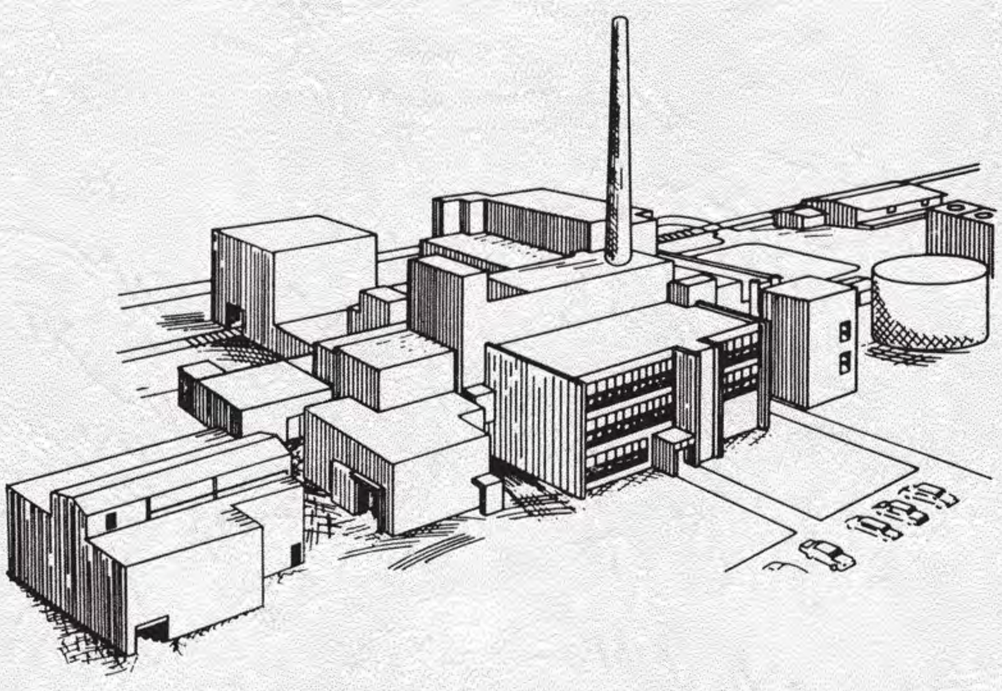
WVDP-040

1987
ENVIRONMENTAL MONITORING REPORT
WEST VALLEY DEMONSTRATION PROJECT

March 1988



West Valley Nuclear Services Company, Inc.
Rock Springs Road
West Valley, New York 14171-0191

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Operated for the U.S. Department of Energy
by
West Valley Nuclear Services Company, Inc.

Rock Springs Road
West Valley, New York 14171-0191

WVDP-040, 1988 Edition

SUMMARY

This Environmental Monitoring Report for the West Valley Demonstration Project gives a description of the monitoring program and a summary of the analytical results of this program for the 1987 calendar year.

The West Valley Demonstration Project (WVDP) is located in Western New York about 50 km south of Buffalo near Lakes Erie and Ontario. The Project was created by public law in 1980 to solidify liquid wastes remaining from the fuel reprocessing activities of Nuclear Fuel Services, Inc. In addition, the Project is responsible for managing both radioactive wastes disposed at the site in the past and any additional wastes produced while transforming the plant into a solidification process facility.

Based on natural features and weather patterns, samples are collected throughout the year on a regular schedule from air, water, sediment from stream beds, plants, and animals. The network of sampling points ranges from the site itself to distant points over 50 km away, outside the possible influence of the Project activities. These remote points provide background readings for comparison with near-site samples.

The small amounts of radioactivity in air and water leaving the facility during routine Project activities in 1987 were well below the regulated levels or concentration guides provided by the U.S. Department of Energy (DOE). A total of 0.00056 curies (0.021 gigabecquerel) of particulate radioactivity was discharged to the air and a total of 0.042 curies (1.5 gigabecquerels) of radioactivity plus 0.72 curies (27 gigabecquerels) of tritium were released to Buttermilk Creek in 1987.

The environmental samples collected near the Project indicate that any additional radioactivity levels which might have resulted from WVDP activities were too low to be distinguished from radioactivity which occurs naturally or was deposited by global fallout.

The natural background for particulate gross alpha activity was slightly elevated for the Route 240 station. Other airborne radioactive particles collected from the air at the site boundaries were statistically no different from background samples collected 10 to 60 km away. The highest monthly airborne gross beta levels were only 11 percent of the most restrictive DOE standard even before subtracting background. The actual measurement of strontium-90 in air around the site was less than 0.002 percent of the DOE derived concentration guide. Subtracting background levels recorded at remote stations from this measurement yields half that percentage.

Water from Cattaraugus and Buttermilk Creeks downstream of the site drainage contained two detectable man-made isotopes: tritium (H-3) and strontium-90 (Sr-90). However, the average level of radioactivity in Cattaraugus Creek downstream, including seasonal variations, was not measurably higher than that in Buttermilk Creek above the site. Buttermilk Creek is not used for drinking water, but is accessible to dairy cattle at one location downstream of the site. Radioactivity levels in milk samples from this herd were at or below background levels for all radionuclides which might originate at the Project site.

Radioactivity measured in water at this location averaged 6.5 percent of the DOE concentration guide for cesium-137 (Cs-137) and 2.2 percent for Sr-90 in 1987. Although sediments from this sample point contained some measurable radioactivity, the trend is downward since the Project start.

Radioactivity levels in fish caught directly downstream of the Project are very much the same as levels found in recent years and before the Project started up. Venison samples taken

from a deer collected near the plant (inside the restricted area) showed the same levels of radioactivity found in samples from the past several years. Radioactivity above the control (background) sample levels for beef, corn, or apples raised near the site was not measurable. Some hay taken from near the site showed Sr-90 above the control sample level, but there was no indication of radioactivity above controls in the milk collected from near-site dairy herds.

Over 90 percent of the calculated dose to a person living near the site (less than 0.16 percent of the regulatory standard) is based on the assumption that fish from Cattaraugus Creek, beef and venison from near-site land, and milk from a nearby farm are the only source of these foods for this person.

