth quarter.

At the end of each month, the filters at each location are composited and submitted for gamma spectrometry. No manmade gamma-emitting radionuclides were found on any of the fourth quarter composites.

Atmospheric Tritium Samplers

Samplers for tritium in water vapor are located offsite in Idaho Falls and onsite at EFS and Van Buren. In these samplers, air is passed through a column of silica gel at a rate of 0.3 L/min. Columns are changed when the silica gel becomes saturated. Tritium concentrations are determined by liquid scintillation counting of water extracted from the columns.

Two samples covering a part of the fourth quarter were collected from each location. No tritium was detected in either the set of samples collected between August 7 to November 6 or from the samples from two locations that were collected from November 6 to January 29. One location, EFS, had an insufficient sample due to mechanical and electrical problems.

Precipitation Samplers

Monthly precipitation samples are collected at Idaho Falls and CFA. These samples are analyzed for tritium and pH. Weekly samples from EFS are also collected and analyzed for tritium.

A total of 11 precipitation samples were collected during the fourth quarter. Tritium was not detected in any of the samples.

Nitrogen Oxides Samplers

Two stations, one located at the intersection of Van Buren Boulevard and Highway 20/26 and another at EFS, continuously monitor the air for nitrogen

oxides (NO and NO₂). Both analyzers are designated as equivalent methods by EPA.

The mean NO₂ concentration measured during the fourth quarter of 1992 was 7.0 ppb (13.2 μg/m³) at EFS and 3.4 ppb (6.4 μg/m³) at Van Buren. These respective concentrations are 13% and 6% of the annual primary and secondary ambient air quality standards for NO₂. Data recovery for the quarter was 87% at EFS and 83% at Van Buren.

Performance checks were made at least biweekly on both samplers by testing the response of both the NO and NO_x channels of the analyzers to purified air and to air with a known concentration of nitric oxide (NO). Details of the performance checks have been sent to the State of Idaho.

Sulfur Dioxide Sampler

A sulfur dioxide monitoring station was in service at the intersection of Van Buren Boulevard and U.S. Highway 20/26 during the fourth quarter. The analyzer is designated as an equivalent method by EPA.

The mean SO₂ concentration measured during the quarter was 0.23 ppb (0.6 μg/m³). This concentration is 0.8% of the annual primary air quality standard. The maximum daily mean SO₂ concentration during fourth quarter was 1.5 ppb (3.9 μg/m³), or 1.1% of the 24-hour primary ambient air quality standard, on November 13. The maximum 3-hour mean SO₂ concentration of 5.4 ppb (14.5 μg/m³), on November 5, was 1.1% of the secondary air quality standard.

Weekly performance checks were made by testing the SO₂ analyzer response to purified air and to air with a known concentration of SO₂. Valid data were collected during 99% of the hours in the quarter.

WATER SAMPLING

Production Wells

NOTE: DOE Order 5400.1 recommends the use of units of $\mu\text{Ci/mL}$ for concentrations of radionuclides in water. However, 40 CFR 141 states standards in units of pCi/L. For the convenience of readers of this report, concentrations in the Water Sampling section are given with exponents which allow easy conversion to the EPA units:

$$1 \times 10^{-9} \mu\text{Ci/mL} = 1 \text{ pCi/L}$$

$$1 \times 10^{-6} \mu\text{Ci/mL} = 1000 \text{ pCi/L}$$

Each month, contractor personnel collect water samples from production wells that are in use. These samples are then analyzed by ACB. Figures B-1 and B-2 show most well locations. Gross alpha activity was detected in 12 of the 80 production well samples collected during the fourth quarter. Detectable concentrations were all near the minimum detectable concentration shown in Table 1, ranging from $1.2 \pm 0.5 \times 10^{-9} \mu\text{Ci/mL}$ (4% DCG) to $2.8 \pm 1.2 \times 10^{-9} \mu\text{Ci/mL}$ (9% DCG). Gross beta activity was reported in only 1 of the 80 samples at a concentration of $5 \pm 2 \times 10^{-9} \mu\text{Ci/mL}$ (5% DCG). Examination of the data for trends with time or geographic location revealed no clear patterns. It is probable that the detectable gross alpha and gross beta activities in the water samples were due to statistical variations in analyses and/or to natural radionuclides derived from rocks that make up the aquifer.

CFA

The tritium concentrations for CFA production wells (CFA-1 and CFA-2 in Figure B-1) and the CFA Distribution system are plotted in Figure B-3.

In the fourth quarter, the mean tritium concentration in water from well CFA #1 was $16.0 \times 10^{-6} \mu\text{Ci/mL}$ (0.8% DCG), noticeably lower than the third quarter value of $18.4 \times 10^{-6} \mu\text{Ci/mL}$ (0.9% DCG). Fourth quarter samples from