The thermoluminescent dosimeters (TLDs) placed around the restricted area fence measured direct external radiation levels near natural background for this region. The 80-mrem (0.80-mSv) yearly average was essentially the same as the 77 mrem (0.77 mSv) measured by the four background TLDs placed at locations 7 to 29 km from the site.

In general, groundwater monitoring wells on site and shallow wells more than a kilometre away from the facility indicated no measurable difference in levels of radioactivity from previous years. Continued surface and groundwater monitoring of several wells inside an area contaminated prior to Project activities assured that identified radioactivity remained confined to that immediate area and did not appear in surface water. Monitoring in 1987 confirmed that both the source of this groundwater contamination and effluent from activities designed to eliminate the source remained within the controlled area and were not identified in adjacent wells or surface runoff water.

The calculated exposure from Project activities to a person living very near the site is several hundred times less than the exposure received from normal background. On the average, persons living within 80 km received from the Project about two billionths of the normal dose they would have received from normal background in this area during 1987. The present regulatory limits restrict continuous exposure of any member of the public to 100 mrem (1 mSv) per year from facility operations such as the WVDP. The highest calculated dose to any person living near the Project was 0.16 percent of this level for the year 1987.

Measurements of compounds and elements normally found in public water treatment plants indicated no discharges which would harm the water quality downstream. During 1987 several nonradiological water quality measurements exceeded the New York State SPDES permit limits at the discharge point. Because these conditions lasted for such a short time and at relatively low levels above the limits, no environmental effects would be expected. Improved wastewater treatment equipment has been adjusted to markedly reduce the constituents for which limits were exceeded. The few recurring problems are being solved by improved operating methods and minor changes to the treatment systems.

The quality and accuracy of monitoring and laboratory measurements done on site are checked periodically by comparison with outside agencies such as the U.S. Environmental Protection Agency (EPA), the U.S. Nuclear Regulatory Commission (NRC), and several DOE laboratories. The environmental program demonstrated acceptable results in all areas and improved the accuracy of gamma isotope measurements by identifying and correcting some calibration procedure deficiencies.

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1.0 INTRODUCTION

This report presents the annual summary of environmental monitoring data collected at the West Valley Demonstration Project (WVDP) from January 1, 1987 through December 31, 1987. The Project was implemented by law as a demonstration of technology and includes sufficient environmental monitoring to help assure public safety with respect to the activities on the site and the waste materials which reside there. The current monitoring program implemented by West Valley Nuclear Services Company (WVNS) provides data in compliance with Department of Energy guidelines and recommendations as well as with applicable federal and New York State laws and regulations.

1.1 Historical Overview

On February 26, 1982, the responsibility for operation and maintenance of the former Nuclear Fuel Services, Inc. (NFS) reactor fuel reprocessing facility at West Valley was transferred to the Department of Energy (DOE). Public Law No. 96-368, enacted in 1980, mandated the demonstration of technology for solidification of the 2.2 million litres (580,000 gallons) of liquid high-level radioactive waste that were produced by commercial fuel reprocessing at the plant. These wastes are now held in underground storage tanks at the facility. The DOE selected West Valley Nuclear Services Company as the contractor to implement the provisions of this law.

When WVNS assumed operational control, the plant was shut down and NFS was conducting an environmental monitoring program appropriate to the maintenance status of the facility as licensed by the NRC. WVNS recognized that the NFS program required substantial change to prepare for high-level waste processing operations currently scheduled to begin with supernatant treatment in May, 1988, followed by the initiation of vitrification in October, 1992. Accordingly, in 1982 WVNS began to implement a full-scale environmental surveillance program in support of these planned operations and by 1985 had fully implemented this program. As recommended in DOE Order 5484.1, Chapter III, Paragraph 1, this program has provided more than two years of environmental baseline data prior to high-level waste processing.

A comprehensive Environmental Evaluation (EE) was published in June 1984 to initiate the decision-making process for disposal of Project low-level radioactive waste (LLW). The intent of the Project was to phase out the methods used by NFS and replace them with state-of-the-art engineered disposal technology. Based on the review of the EE by the Department of Energy, the Project staff was directed to prepare an Environmental Assessment (EA) which analyzed alternative disposal options more thoroughly than was appropriate in the EE. In April of 1986, the Department of Energy approved the LLW disposal EA, and after an appropriate public comment period, issued a Finding of No Significant Impact (FONSI) in August of the same year.

Environmental Evaluations were also prepared in 1985 and 1986 for the major solidification process support systems, including the High Level Waste Vitrification System, Supernatant Treatment System (STS), Cement Solidification System (CSS), and Liquid Waste Treatment System (LWTS). These documents were approved by Project management and submitted to DOE for review and approval.

Decontamination activities to convert the reprocessing plant for use in the vitrification process have required continued operation of basic services, including low-level radioactive waste management. Facility operations through 1986 included periodic disposal of plant wastes, low-level solid radioactive waste from decontamination and maintenance activity, in the NRC-licensed disposal area.

1.2 1987 Program Overview

During 1987 the environmental surveillance plan was again updated to reflect the nearing completion of process facilities. The revisions also reflected Project monitoring experiences to date. The updated plan provides for coverage of new on-site effluent points and monitoring of active waste management areas. The revised plan is described in detail in Appendix A which includes a summary of the changes that were made in 1987. As this summary indicates, several more additions and modifications identified in 1987 are planned for implementation in 1988 as facilities become operational.

Throughout 1987 liquid wastes resulting from plant activities were processed at the existing low-level waste treatment facility (LLWTF) prior to discharge.

Construction was completed in 1987 on an above-ground storage facility for Class B and C low-level radioactive wastes. This drum storage cell is located to the southwest of the plant and adjacent to the NRC-licensed disposal area. Covered storage facilities for Class A wastes were also expanded in 1987. The expansion of LLW storage facilities has been necessitated by the conditions of a settlement agreement resulting from a lawsuit brought against the Project by the Coalition on West Valley Nuclear Wastes and the Radioactive Waste Campaign. This settlement is conditioned upon the Project's cessation of LLW waste disposal pending the preparation of an Environmental Impact Statement (EIS). Both operational and environmental monitoring programs have been expanded to accomodate these expanded storage operations.

Approval of several EEs has recently been received from the Department of Energy's Idaho Operations Office. These have included the EEs for the Vitrification Facility, STS, CSS, and LWTS.