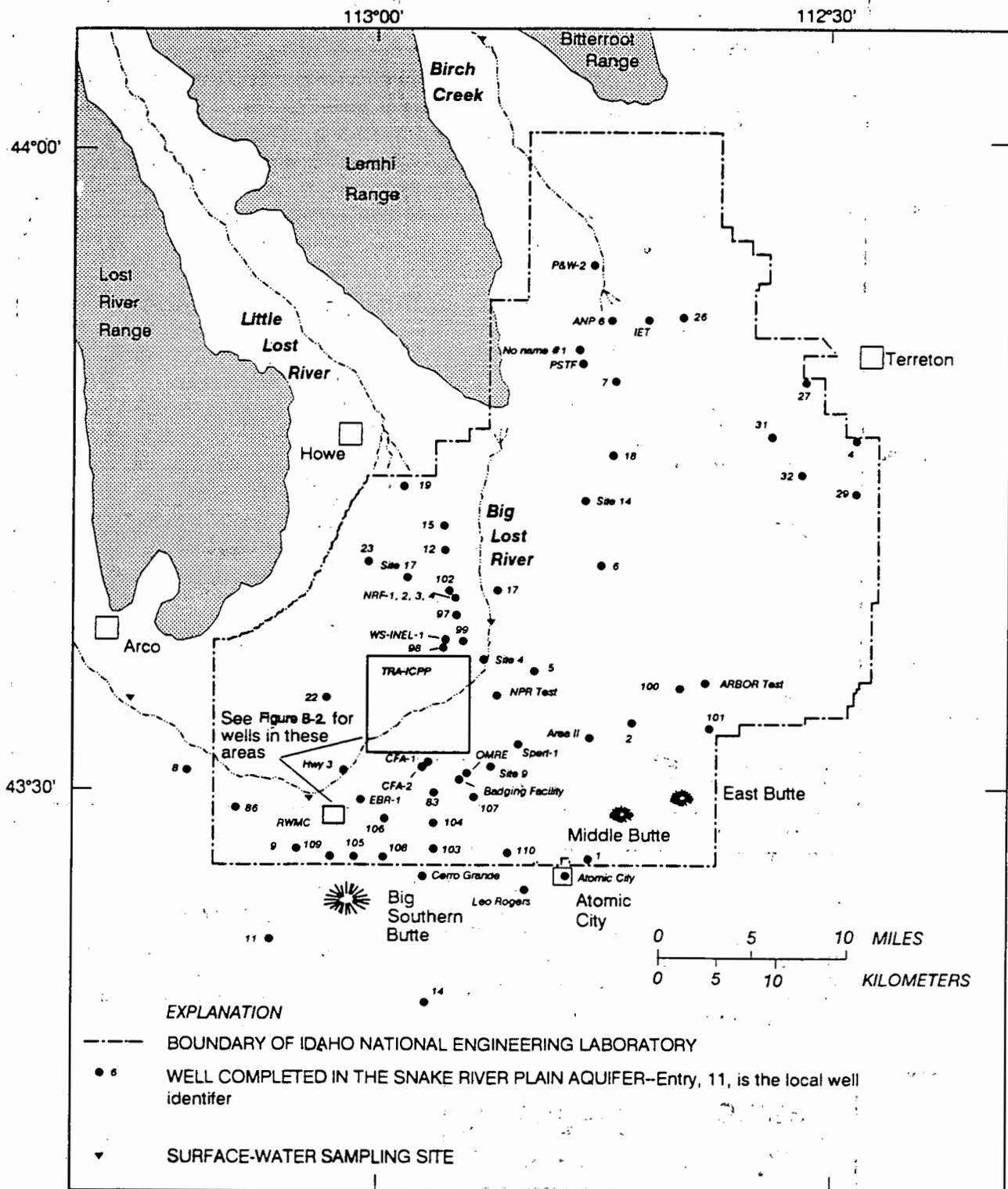


Figure B-1. USGS Well Locations for the INEL Site and Vicinity

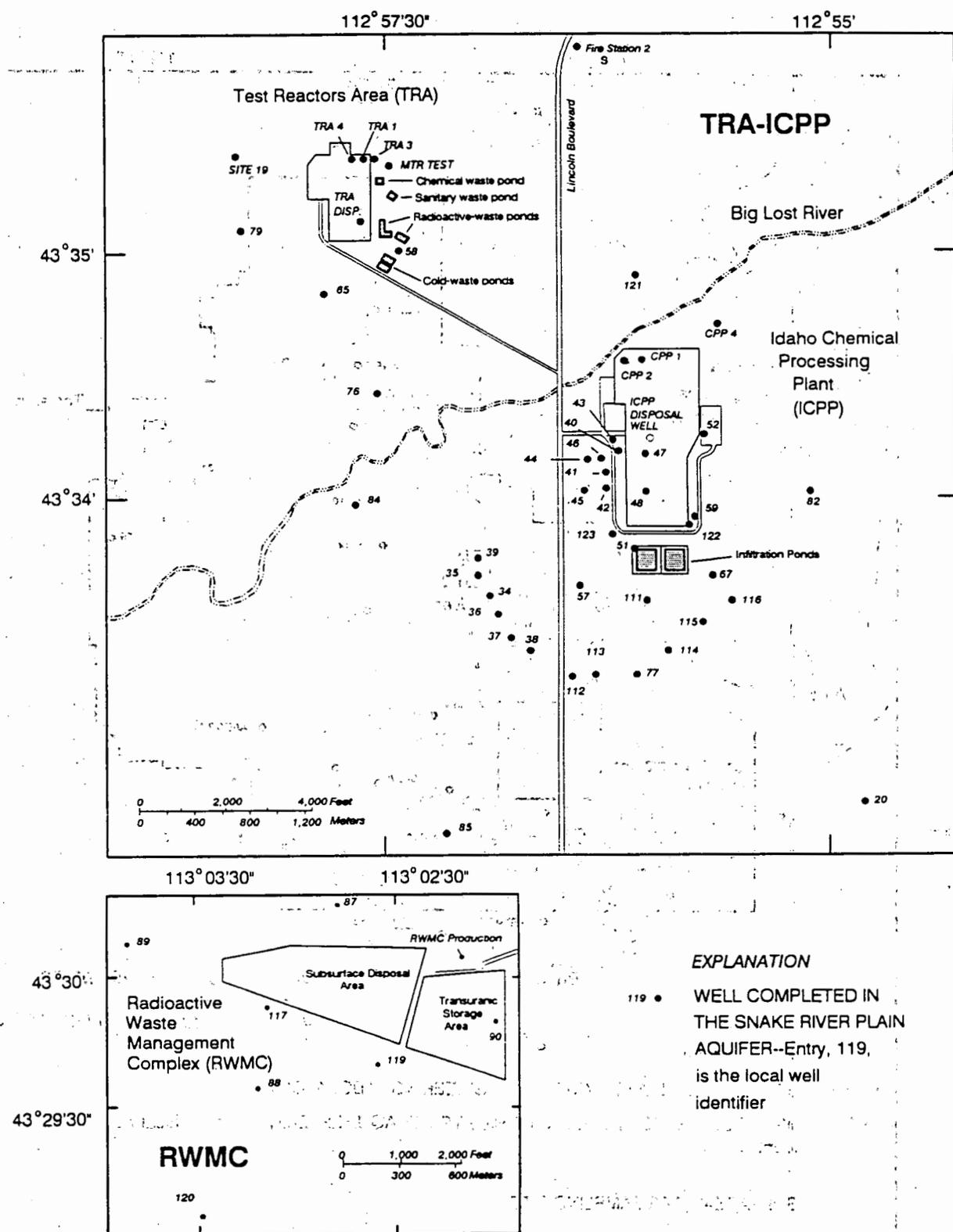


Figure B-2. USGS Detailed Sample Location Map for ICPP, TRA, RWMC

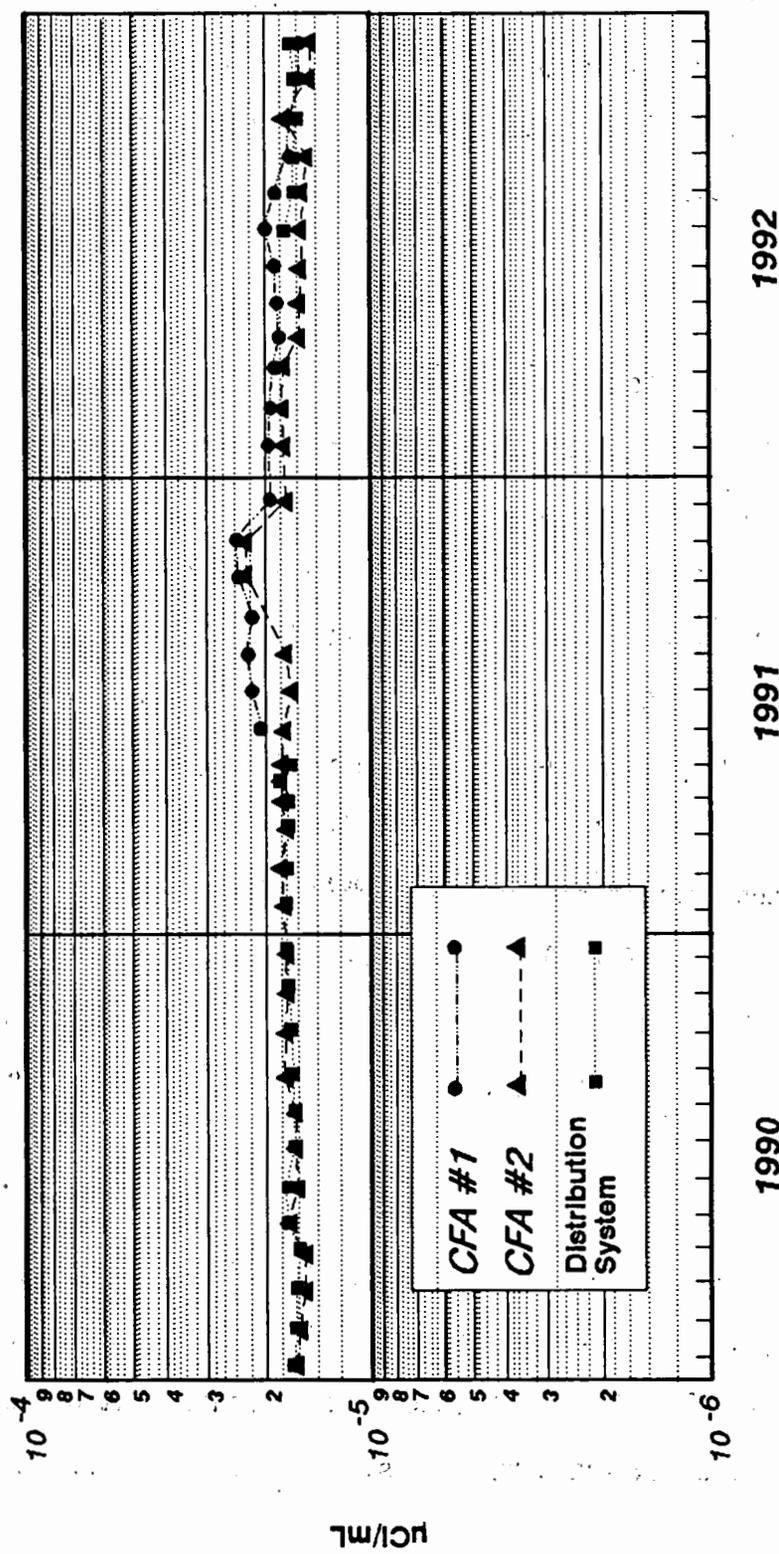


Figure B-3. Tritium Concentrations in CFA Production Wells

CFA #2 had a mean tritium concentration of $15.7 \times 10^{-6} \mu\text{Ci/mL}$ (0.8% DCG), about the same as in the third quarter. EG&G began sampling the CFA distribution system (which generally obtains a greater percentage of water from CFA #2 than CFA #1) in July of 1992; the mean tritium concentration in the fourth quarter was $16.2 \times 10^{-6} \mu\text{Ci/mL}$ (0.8% DCG).

ICPP

The monitoring results for ICPP production wells (CPP 1 and CPP 2 in Figure B-2) are summarized in Figures B-4 and B-5. Well ICPP #2 was sampled in October, and well #1 was sampled in November and December. The tritium concentration in all three samples was below the minimum detectable concentration shown in Table 1. Sr-90 was detected in water from well ICPP #1 at concentrations of $0.33 \pm 0.11 \times 10^{-9} \mu\text{Ci/mL}$ (0.03% DCG) in November and $0.96 \pm 0.13 \times 10^{-9} \mu\text{Ci/mL}$ (0.10% DCG) in December.

The drinking water well, ICPP #4, is sampled each month, and has never shown detectable concentrations of tritium. Strontium-90 was detected in the November sample at $0.56 \pm 0.12 \times 10^{-9} \mu\text{Ci/mL}$ (0.06% DCG). The only previously detected Sr-90 concentrations in samples from this well were in April 1985 and February 1991, both at concentrations of $0.8 \pm 0.2 \times 10^{-9} \mu\text{Ci/mL}$ (0.08% DCG).

Rifle Range

The PTI Rifle Range is located northwest of CFA about halfway between well #85 and well Highway 3. Fourth quarter samples had a mean tritium concentration of $4.2 \times 10^{-6} \mu\text{Ci/mL}$ (0.2% DCG). This concentration is consistent with those over the past two years.

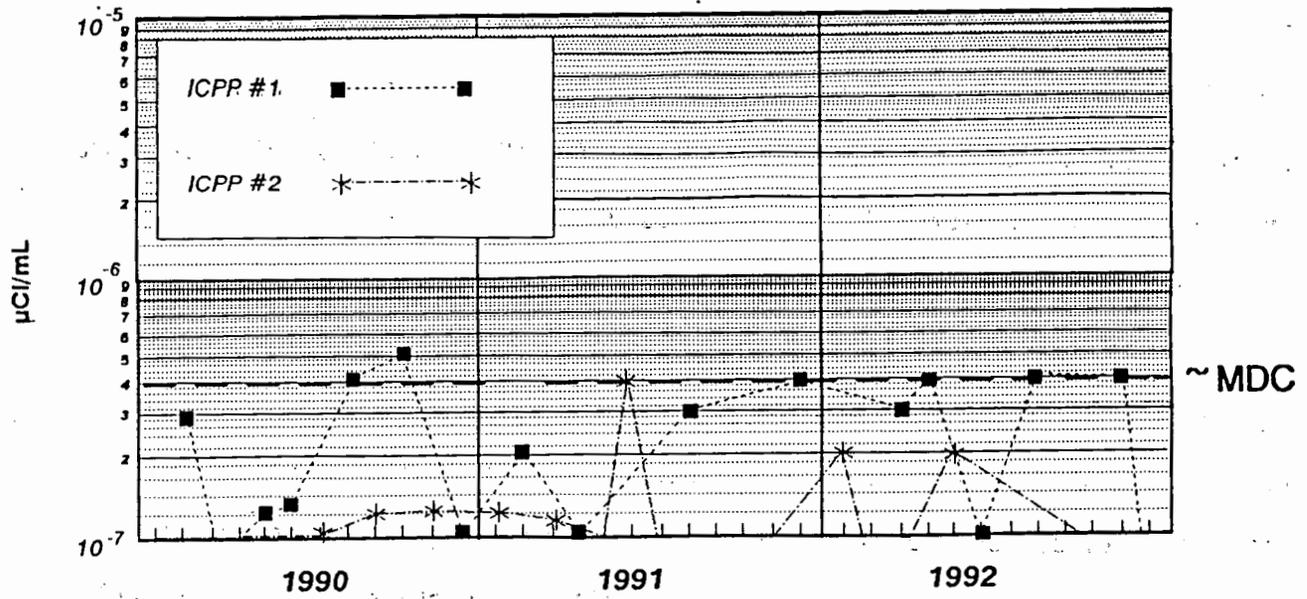


Figure B-4. Tritium Concentrations in ICPP Production Wells

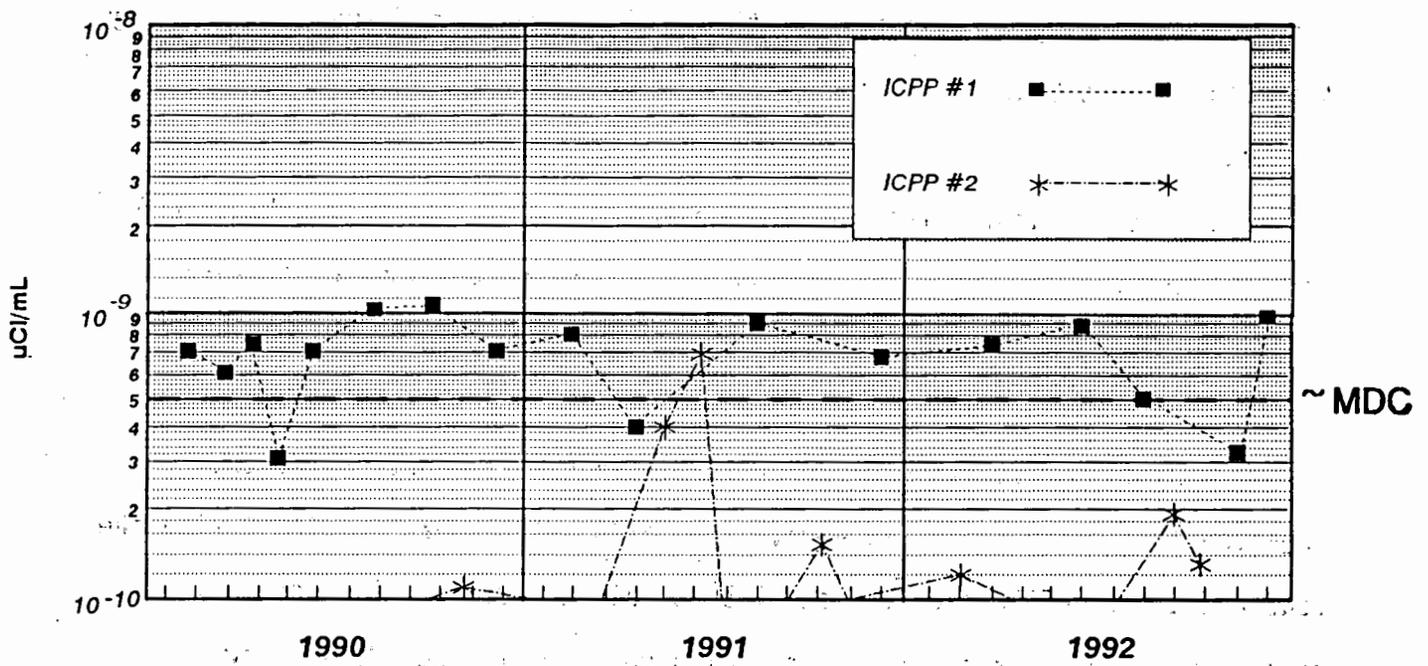


Figure B-5. Strontium-90 Concentrations in ICPP Production Wells

RWMC

During the fourth quarter, the mean tritium concentration in water samples from the RWMC production well was 1.7×10^{-6} $\mu\text{Ci/mL}$ (0.09% DCG), about the same as that measured in the previous quarter.

Observation Wells

The U.S. Geological Survey (USGS) has access to about 300 observation wells and auger holes on or near the INEL Site. About 160 of these are sampled on varied schedules depending on USGS hydrologic studies in progress and on the needs of the environmental surveillance program. USGS personnel measure water levels periodically for an indication of the amount of recharge to the ground-water system and the amount of water in storage in the Snake River Plain aquifer and perched-water bodies. The specific conductance of each sample is measured in the field to provide an indication of dissolved electrolytes at a given location. Other analyses performed are determined by the needs of the USGS in following the movement of specific waste constituent plumes.

Analyses of samples from several observation wells located between CFA and the southern INEL boundary show detectable concentrations of tritium. Well #106, about 6 km (3.5 mi) north of the southern INEL boundary (Figure B-1), had a tritium concentration of $1.87 \pm 0.11 \times 10^{-6}$ $\mu\text{Ci/mL}$ (0.09% DCG) in the fourth quarter of 1992. Four wells just inside the southern INEL boundary (wells #103, #105, #108, #109) were sampled during the fourth quarter and none of the samples contained a detectable amount of tritium. These wells are now on a semiannual sampling schedule. Low concentrations of tritium have been detected in some samples from three of the boundary wells in the past, most recently in third quarter 1986, but tritium

from INEL operations has not been detected in water from the nearest offsite wells south of the INEL boundary. For more information on concentrations and movement of tritium in the aquifer, see the USGS report, Tritium in Ground Water at the Idaho National Engineering Laboratory, Idaho: USGS Water-Resources Investigations Report 90-4090, DOE/ID-22090, June 1990.

Results of sample analyses from a few wells around ICPP, TRA, and RWMC are discussed below. Hydrographs are provided for selected wells as an indication of recharge to the aquifer and the amount of water in storage.

ICPP

Since February 1984, ICPP service wastes have been discharged to the ICPP infiltration ponds south of the facility. Well #57, located southwest of the ICPP infiltration ponds, and wells #111 through #116, south of the ponds, are used to monitor the aquifer downgradient from the ponds. Well #40 is used to sample the aquifer about 215 m southwest of the old ICPP disposal well, which was not used for routine discharges after 1984. The disposal well was formally capped in November 1989. Well #50 is used to sample a deep perched zone approximately 100 m north of the disposal well.

Well #40 was not sampled in the fourth quarter due to a malfunction in the pump. Water from well #57 contained tritium at a concentration of $21.1 \pm 0.6 \times 10^{-6} \mu\text{Ci/mL}$ (1.2% DCG), similar to the concentration in the third quarter (Figure C-1). The strontium-90 concentration in well #57 samples has remained about the same in the previous few years, except for sharply lower concentrations reported in the second quarters of 1989 and 1991, and during the third quarter of 1992 (Figure C-2). The fourth quarter result was not available. The water level measurements in well #40 are shown in Figure C-3.