1.3 Site Characteristics

The WVDP site is located in a rural setting approximately 50 km (30 mi) south of Buffalo, New York (Figure 1-1), at an average elevation of 400 m (1,300 ft) on New York State's western plateau. The plant facilities used by the Project occupy approximately 63 hectares (156 acres) of chain-link fenced area within a 1,350-hectare (3,300-acre) reservation that constitutes the Western New York Nuclear Service Center (WNYNSC). The communities of West Valley, Riceville, Ashford Hollow, and the village of Springville are located within 8 km (5 mi) of the plant. Several roads and one railway pass through the Center, but no human habitation, hunting, fishing, or public access are permitted on the WNYNSC.

The land immediately adjacent to the WNYNSC is used primarily for agriculture and arboriculture. Cattaraugus Creek to the north serves as a water recreation area (swimming, canoeing, and fishing). Although limited irrigation of adjacent golf course greens and tree farms is taken from Cattaraugus Creek, no public water supply is drawn from the creek downstream of the WNYNSC.

The average annual temperature in the region is 7.2 °C (45.0 °F) with recorded extremes of 37 °C (98.6 °F) and -42 °C (-43.6 °F). Rainfall is relatively high, averaging about 104 cm (41 in.) per year. Precipitation is evenly distributed throughout the year and is markedly influenced by Lake Erie to the west and Lake Ontario to the north. All surface drainage from the WNYNSC is to Buttermilk Creek which flows into Cattaraugus Creek and ultimately into Lake Erie. Regional winds are predominantly from the west and south at over 4 m/s (9 mph) during most of the year.

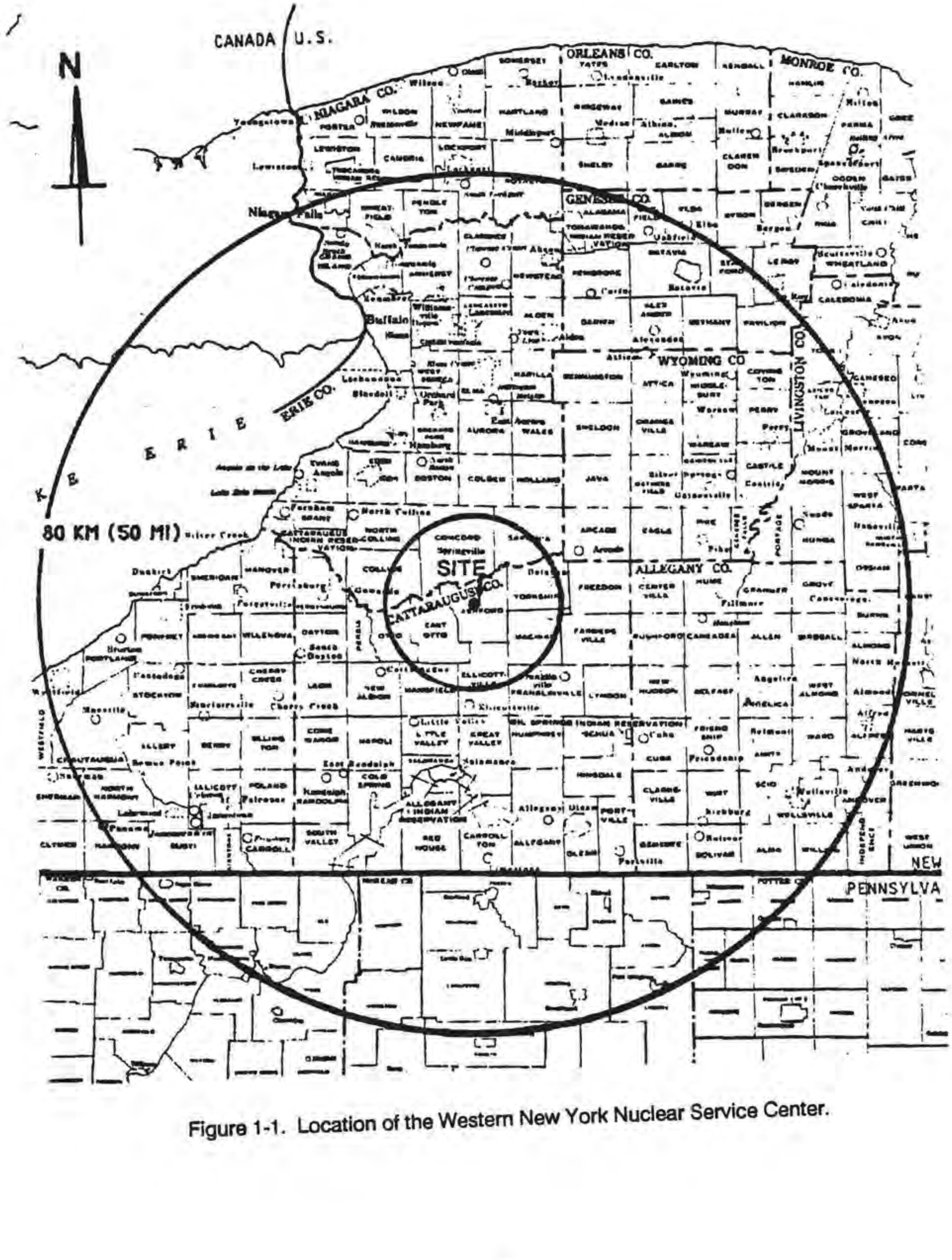


Figure 1-1. Location of the Western New York Nuclear Service Center.

The WNYNSC lies within the northern hardwood forest region, and the diversity of its vegetation is typical of the area. Equally divided between forest and open land, the site provides habitats especially attractive to white-tailed deer and the various birds, reptiles, and small mammals indigenous to the region. No endangered species are known to be present on the reservation.

The geology of the site is characterized by glacial deposits of varying thickness in the valley areas underlain by sedimentary rocks which are exposed in the upper drainage channels in hillsides. The soil is principally silty till consisting of unconsolidated rock fragments, pebbles, sand, and clays. The uppermost till unit is the Lavery, a very compact gray silty clay. Below the Lavery till is a more granular unit referred to as the Lacustrine unit comprised of silts, sands, and in some places, gravels which overlie a varved clay.