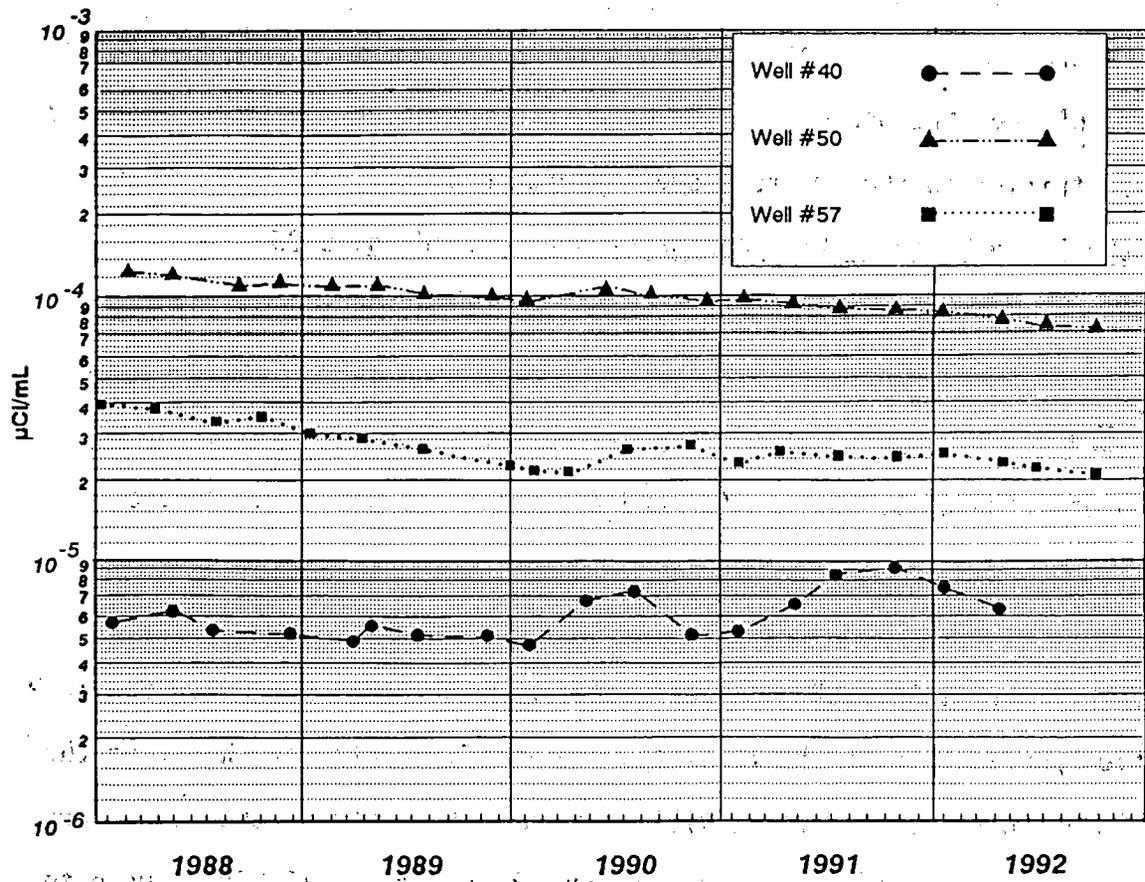


Figure C-1. Tritium in ICPP Area Ground Water

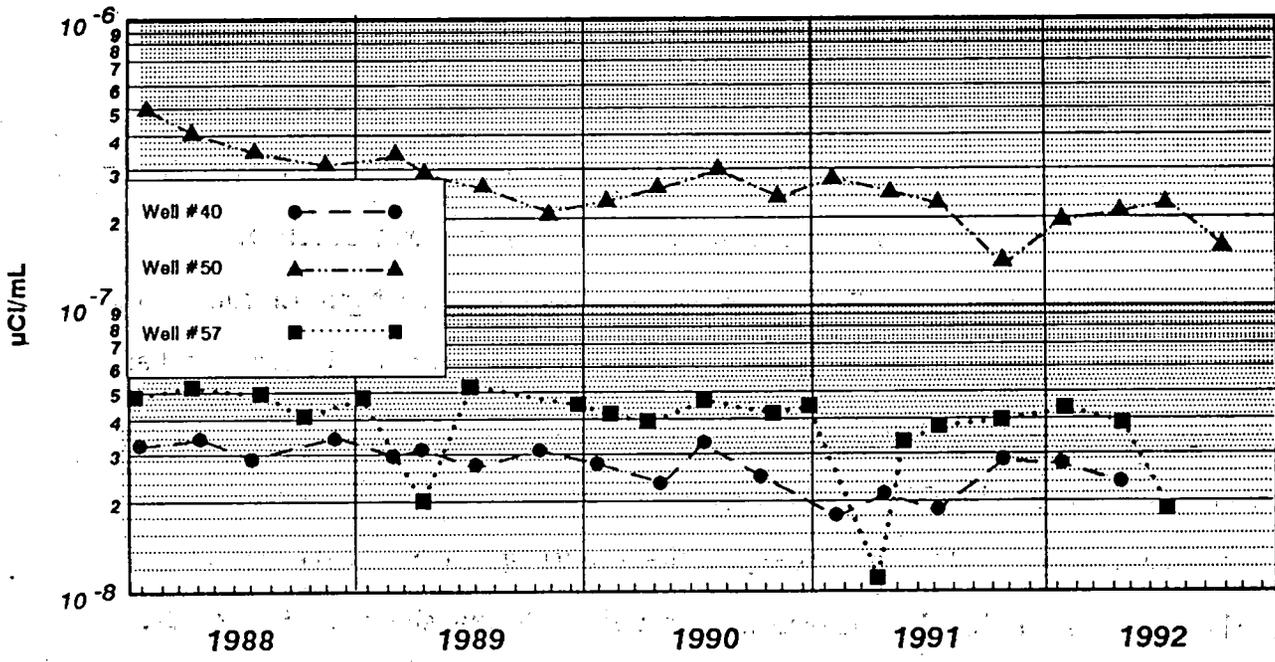


Figure C-2. Strontium-90 in ICPP Area Ground Water

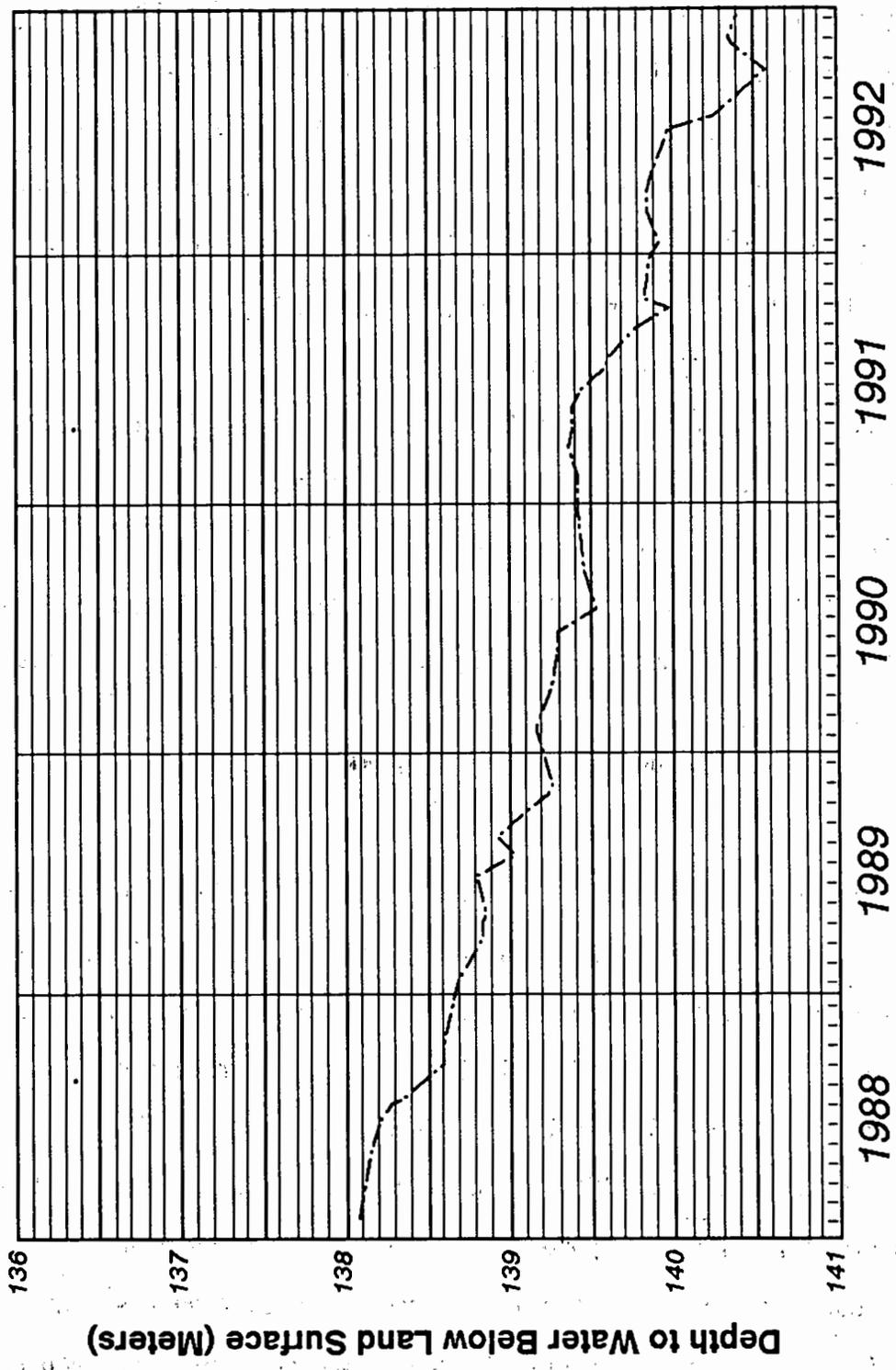


Figure C-3. Hydrograph of USGS Well #40 (Aquifer Ground Water)

Gamma spectrometric analysis was performed on the fourth quarter sample from well #50, and no manmade gamma-emitting radionuclides were detected.

The tritium concentration decreased slightly in the well #50 sample (deep perched water), and Figure C-1 indicates that tritium concentrations decreased from 1988 through mid-1989, leveled off during late 1989 and 1990, and may be slowly decreasing again. The Sr-90 concentration in water from this well decreased throughout 1988 and 1989, but has leveled off since that time (Figure C-2). The water level in well #50 is shown in Figure C-4.

Fourth quarter samples from wells #112 through #116 all contained tritium at concentrations ranging from $6.4 \pm 0.3 \times 10^{-6} \mu\text{Ci/mL}$ to $27.0 \pm 0.7 \times 10^{-6} \mu\text{Ci/mL}$ (0.3% to 1.4% DCG). Strontium results were not available for the fourth quarter. For more information on waste material plumes, their extent and direction of movement, see the USGS report, Hydrologic Conditions at the Idaho National Engineering Laboratory, 1986 to 1988: USGS Water-Resources Investigations Report 91-4047, DOE/ID-22096, March 1991.

TRA

Tritium, specific conductance, and total chromium levels were measured in water from wells #54, #65 and #A-77. No samples were available from well #A-13 from the fourth quarter because it was dry. Well #65 is used to sample Snake River Plain aquifer water and well #54 is used to sample a deep perched-water zone. Auger-holes #A-77 and #A-13 penetrate a shallow perched-water zone near the TRA 1964 radioactive infiltration pond and the 1982 nonradioactive infiltration pond. Well #65 and auger-hole #A-77 are used to monitor the downward movement of tritium from the retention basin and the radioactive infiltration pond. Auger-hole #A-77, which is used to sample a shallow perched-water zone below the retention basin, is located near the

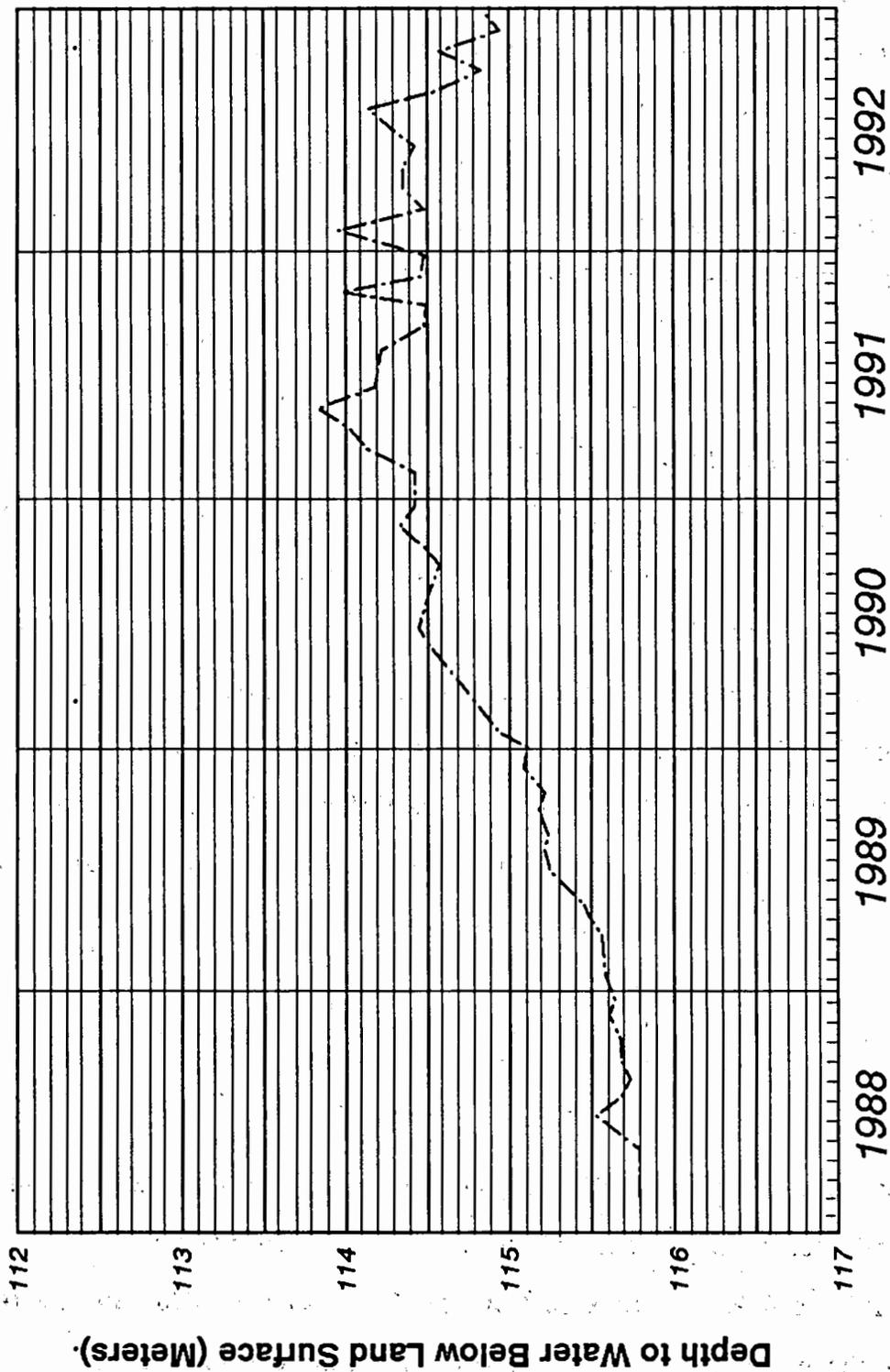


Figure C-4. Hydrograph of USGS Well #50 (Deep Perched)

basin and about 100 m west of the TRA radioactive infiltration pond. The retention basin consists of two rectangular concrete tanks separated by a 30-cm thick concrete wall. The west side of the basin apparently leaks more rapidly than the east side and soon affects the water levels in perched-water bodies. When the side of the retention basin receiving waste fills to a certain level, its pumps are activated and the contents of the basin are discharged to the TRA radioactive waste infiltration pond.

The tritium concentration in water from well #65 has decreased gradually over the last five years (Figure D-1). The concentration measured in the fourth quarter sample was $32.9 \pm 0.8 \times 10^{-6} \mu\text{Ci/mL}$ (1.6% DCG), down slightly from the previous quarter. Gamma spectrometric analysis was performed on a sample from well #65 and no manmade nuclides were detected.