There are two aquifers in the site area. The upper aquifer is a transient water table aquifer in the upper 6 m (20 ft) of weathered till and alluvial gravels concentrated near the western edge of the site. High ground to the west and the Buttermilk Creek drainage to the east intersect this aquifer, precluding off-site continuity. Several shallow, isolated, water-bearing strata also occur at various other locations within the site boundary but do not appear to be continuous. The zone at which the till meets bedrock forms another aquifer that ranges in depth from 2 m (6 ft) underground on the hillsides to 170 m (560 ft) deep just east of the boundary of the facility exclusion area.

A more detailed description of the site hydrogeology is included in Section 3.1.

2.0 ENVIRONMENTAL MONITORING PROGRAM - DESCRIPTION AND RESULTS

This report reflects the changes in the environmental monitoring network which have been implemented in the past five years to provide an enhanced level of environmental surveillance in anticipation of high-level waste processing activities.

The surveillance program as outlined for 1986 was implemented in 1987 (including effluent, on-site, and off-site monitoring). Several new monitoring points not identified in the 1986 program plan were implemented during the year, most of them addressing specific effluent monitoring requirements for new Project facilities completed in 1987.

The major pathways for off-site movement of radionuclides are by surface water drainage and airborne transport. For that reason, the environmental monitoring program emphasizes the collection of air and surface water samples. Another potentially significant pathway is the ingestion and assimilation of radionuclides by game animals and fish that include the WNYNSC in their range. Appropriate animal, soil and vegetation specimens are gathered and analyzed for radionuclide content in order to reveal any long-term trends.

In addition to the radiological environmental monitoring program, WVNS participates in the State Pollution Discharge Elimination System (SPDES) and operates under state-issued air and water discharge permits for nonradiological plant effluents. Section 2.2 summarizes nonradiological monitoring in 1987, and Appendix C-5 provides greater detail on these activities. Groundwater monitoring is covered in Section 3.0.

2.1 Radiological Monitoring

Air, water, and selected biological media were sampled and analyzed to meet Department of Energy and plant Technical Specification (also referred to as Operational Safety Requirements or OSRs) monitoring requirements. To provide appropriate reference parameters, several additional sampling points were added in 1987 in support of Project facilities which became operational (see Appendix A). There were no abnormal radiological releases or special investigations of environmental radiological conditions in 1987. Although several new effluent points were activated, all functioned as expected.

2.1.1 Radioactivity in Air

In 1987 airborne particulate radioactivity was collected continuously by four perimeter air samplers and by three remote samplers at locations shown in Figures 2-1 and 2-2. (A complete tabulation of the concentrations measured at each of these stations is given in Appendix C-2, Tables C-2.2.1 through C-2.2.7.) Three of the perimeter air samplers, mounted on 4-m high towers, maintain an average air flow of about 40 L/min (1.5 ft^3/min) through a 47-mm glass fiber filter. The fourth perimeter air sampler, located on Rock Springs Road, is near the residence which would be subject to the highest average relative concentration of airborne effluent from a long-term, ground-level release from the plant (AFRSPRD, see Figure 2-1). The fourth perimeter sampler and the three remote samplers operate with the same air flow rate as the three mounted on towers, but the sampler head is set at 1.7 m above the ground (the height of the average human breathing zone). The three remote samplers are located in Great Valley, Springville, and West Valley (Figure 2-2).

Concentrations measured at Great Valley (AFGRVAL), 28 km south of the site, are considered to be representative of natural background. A second background monitoring station was put into operation for the fourth