The tritium concentration in auger-hole #A-77 increased slightly during the fourth quarter as shown in Figure D-1. Tritium concentrations in samples from #A-77 generally follow the trend of tritium concentrations in discharges from the retention basin to the TRA radioactive waste infiltration pond. (Figure D-2). Gamma spectrometric analysis was performed on a sample from auger-hole #A-77 and results were as follows:

Nuclide	Concentration ($10^{-6} \mu\text{Ci/mL}$)	%DCG
Cs-137	0.63 ± 0.05	21
Co-60	2.57 ± 0.11	51
Cr-51	24.5 ± 1.1	2

The USGS has begun performing Sr-90 analyses on water from this auger hole. This radionuclide has been detected at concentrations ranging from $1.36 \pm 0.04 \times 10^{-6}$ to $4.95 \pm 0.13 \times 10^{-6} \mu\text{Ci/mL}$ (136% to 495% DCG) in samples analyzed since the beginning of 1991. The most recent concentration available, that measured in the third quarter of 1992, was $2.53 \pm 0.07 \times 10^{-6} \mu\text{Ci/mL}$ (253% DCG). Analysis of the fourth quarter sample was not yet completed.

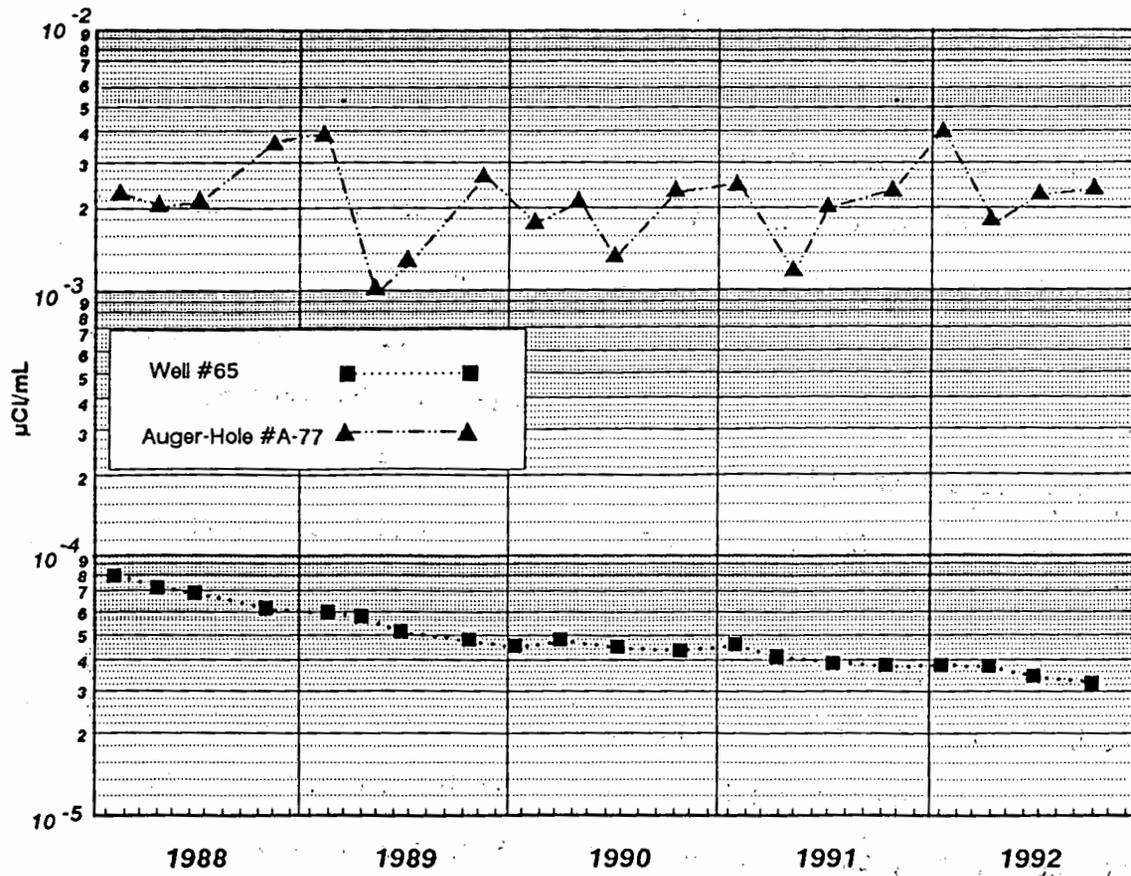


Figure D-1. Tritium in TRA Area Ground Water

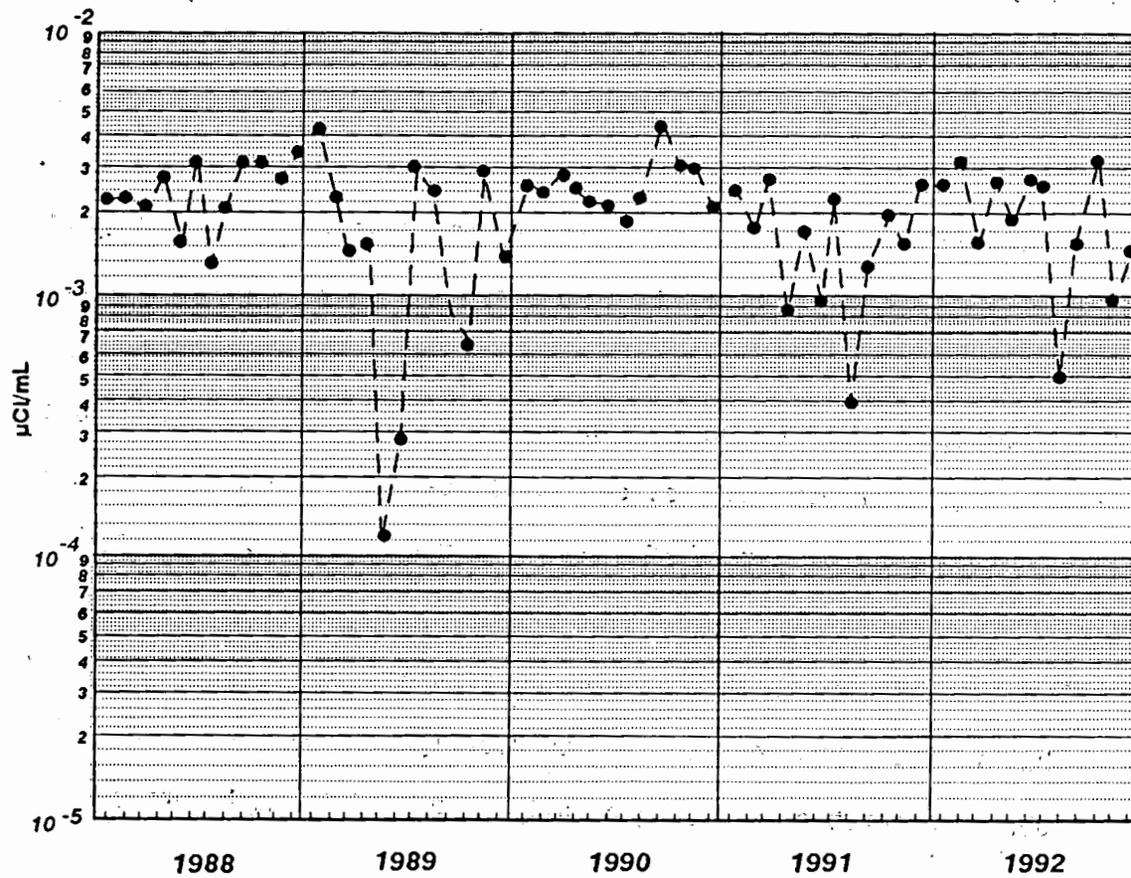


Figure D-2. Tritium Concentration in Discharges to TRA Radioactive Infiltration Pond

Since March of 1983, samples from auger-hole #A-13 and well #54 have generally shown specific conductance at higher levels than in other wells in the area. This is probably due to recharge containing dissolved ions from the nonradioactive infiltration pond reaching the perched water bodies penetrated by these two wells. Over the past few years, specific conductance has been fluctuating in samples from well #54 (Figure D-3); water from well #65 showed a gradual increase until 1989 but has leveled off. Specific conductance in samples from auger-hole #A-77 has generally stayed at about the same level, but showed a fairly substantial increase during the second quarter of 1992.

Figure D-4 shows the chromium concentration of water from wells #65, #A-77, #A-13, and #54, none of which provides water for a drinking water system. (For comparison, the EPA Drinking Water Standard for chromium is 1 E-6 mol/L or 0.05 mg/L). Data shown in Figure D-4 prior to fourth quarter 1989 were measurements of dissolved chromium made by the RESL Analytical Chemistry Branch, whose minimum detectable concentration was 0.05 mg/L . Starting in October 1989, measurements have been made at the USGS Laboratory in Arvada, Colorado. This lab has a reporting level of 0.001 mg/L . Data from October 1989 through April 1990 are of both dissolved and suspended chromium, while measurements after April 1990 are of dissolved chromium only.

Chromium concentrations were below the minimum detectable concentration in well #A-13 from 1985 until the change in analytical laboratories, and have stayed at levels less than 0.05 mg/L since. Well #54 was similarly less than 0.05 mg/L until the first quarter of 1992 when a concentration of 0.06 mg/L was reported. The higher concentration coincides with a lower water level in the well. In the third quarter the chromium concentration was at the RESL MDC of 0.05 mg/L but in the fourth quarter it was 0.07 mg/L . Well #A-77 was only occasionally above detectable levels, generally at $0.06\text{-}0.08 \text{ mg/L}$, until

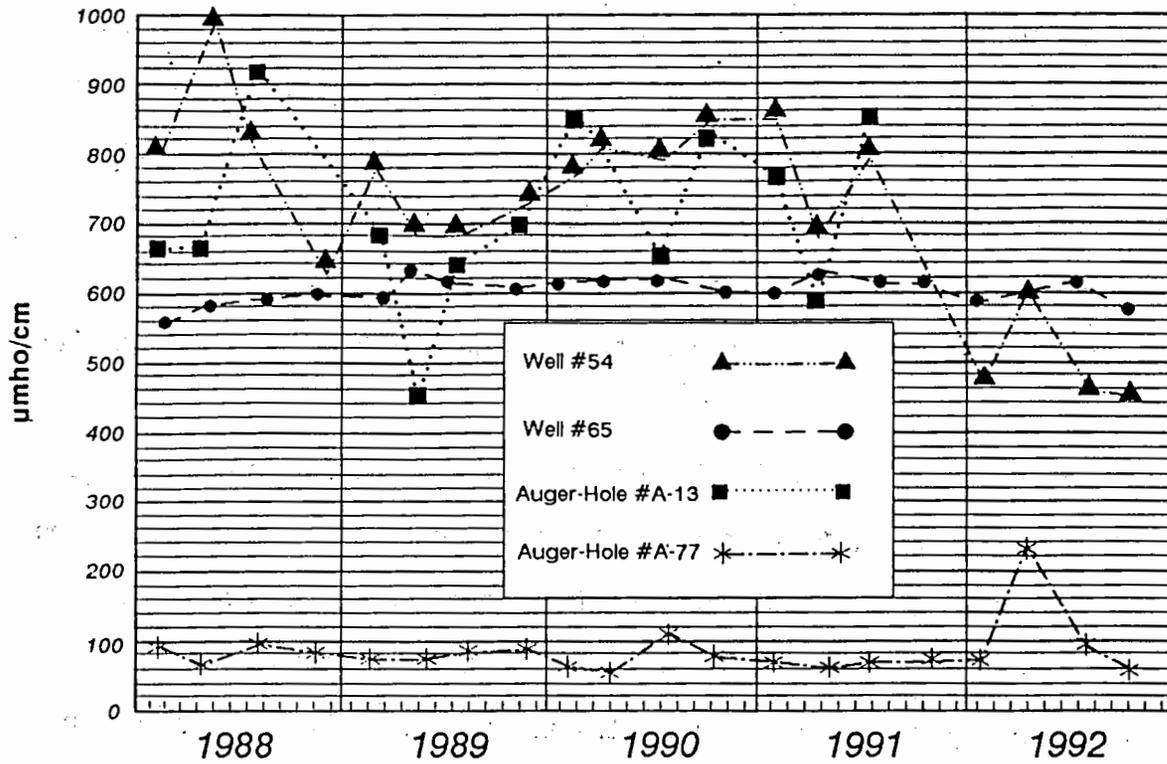


Figure D-3. Specific Conductance in TRA Area Ground Water

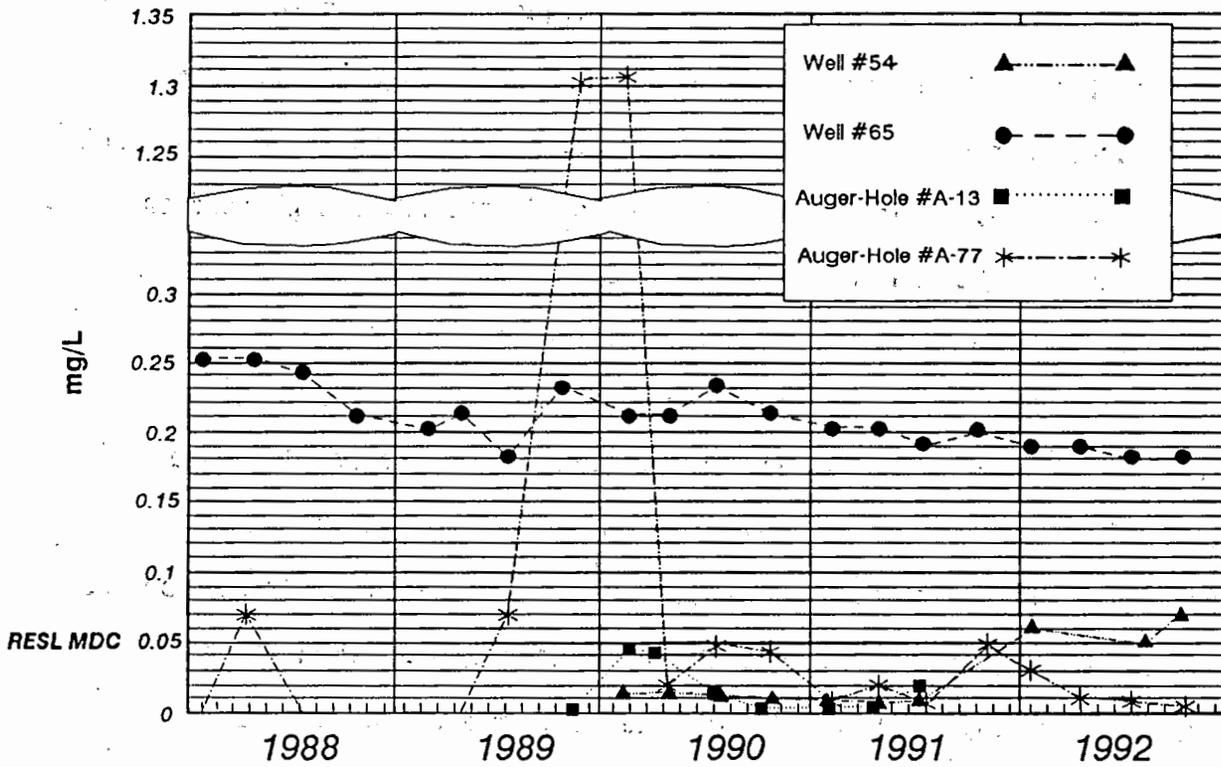


Figure D-4. Total Chromium in TRA Area Ground Water

October 1989. The increase during October 1989 and January 1990 possibly reflects the inclusion of suspended chromium in the samples, as discussed in previous quarterly reports. Measurements of water from well #65 have remained about the same over the last three years, and a chromium concentration of 0.18 mg/L was reported for the fourth quarter. Figures D-5 through D-8 present water levels in these wells plus those of well #58, a regional aquifer well.