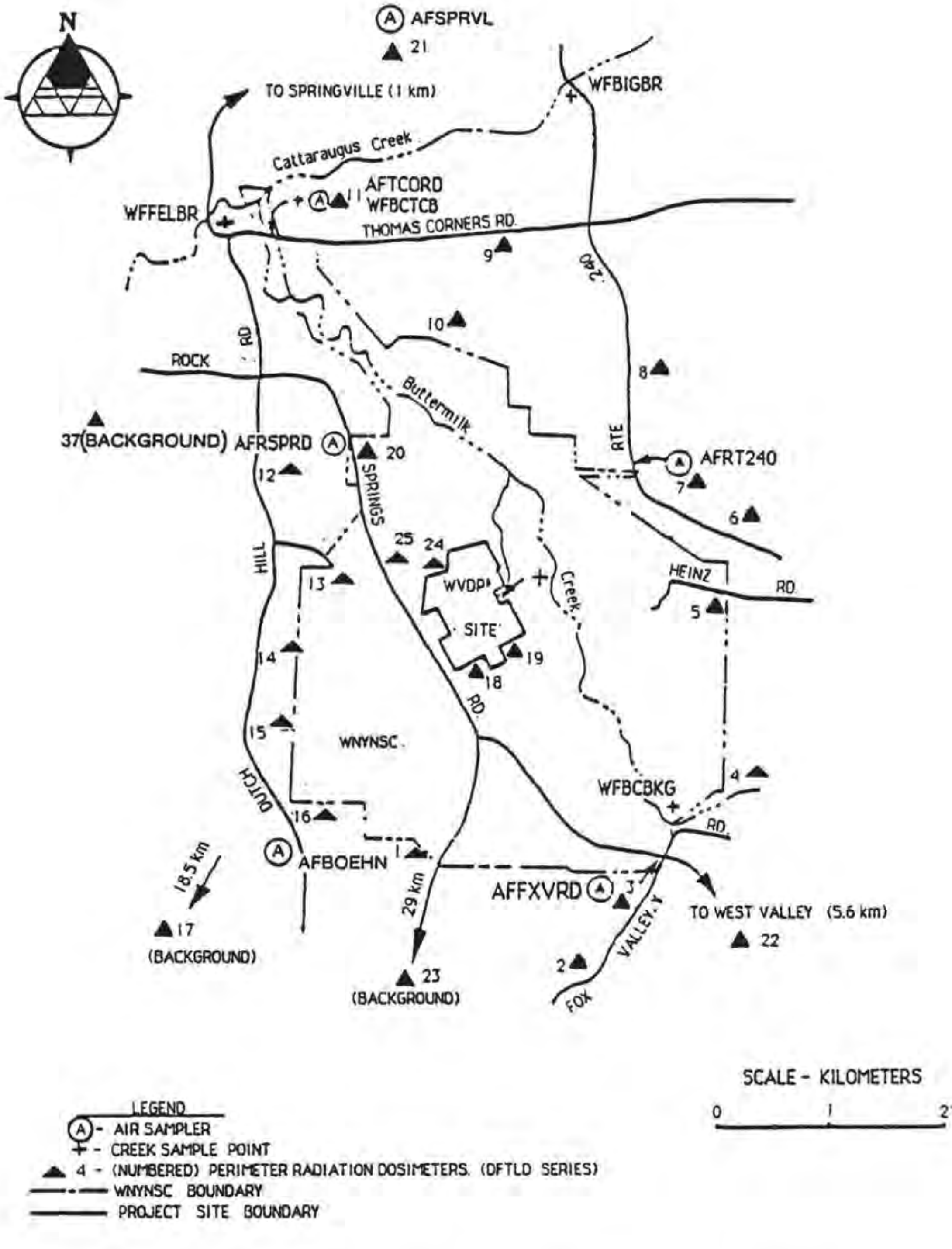
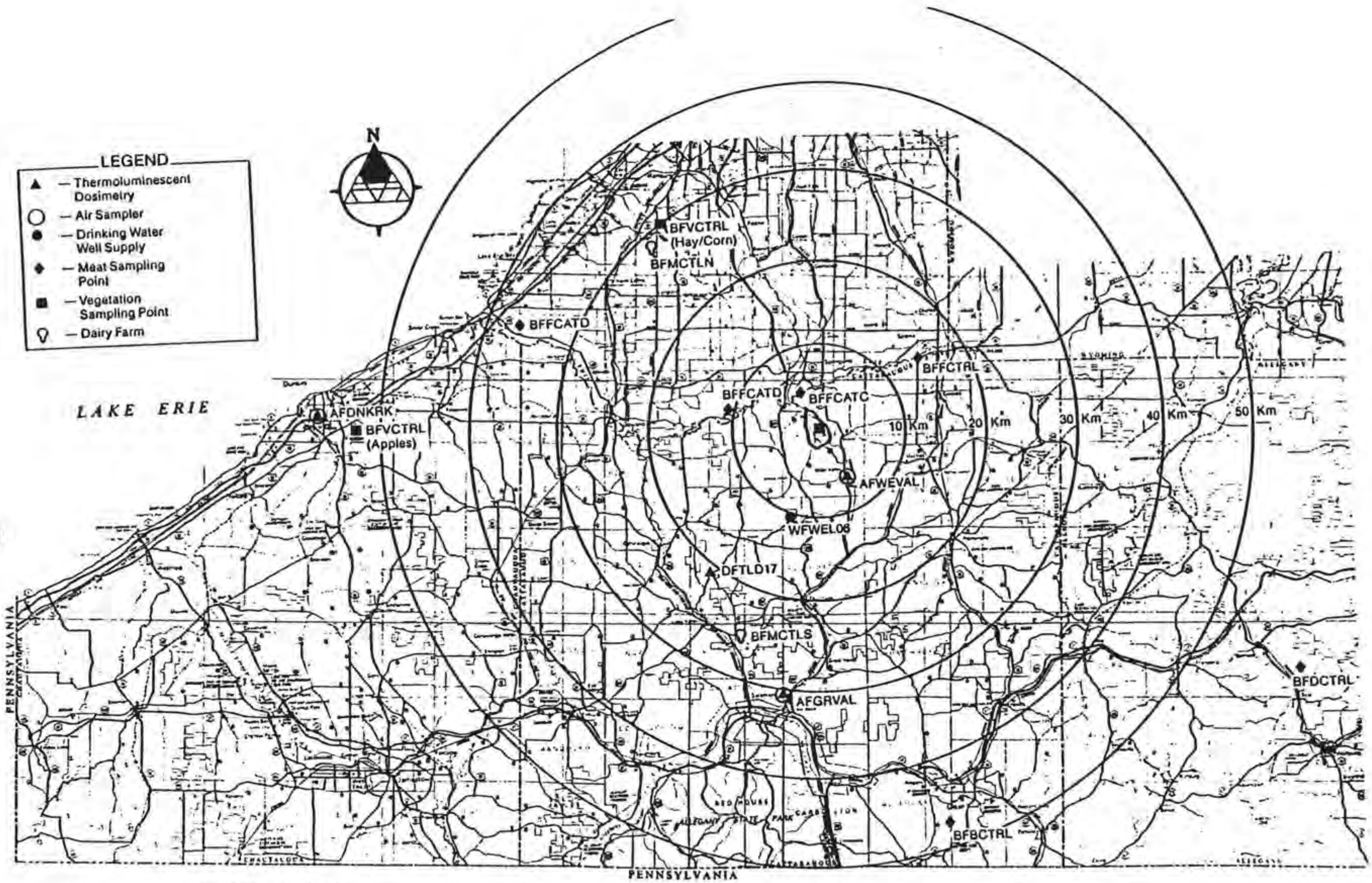


Figure 2-1. Locations of Perimeter Environmental Monitoring Stations.



REF: NYSDOT, New York State Map — West Sheet, 1:250,000, Revised 1982

0 5 10 15 20 25K

Figure 2-2. Environmental Sampling Points More than 5 km from the WVDP Site.

quarter of 1987 at Dunkirk 50 km to the west of the site. Data from this sampler are provided in Table C-2.2.8. A fifth perimeter station (AF-BOEHN on Dutch Hill Road, Figure 2-1) began operation too late in 1987 to provide any reportable data.

Filters from all samplers were collected weekly and analyzed after a seven-day decay period to remove interference from short-lived naturally occurring radioactivity. Gross alpha and gross beta measurements of each filter were made using a low-background gas proportional counter. The average monthly concentrations ranged from 1.1 to 3.6 E-14 μCi/mL (4.07 E-4 to 1.3 E-3 Bq/m^3) of beta activity and 7.3 E-16 to 2.2 E-15 μCi/mL (2.7 E-5 to 8.14 E-5 Bq/m^3) of alpha activity. Additionally, quarterly composites consisting of 13 weekly filters from each sample station were analyzed.

In all cases, the measured monthly gross activities were below 3 E-12 μCi/mL (1.1 E-1 Bq/m^3) beta, and 2 E-14 μCi/mL (7.4 E-4 Bq/m^3) alpha, the most limiting DOE Derived Concentration Guides (DCG) for any of the isotopes present at WVDP. (The standards and concentration guides for radionuclides of interest at West Valley are reproduced from the DOE orders in Appendix B.) Results of the analyses of perimeter air sample filters are presented in Appendix C-2.

For comparison, the 1986 data from the New York State Department of Health (NYSDOH) indicated a normal background concentration of gross beta activity in air which averaged 2.6 E-14 μCi/mL (9.6 E-4 Bq/m^3) in Albany, New York (Huang, 1987). Annual data for the three samplers which have been in operation since 1983 are compared in Figure 2.3. The values average about 2.4 E-14 μCi/mL (8.9 E-4 Bq/m^3) of gross beta activity in air, with a temporary rise in 1986 after the Chernobyl incident. The annual average gross beta concentration at the Great Valley background station was 1.9 E-14 μCi/mL (7.0 E-4 Bq/m^3) in 1986, but averaged 2.1 E-14 μCi/mL (7.8 E-4 Bq/m^3) in 1987.

At four perimeter sampler locations, open pots are used to collect fallout. The data from these analyses also are presented in Appendix C-2, Tables C-2.3.1 and C-2.3.2. These collections represent an indication of short-term effects. Long-term deposition is measured by surface soil samples collected near each air sampling

uCi/ml

	AFFXVRD	AFRT240	AFTCORD
1983	1.61 E-14	1.82 E-14	1.82 E-14
1984	1.78 E-14	2.07 E-14	1.96 E-14
1985	1.75 E-14	1.80 E-14	1.97 E-14
1986	4.38 E-14	2.86 E-14	3.08 E-14
1987	2.32 E-14	2.36 E-14	2.39 E-14

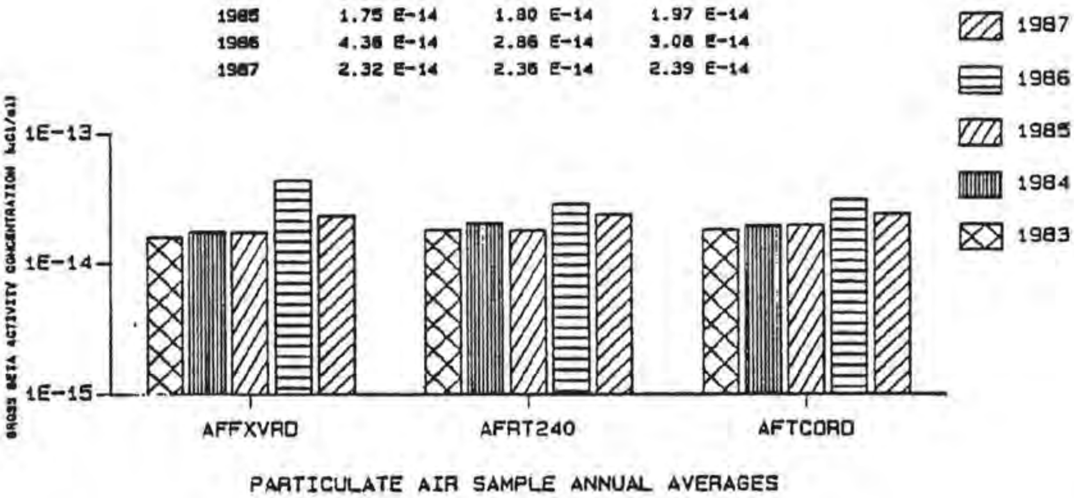


Figure 2-3. Trends of Gross Beta Activity in Perimeter Air Samplers (AFFXVRD, AFRT240, and AFTCORD) 1983 - 1987.

station. The triennial collections were performed in 1985 and are next scheduled for 1988.

The main ventilation stack (ANSTACK) sampling system was the most significant airborne effluent point again in 1987. A high flow rate and multiple nozzles assure a representative sample for both the long-term collection filter and the on-line monitoring system. Variations in concentrations of airborne radioactivity reflect the level of decontamination activities within the facility (Figure 2.4). However, at the point of discharge, average radioactivity levels were below the concentration guides for airborne radioactivity in an unrestricted environment (see Table C-2.1.3).

Because of the low concentrations, the large volume samples from the plant stack provide the only practical means of determining the amount of specific radionuclides released from the facility.

The total quantity of gross alpha and beta radioactivity released each month from the main stack, based on the weekly filter measurements, is shown in Table C-2.1.1. The results of analyses for specific radionuclides in the four quarterly composites of stack effluent samples are listed in Table C-2.1.2.

A sampling system similar to the main stack system monitors airborne effluents from the Cement Solidification System ventilation stack (ANCSSTK). The 1987 samples showed detectable gross radioactivity and beta- and alpha-emitting isotopes, but did not approach any DOE effluent limitations (Tables C-2.1.4 and C-2.1.5).

Three significant effluent points were added in 1987. The Supernatant Treatment System ventilation required monitoring while operating periodically for testing and sampling. The Supercompaction Volume Reduction System also operated intermittently. The Contact Size Reduction Facility ventilation began operation in October 1987. Only the last facility operated long enough in 1987 to provide statistically valid