Changes in water levels in #A-77 were probably due to operational shifts in liquid waste disposal back and forth between the east side of the retention basin and the faster-leaking west side mentioned earlier. The changes in water levels of #A-13 and #54 are related to discharges made to the nonradioactive infiltration ponds. When the north pond is being used, water levels in #A-13 and #54 rise several meters.

RWMC

The tritium concentrations in water from aquifer wells #87 and #90 and in USGS samples of the RWMC production well are plotted in Figure E-1. Since tritium is rarely detected in wells #88 and #89, data from these wells are not included in Figure E-1. Water levels for wells #87 and #90 are plotted in Figure E-2, and for #88 and #89 in Figure E-3.

Fourth quarter samples from the RWMC wells were analyzed for gamma-emitting radionuclides, Strontium-90, and transuranic elements. Strontium-90 was not detected in any of the wells for which results were available. Cesium-137 was indicated in the sample from well #119 at a concentration of $50 \pm 20 \times 10^{-9} \mu\text{Ci/mL}$ (1.7% DCG). Americium-241 was reported above the minimum detectable concentration in two samples: well #92 at $0.14 \pm 0.04 \times 10^{-9} \mu\text{Ci/mL}$ (0.5% DCG) and the RWMC Production well at

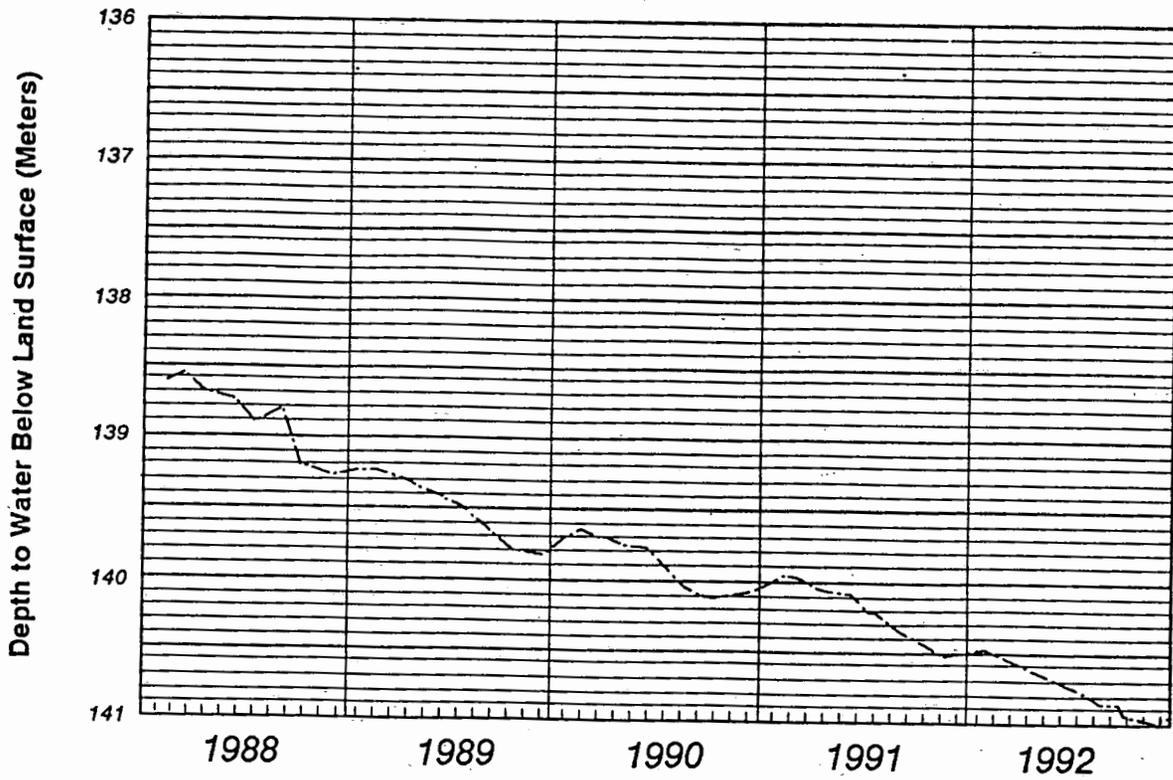


Figure D-5. Hydrograph of USGS Well #58 (Regional Ground Water)

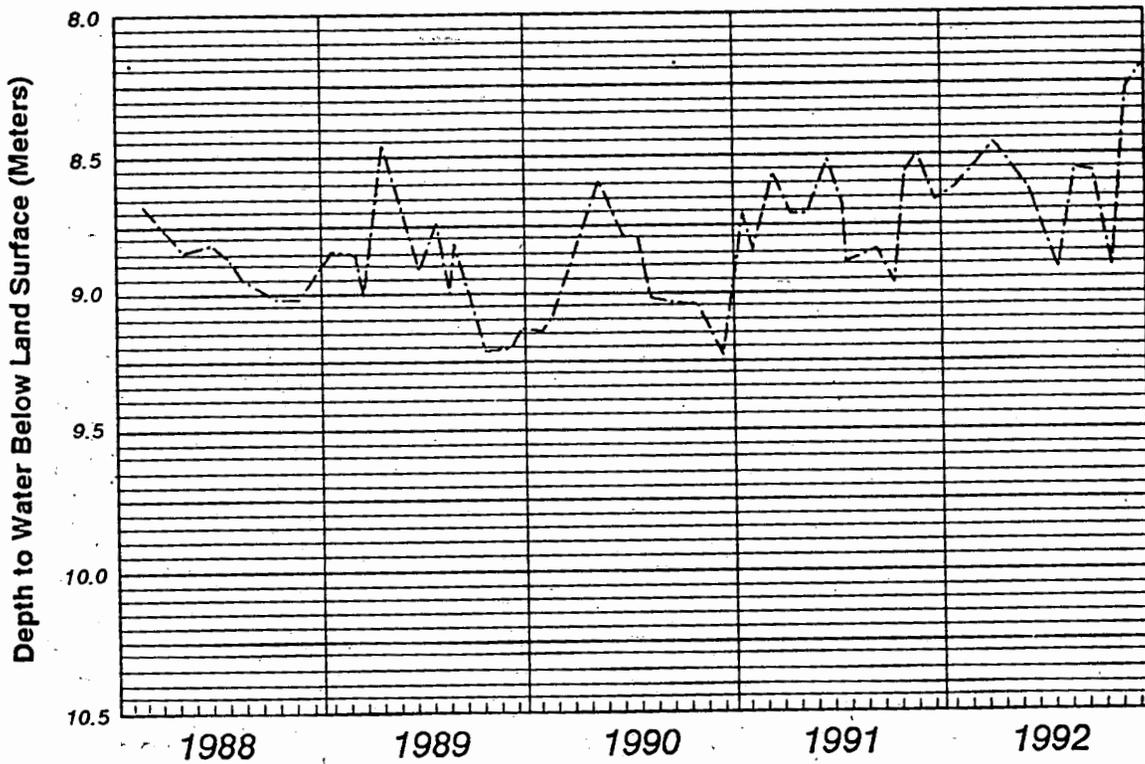


Figure D-6. Hydrograph of Auger Hole TRA #A-77 (Shallow Perched)

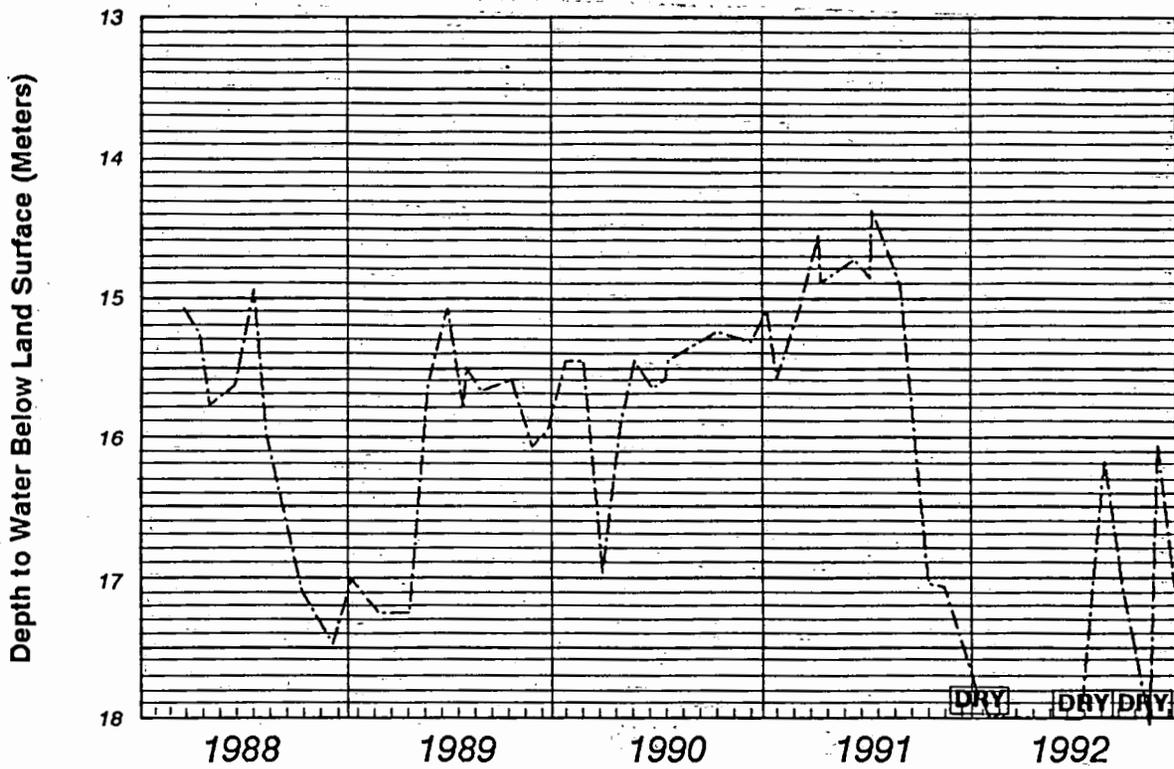


Figure D-7. Hydrograph of Auger Hole TRA #A-13 (Shallow Perched)

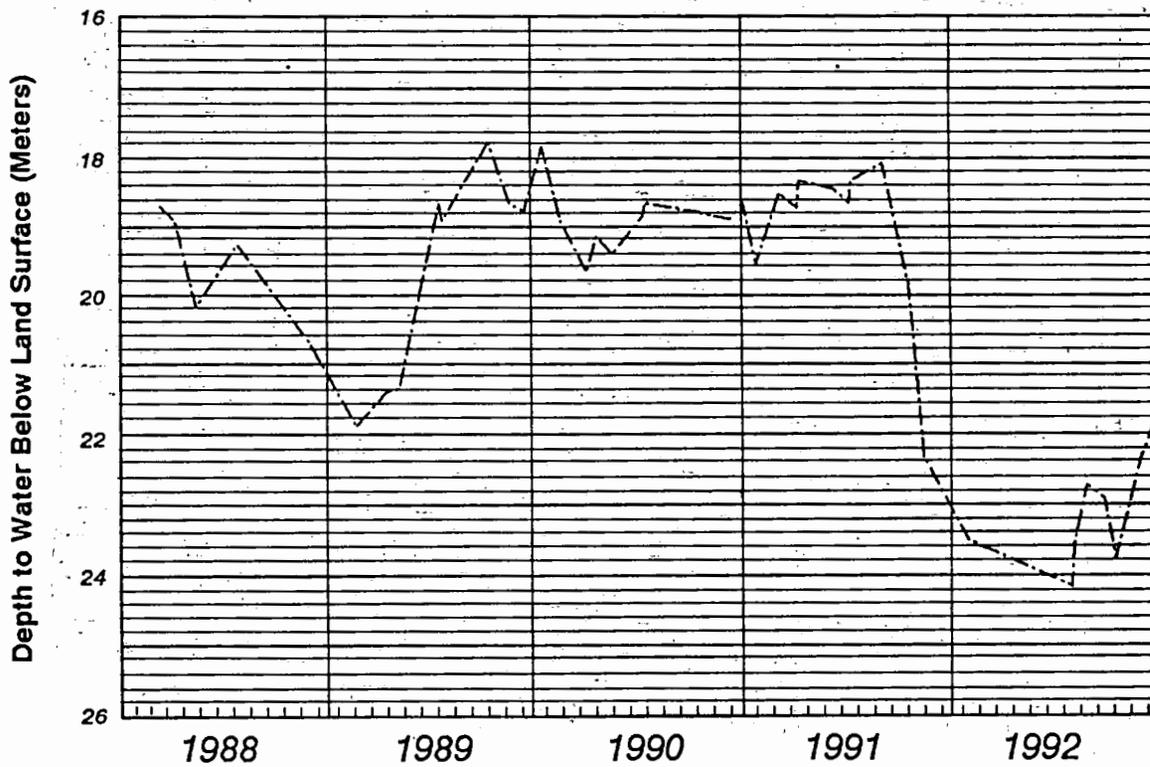


Figure D-8. Hydrograph of USGS Well #54 (Deep Perched)