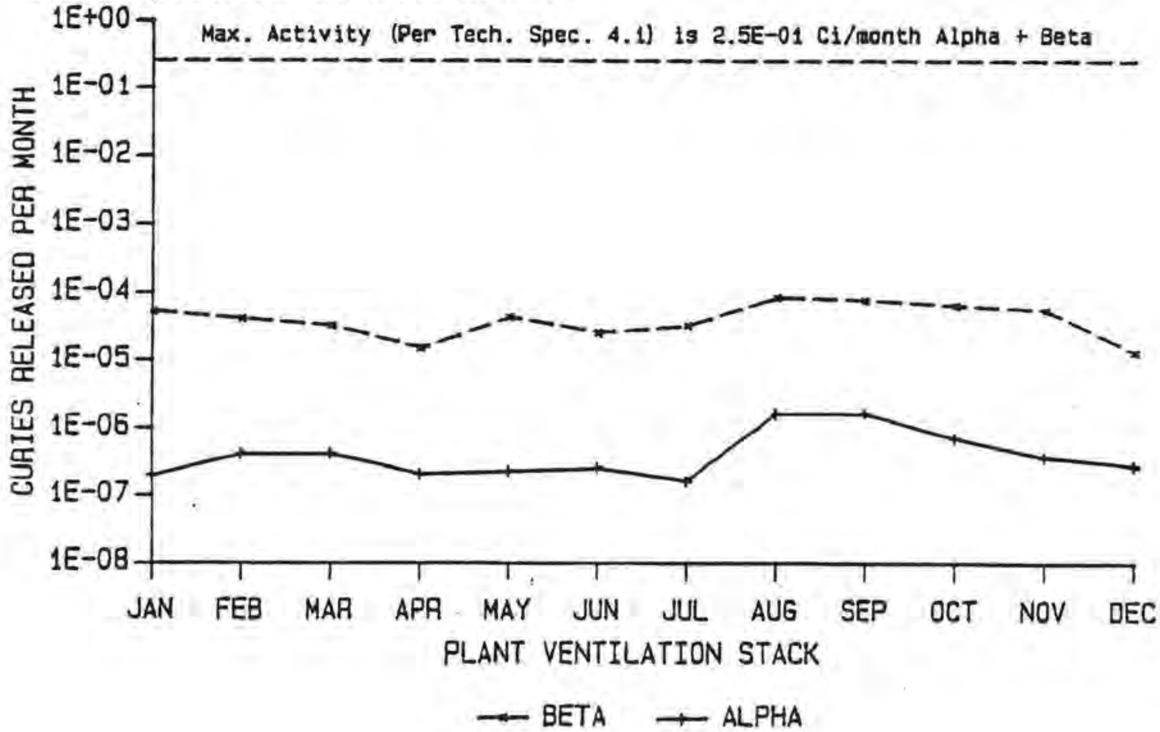


Figure 2-4. 1987 Sampling Data for Station ANSTACK.

effluent measurement (Tables C-2.1.6 and C-2.1.7).

Two other facilities are routinely monitored for airborne radioactivity releases: the Low-Level Waste Treatment Facility (LLWTF) and the contaminated clothing laundry.

The total amount of radioactivity discharged from the last five facilities is less than 2 percent of the airborne radioactivity released from the site, and was not a significant factor in the airborne pathway in 1987.

2.1.2 Radioactivity in Surface Water and Sediment

Four automatic samplers collect surface water at points along the site drainage channels. An off-site sampler is located on Cattaraugus Creek (at Felton Bridge) just downstream of the confluence with Buttermilk Creek, the major surface drainage from the WNYNSC (Figure 2-1). This sampler (WFFELBR) periodically collects a small volume of water (approximately 100 mL/hr) from the creek. A stream stage-level chart recorder provides a means of flow-weighting the weekly composite based on relative stream depth. Gross alpha, beta, and tritium analyses are performed each week, and a weighted monthly composite is analyzed for Sr-90 and gamma-emitting isotopes.

In addition to the Cattaraugus Creek sampler, three surface water monitoring stations are located upstream of the Buttermilk Creek/Cattaraugus Creek confluence. Samplers collect water from a background location on Buttermilk Creek upstream of the Project (WFBCBKG) and from a location at Thomas Corners Road downstream of the plant and upstream of the confluence with Cattaraugus Creek (WFBCTCB). The third station (WNSP006) is located on Frank's Creek (also known as Erdman Brook) just upstream of the point where Project site drainage leaves the security area (Figure 2-1).

These samplers currently operate in a time composite mode, collecting a 25-mL aliquot every half-hour. The samples are collected biweekly, composited monthly, and analyzed for tritium, gross alpha, and gross beta radioactivity. A quarterly composite of the biweekly samples is analyzed for gamma-emitting isotopes and Sr-90. Quarterly composites from WNSP006 also are analyzed for I-129. The schedule for analysis of samples from WNSP006 will be modified in 1988 as indicated in Appendix A.

Radiological concentration data from these sample points show that average gross radioactivity concentrations generally tend to be higher in Buttermilk Creek below the WVDP site, presumably because of the small amount of activity from the site which enters via Frank's Creek. However, the average concentrations below the site in Cattaraugus Creek are not statistically significantly higher than the background (upstream) concentrations. The range of gross beta activity, for example, was 2.01 E-9 to 5.02 E-9 μCi/mL (7.4 E-2 to 1.9 E-1 Bq/L) upstream in Buttermilk Creek at Fox Valley (WFBCBKG), and from 3.1 E-9 to 7.4 E-9 μCi/mL (1.1 E-1 to 2.7 E-1 Bq/L) in Buttermilk Creek at Thomas Corners Bridge (WFBCTCB). (See Figure 2-5.)

In comparison, if the most restrictive beta-emitting radionuclide is used (Ra-228), the maximum concentration measured in Buttermilk Creek at Thomas Corners Bridge (WFBCTCB) where dairy cattle have access is 7 percent of the DOE concentration guide for unrestricted use (Appendix B). At the Project Security Fence (WNSP006), over 4 km from the nearest public access point, the most significant beta-emitting nuclides were measured at 4.0 E-7 μCi/mL (14.8 Bq/L) for Cs-137 and 3.5 E-08 (1.3 Bq/L) for Sr-90 during the period of highest concentration. This corresponds to 13.3 and 3.5 percent of the DCGs for Cs-137 and Sr-90, respectively. The annual average was 6.5 percent for Cs-137 and 2.2 percent for Sr-90. Tritium, at an annual average of 1.0 E-6 μCi/mL (37 Bq/L), was 0.05 percent of the DCG values. Except for two months of the year when positive values were