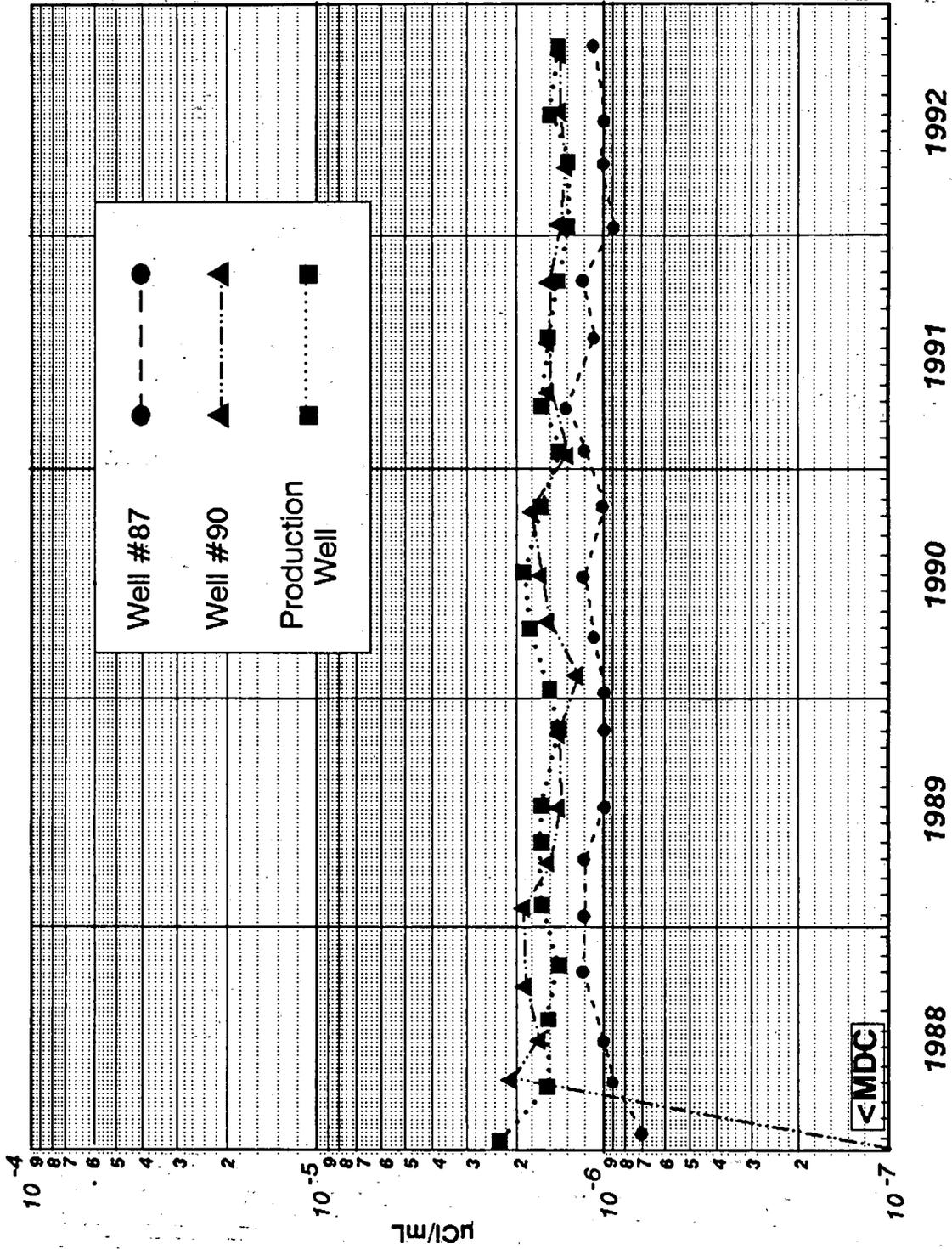


Figure E-1. Tritium Concentrations in RWMC Wells

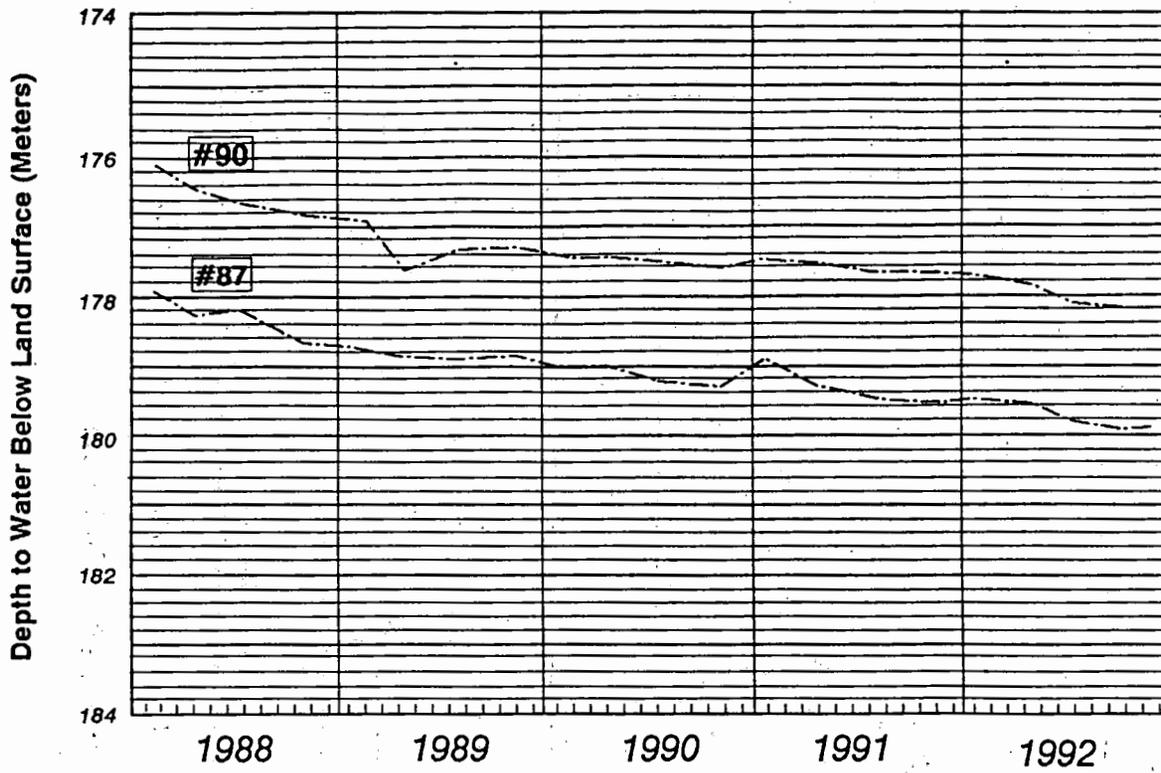


Figure E-2. Hydrographs of RWMC Wells #87 and #90

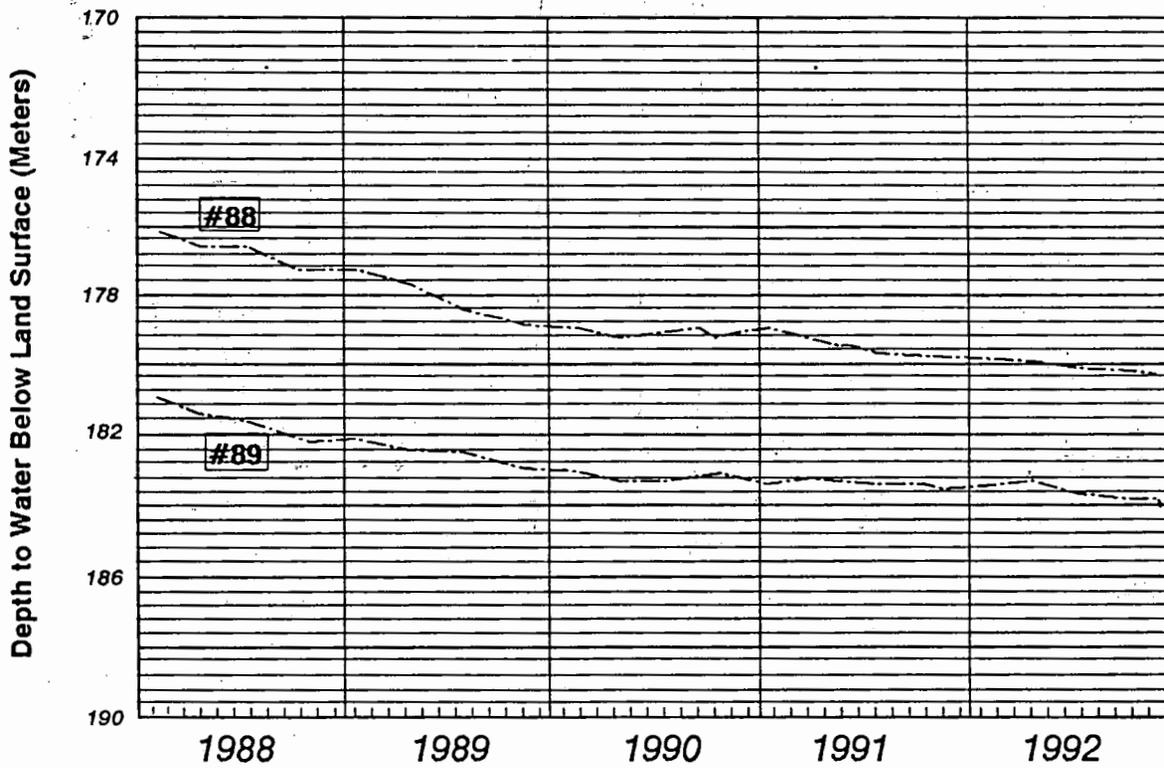


Figure E-3. Hydrograph of RWMC Wells #88 and #89

0.08 ± 0.03 × 10⁻⁹ μCi/mL (0.3% DCG). Well #92 samples a perched water zone inside the Subsurface Disposal Area (SDA).

USGS has continued sampling wells at the RWMC for purgeable organic compounds during 1992. Results are consistent with those reported previously by USGS. For example; the mean concentration of carbon tetrachloride in three fourth quarter RWMC production well samples was 2.3 μg/L.

ENVIRONMENTAL RADIATION

Environmental Dosimeters

Environmental dosimeters consisting of five lithium fluoride (LiF) thermoluminescent dosimeter (TLD) chips in a laminated package were used to measure ionizing radiation exposures around the perimeters of major facilities and at offsite locations. The ionizing radiation exposure data for onsite locations for the period of May 1992 through October 1992 are presented in Table II, along with data of the three preceding exposure periods. The uncertainties given in the right-hand column represent $2s$ where "s" is the estimated uncertainty. Data from the previous exposure periods are listed without uncertainties for easier comparison. Figures F-1 through F-9 show the current environmental dosimeter locations around each facility, and Figure F-10 shows dosimeter locations along Lincoln Boulevard and along U.S. Highways 20 and 26.

The dosimeters were positioned one meter above ground level for a period of approximately six months. The exposures result from natural radioactivity, cosmic radiation, fallout, and facility operations. Background exposures shown in Table III were measured at Aberdeen, Blackfoot, Craters of the Moon National Monument, Idaho Falls, Minidoka, Rexburg, and Roberts.

The mean exposure of the distant communities (66 ± 7) is statistically the same as the mean exposure for the same period of a year ago, May 1991 through October 1991, using an unpaired t-test ($\alpha=0.05$) for comparison. There is also no statistical difference between the mean exposure for the second half of 1992 compared to the first half of 1992.

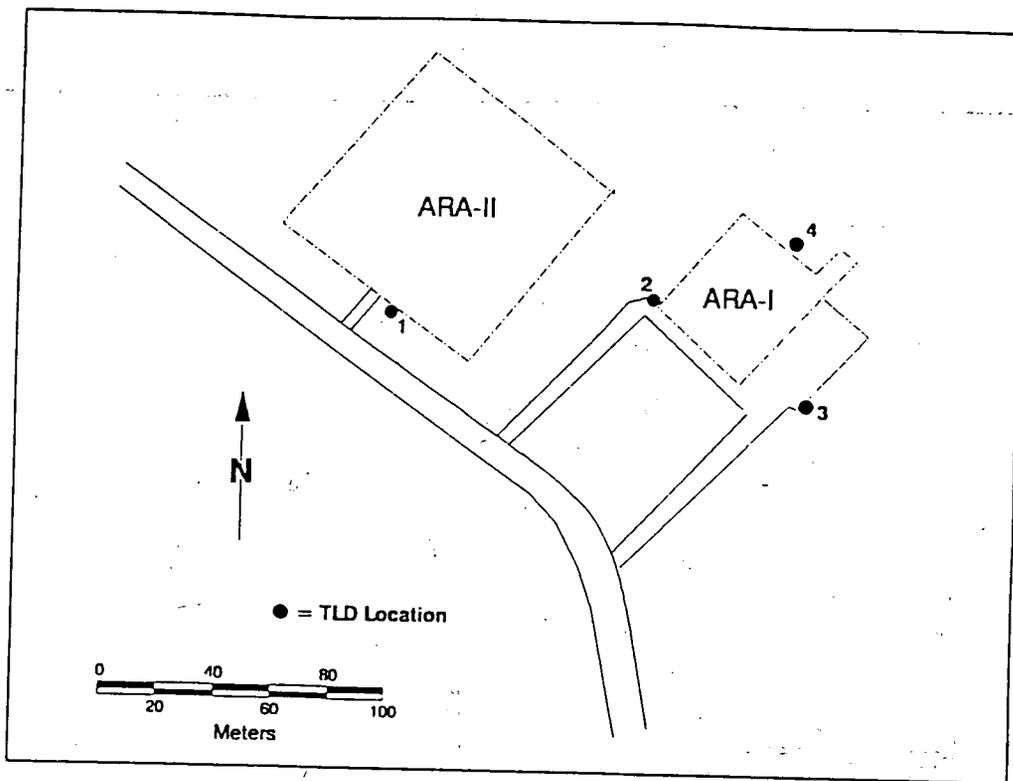


Figure F-1. Environmental Dosimeters at ARA

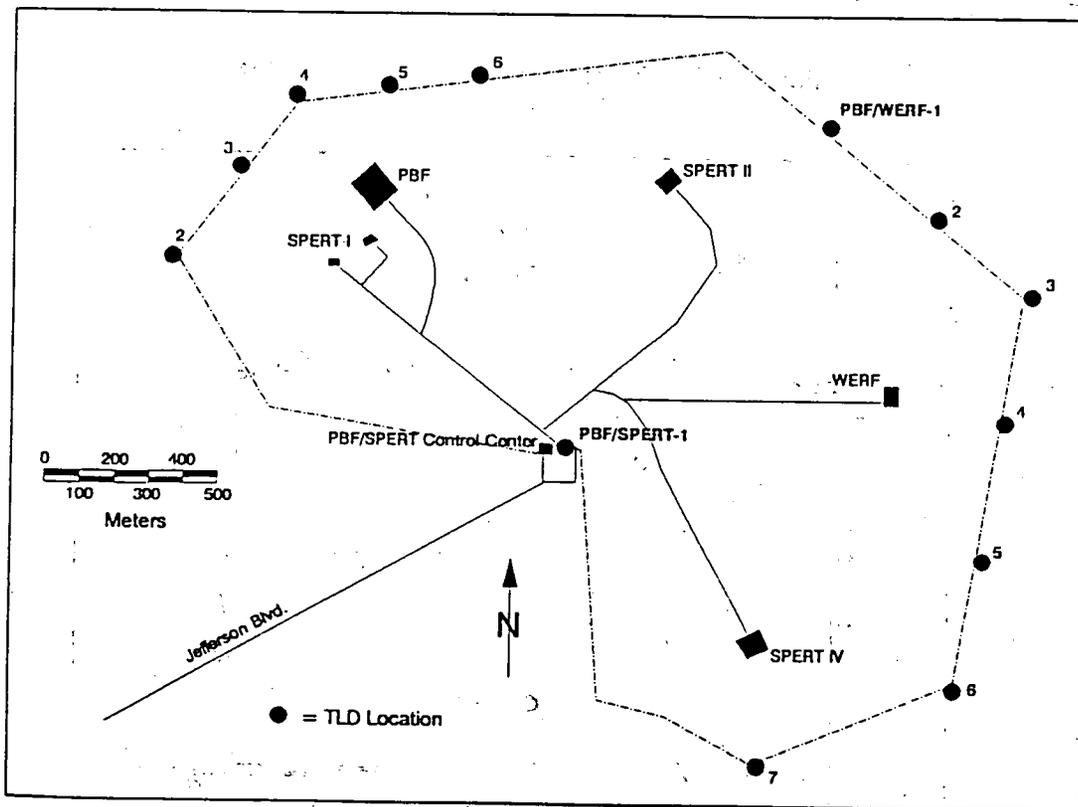


Figure F-2. Environmental Dosimeters at SPERT/PBF/WERF

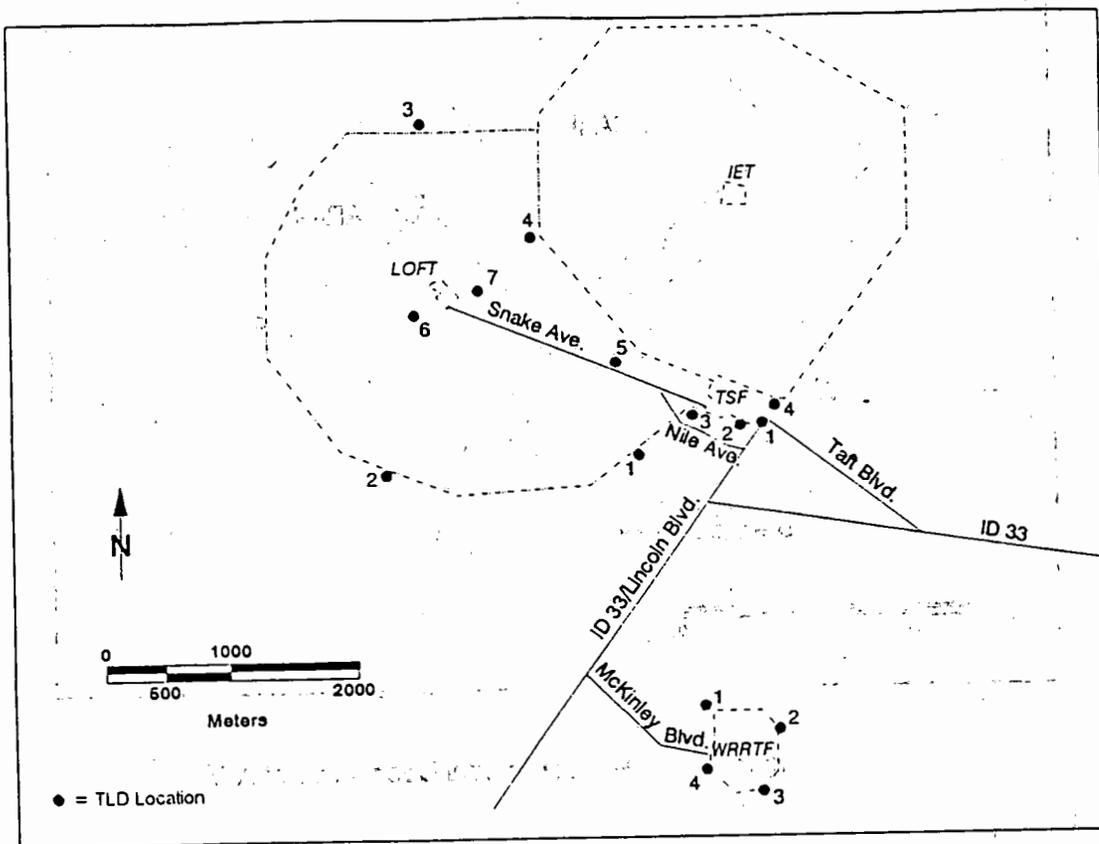


Figure F-3. Environmental Dosimeters at TAN

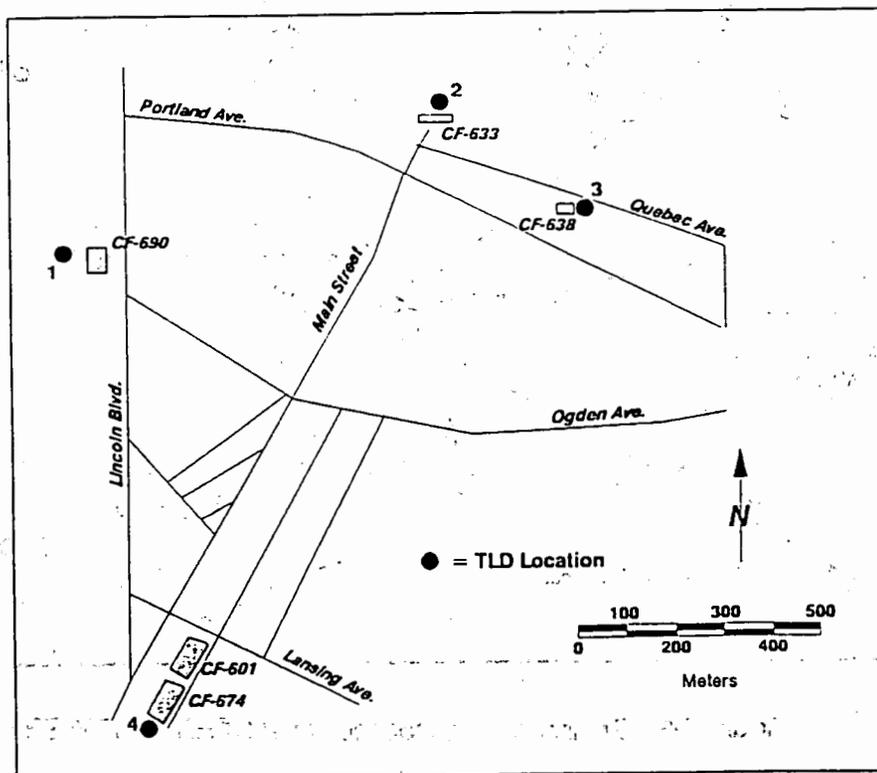


Figure F-4. Environmental Dosimeters at CFA.

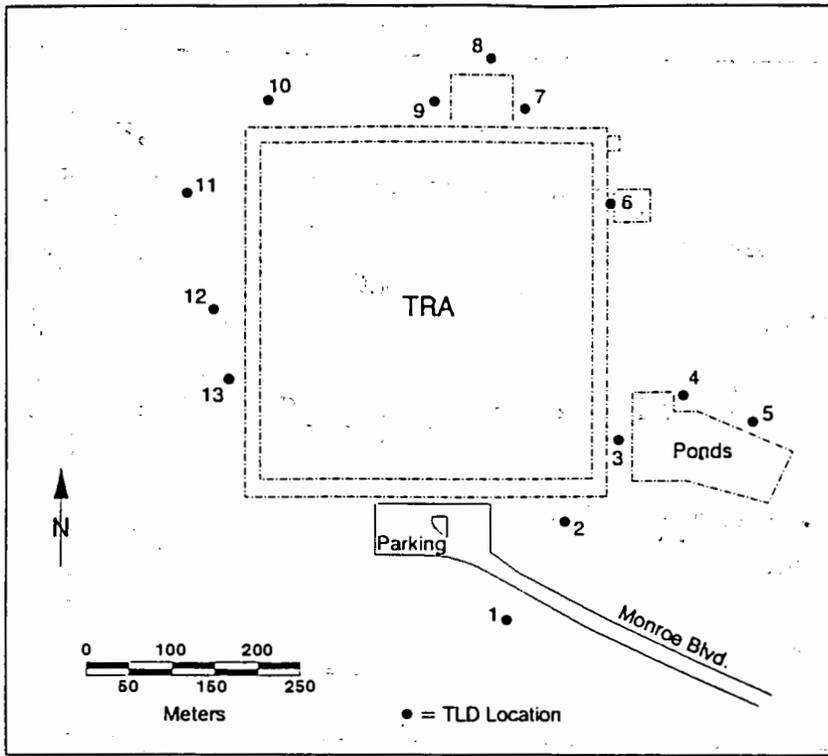


Figure F-5. Environmental Dosimeters at TRA

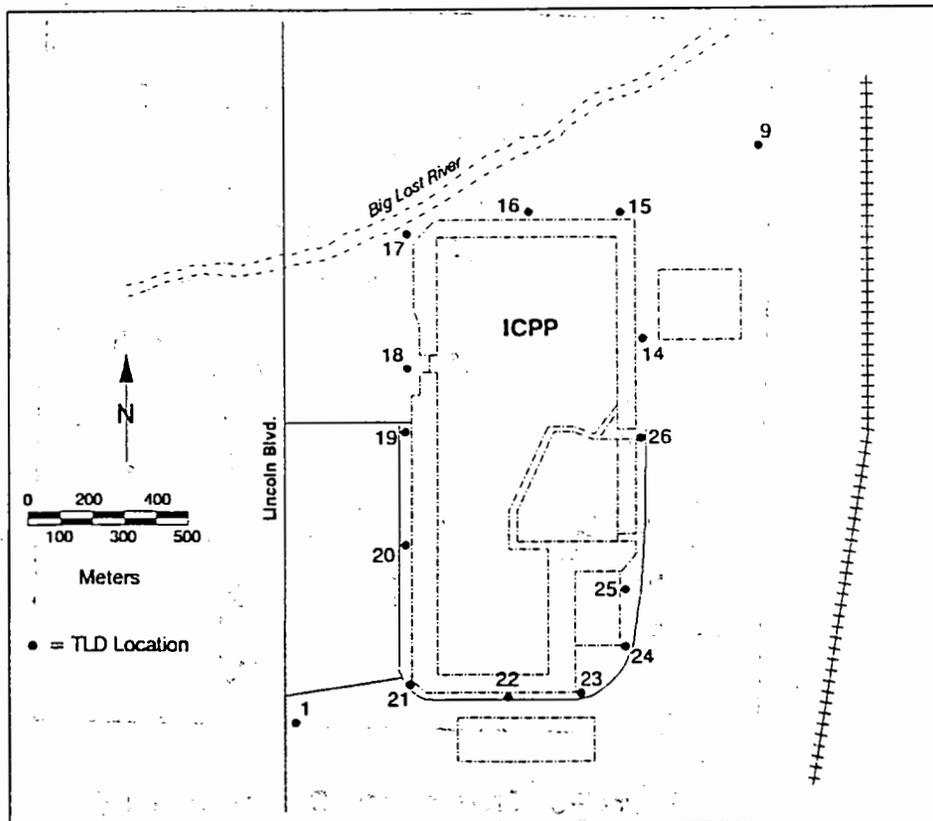


Figure F-6. Environmental Dosimeters at ICPP

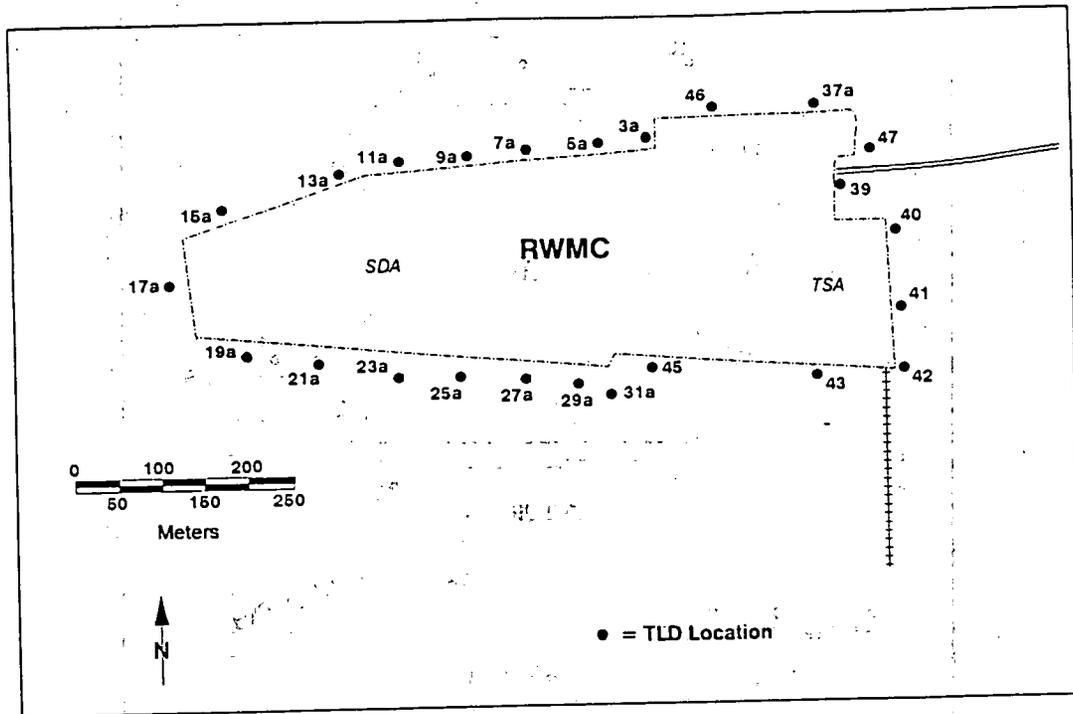


Figure F-7. Environmental Dosimeters at RWMC

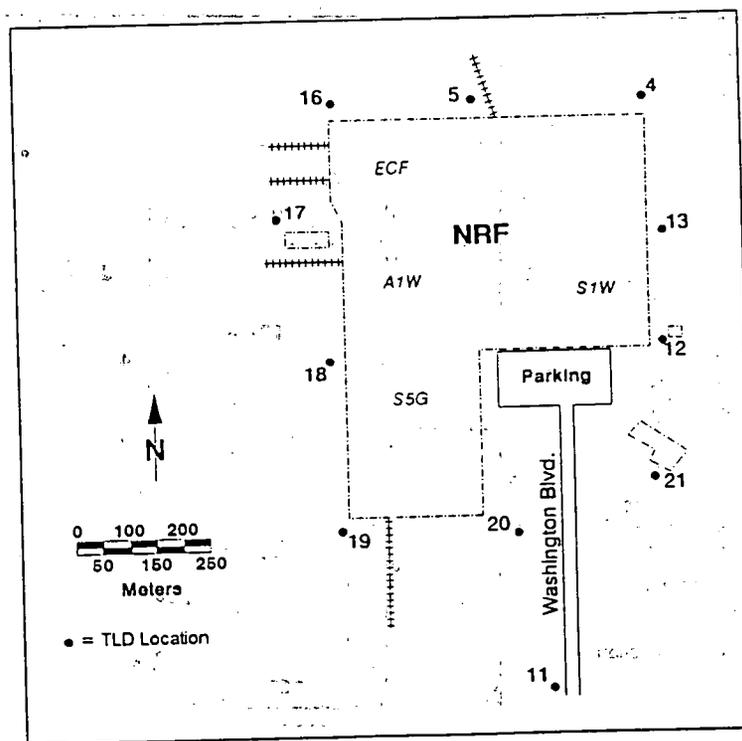


Figure F-8. Environmental Dosimeters at NRF

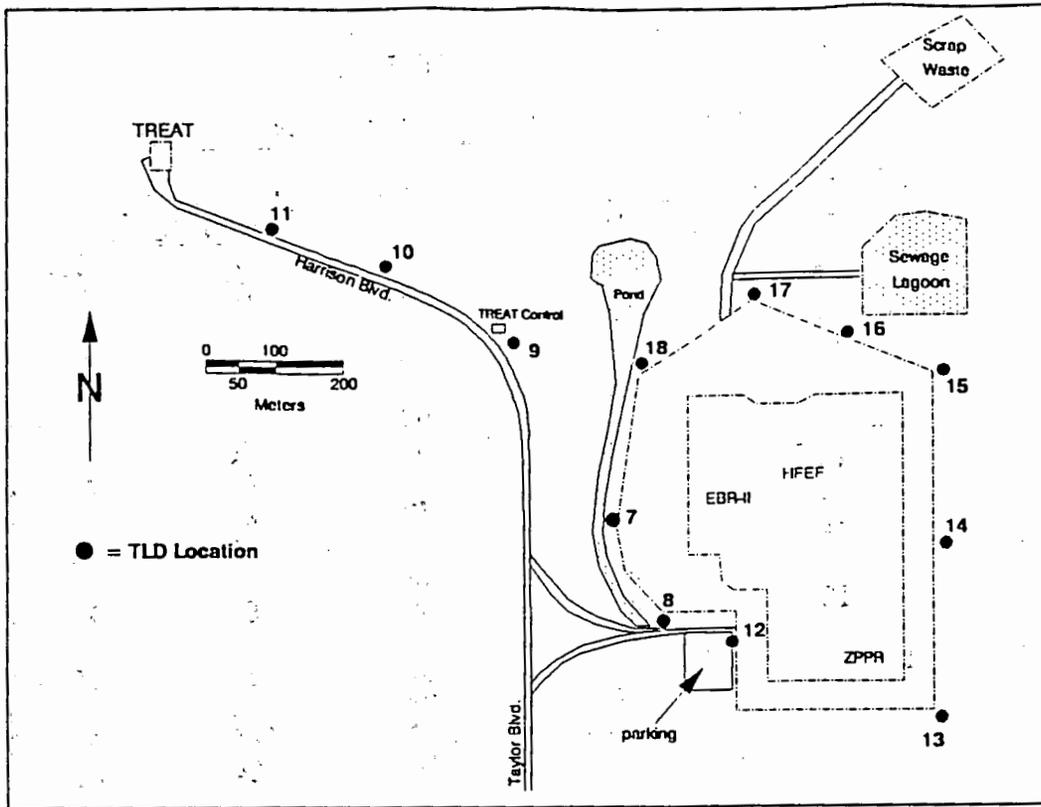


Figure F-9. Environmental Dosimeters at ANL-W

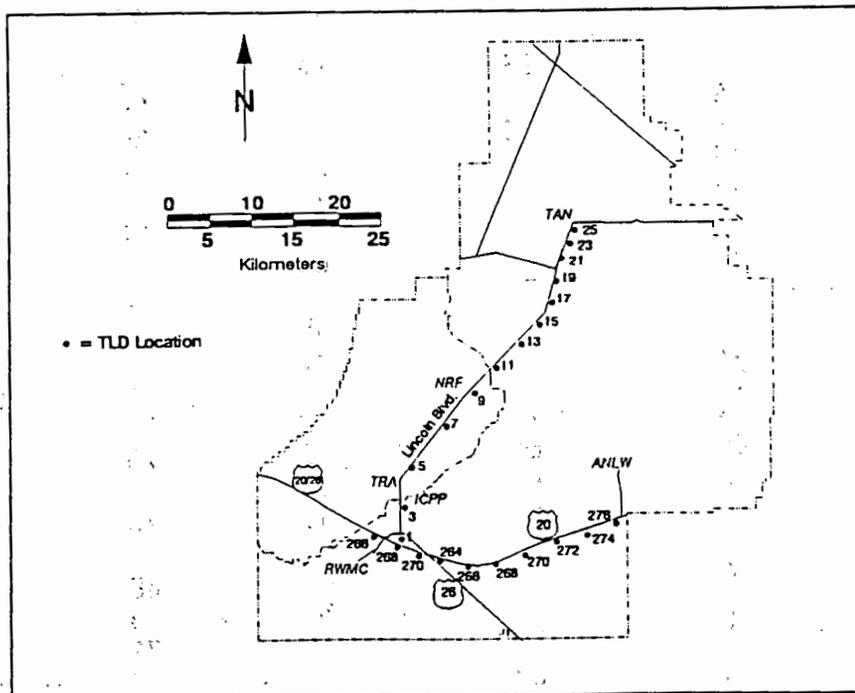


Figure F-10. Environmental Dosimeters along Lincoln Blvd. and US 20 and 26

TABLE II
ONSITE IONIZING RADIATION EXPOSURE DATA

Facility	Dosimeter Location #	Six-Month Exposure in mR				
		11/90-4/91	5/91-10/91	11/91-4/92	5/92-10/92	
ANL-W	7	64	68	66	82 ± 5	
	8	83	76	80	46 ± 5	
	9	72	72	74	82 ± 5	
	10	62	58	57	63 ± 4	
	11	65	65	63	69 ± 4	
	12	67	63	65	67 ± 4	
	13	68	65	66	a	
	14	60	63	62	68 ± 4	
	15	69	73	87	99 ± 5	
	16	74	71	79	86 ± 5	
	17	64	63	65	66 ± 3	
	18	69	68	67	71 ± 4	
	ARA-I & II	1	85	87	83	90 ± 4
		2	89	83	85	90 ± 5
		3	116	132	124	132 ± 8
		4	83	84	84	85 ± 6
	CFA	1	73	72	72	69 ± 4
		2	66	61	63	62 ± 3
3		76	70	72	73 ± 6	
4		75	70	71	65 ± 4	
EBR-I	1	69	65	68	68 ± 3	
ICPP	1	85	86	85	87 ± 5	
	9	105	113	109	122 ± 6	
	14	78	79	84	84 ± 5	
	15	84	80	82	86 ± 4	
	16	73	73	80	52 ± 5	
	17	77	74	74	76 ± 4	
	18	75	68	70	69 ± 3	
	19	74	71	74	73 ± 4	
	20	103	95	92	99 ± 5	
	21	81	91	88	86 ± 6	
	22	96	107	104	111 ± 6	
	23	72	74	84	83 ± 5	
	24	64	66	75	71 ± 4	
	25	66	59	68	68 ± 4	
26	66	66	75	72 ± 4		
NRF	4	72	67	68	74 ± 4	
	5	74	76	79	57 ± 6	
	11	71	72	71	73 ± 4	
	12	80	76	77	79 ± 4	
	13	71	72	71	75 ± 4	

a. Dosimeter missing at collection time.

TABLE II (Continued)

ONSITE IONIZING RADIATION EXPOSURE DATA

Facility	Dosimeter Location #	Six-Month Exposure in mR			
		11/90-4/91	5/91-10/91	11/91-4/92	5/92-10/92
NRF (Cont.)	16	68	69	71	70 ± 4
	17	75	69	71	71 ± 5
	18	70	73	70	76 ± 5
	19	71	79	73	76 ± 5
	20	69	73	73	75 ± 4
	21	70	66	67	75 ± 4
PBF-SPERT	1	66	61	65	63 ± 5
	2	63	66	67	70 ± 4
	3	65	66	66	74 ± 8
	4	72	71	71	74 ± 4
	5	67	64	67	73 ± 3
	6	68	68	67	74 ± 4
PBF-WERF	1	62	65	65	70 ± 4
	2	58	51	60	62 ± 4
	3	61	64	65	70 ± 4
	4	62	65	66	68 ± 3
	5	58	62	68	69 ± 4
	6	58	65	63	64 ± 3
	7	68	68	66	69 ± 4
RWMC	3	94	101	87	91 ± 5
	5a	126	121	105	75 ± 4
	7a	101	109	99	63 ± 4
	9a	84	89	79	84 ± 5
	11a	72	73	70	76 ± 5
	13a	67	56	66	70 ± 4
	15a	68	68	67	72 ± 5
	17a	71	67	69	72 ± 3
	19a	68	67	65	70 ± 4
	21a	72	70	73	75 ± 4
	23a	66	67	68	71 ± 4
	25a	76	71	75	79 ± 4
	27a	90	90	85	89 ± 6
	29a	101	98	92	95 ± 5
	31a	82	86	82	85 ± 5
	37a	71	73	75	75 ± 5
	39	80	88	92	96 ± 5
	40	68	67	73	73 ± 3
	41	82	81	79	83 ± 4
	42	72	69	71	70 ± 5
43	68	66	67	71 ± 3	
45	79	79	82	84 ± 5	
46	79	78	76	56 ± 6	
47	70	70	73	54 ± 5	

TABLE II (Continued)

ONSITE IONIZING RADIATION EXPOSURE DATA

Facility	Dosimeter Location #	Six-Month Exposure in mR			
		11/90-4/91	5/91-10/91	11/91-4/92	5/92-10/92
TAN-TSF	1	64	64	67	74 ± 4
	2	74	71	71	75 ± 4
	3	64	70	72	73 ± 4
	4	57	58	61	65 ± 4
TAN-LOFT	1	69	a	64	71 ± 4
	2	75	69	71	77 ± 4
	3	53	53	60	59 ± 3
	4	57	59	60	60 ± 4
	5	60	60	60	64 ± 4
	6	70	71	70	77 ± 4
	7	68	73	66	73 ± 4
TAN-WRRTF	1	57	54	63	69 ± 4
	2	64	64	61	63 ± 4
	3	67	54	59	62 ± 3
	4	65	58	57	63 ± 3
TRA	1	79	92	87	98 ± 5
	2	179	229	225	292 ± 17
	3	1749	2181	2220	b
	4	1218	1832	1688	b
	5	819	908	895	b
	6	108	122	120	132 ± 8
	7	89	93	104	108 ± 6
	8	123	123	123	125 ± 7
	9	80	80	80	86 ± 5
	10	74	76	78	82 ± 5
	11	74	76	70	82 ± 4
	12	79	75	69	a
	13	73	73	72	77 ± 4
Lincoln Blvd.	1	66	63	69	64 ± 4
	3	79	79	69	81 ± 4
	5	74	73	75	80 ± 5
	7	73	75	71	71 ± 4
	9	80	75	74	76 ± 4
	11	68	70	76	69 ± 5

a. Dosimeter missing at collection time.

b. Location lost during pond cleanup. New location established May 1992.

TABLE II (Continued)

ONSITE IONIZING RADIATION EXPOSURE DATA

Facility	Dosimeter Location #	Six-Month Exposure in mR			
		11/90-4/91	5/91-10/91	11/91-4/92	5/92-10/92
Lincoln Blvd. (Cont.)	13	74	74	76	73 ± 4
	15	68	75	75	74 ± 4
	17	74	76	58	73 ± 4
	19	70	68	68	71 ± 5
	21	71	66	68	66 ± 4
	23	66	68	60	69 ± 4
	25	72	68	60	68 ± 3
US 20	264	65	65	63	67 ± 3
	266	64	59	65	64 ± 4
	268	67	63	64	67 ± 4
	270	64	65	65	67 ± 4
	272	60	59	54	59 ± 4
	274	57	53	54	56 ± 3
	276	67	61	62	69 ± 4
US 26	266	70	66	66	71 ± 4
	268	67	67	68	69 ± 8
	270	69	65	72	69 ± 4

TABLE III

DISTANT COMMUNITY IONIZING RADIATION EXPOSURE DATA

Community	Dosimeter Location #	Six-Month Exposure in mR			
		11/90-4/91	5/91-10/91	11/91-4/92	5/92-10/92
Aberdeen	1	63	63	61	a
Blackfoot	1	61	61	59	63 ± 3
Craters of the Moon	1	66	65	69	63 ± 3
Idaho Falls	1	67	60	66	72 ± 8
Minidoka	1	53	50	61	68 ± 5
Rexburg	1	60	53	53	56 ± 3
Roberts	1	70	67	64	72 ± 4

a. Dosimeter missing at collection time.