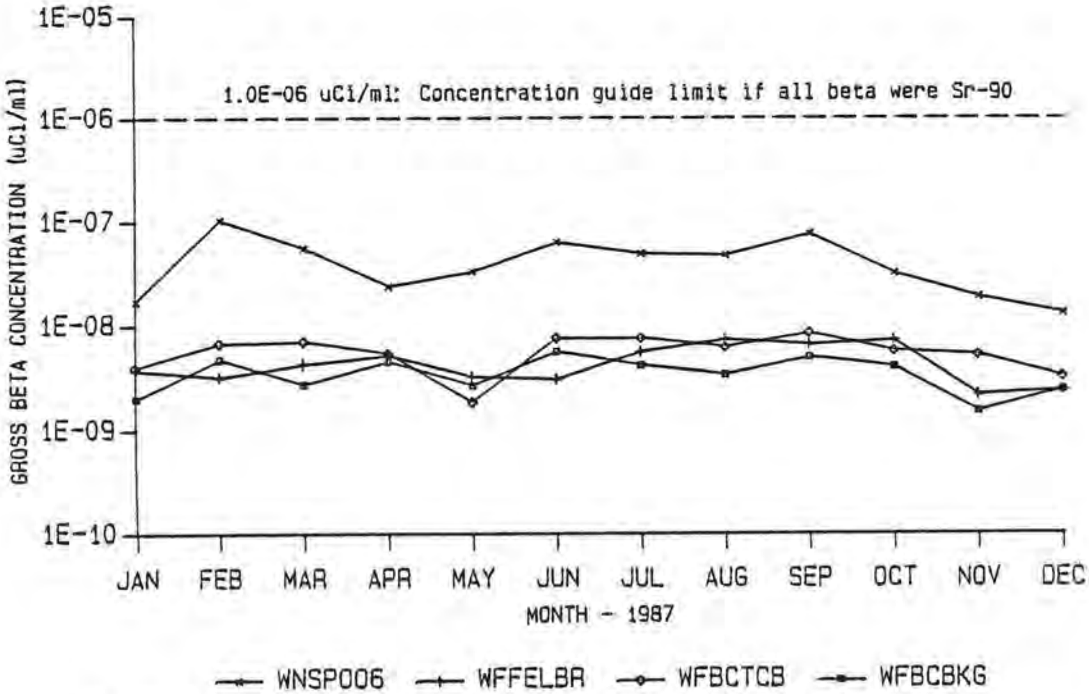


Figure 2-5. Gross beta concentrations in surface water downstream of WVDP - 1987.

noted, the gross alpha was below the average detection limits of 2 E-09 μCi/mL (7.4 E-02 Bq/L), or less than 7 percent of the DCG for Am-241. The positive values were 9 and 12 percent of the DCGs in March and June, respectively, assuming that all alpha-emitting isotopes were Am-241.

The most elevated concentrations in monthly composite water samples from Cattaraugus Creek during 1987 show Sr-90 to be less than 0.9 percent of the DCG for drinking water. Gross alpha and tritium were detected one month each in Cattaraugus Creek water during 1987. No gamma-emitting fuel cycle isotopes were detected in Cattaraugus Creek water during 1987 (Table C-1.5). A plot of monthly gross beta activity in Cattaraugus Creek for five years is presented in Figure 2-6. No trend is apparent over this extended period.

Sediments from Buttermilk Creek and Cattaraugus Creek were analyzed for gross activity, Sr-90, gamma-emitting isotopes and transuranic nuclides. The results are comparable to previous analyses during the past four years, indicating that there has been no measurable change attributable to Project activities. Data for 1987 are presented in Table C-1.7. A comparison of 1983-1987 gross beta activity in sediment from Buttermilk Creek is presented in Figure 2-7. Data for 1984 were not available for this parameter.

The largest single source of radioactivity released to surface waters from the Project is the discharge from the low-level waste treatment facility through the Lagoon 3 weir (WNSP001, Figure 2-8) into Erdman Brook. There were five batch releases (a total of about 36 million litres) from Lagoon 3 in 1987. The effluent was grab sampled daily during the 39 days of release and analyzed. The total amounts of activity in the effluent are listed in Table C-1.1.1. Of the activity released, 10.7 percent of the tritium and 2.0 percent of the other gross radioactivity originated in the New York State disposal area (based on measurements of water transferred in 1987 from the state area to the LLWTF) and not from previous or current Project operations (see Table C-1.8). The annual average release concentrations from the Lagoon 3 effluent discharge weir, including all measured isotope fractions, was less than 50 percent of the DCGs (Appendix B and Table C-1.1.2).

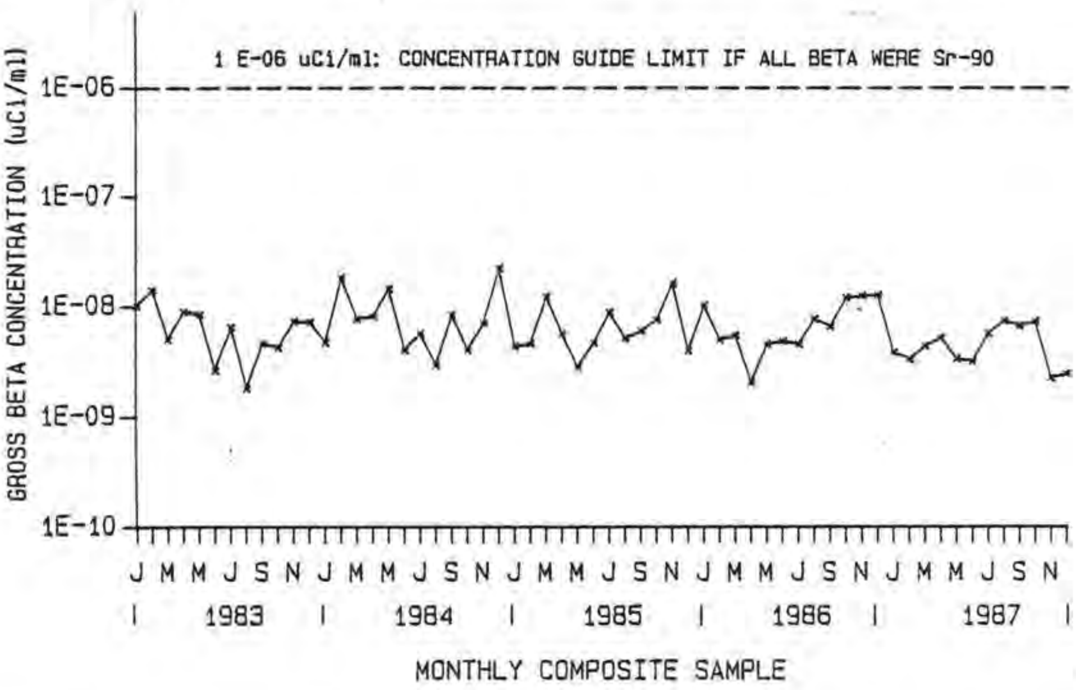


Figure 2-6. Trends of gross beta activity in surface water from Cattaraugus Creek, 1983-1987.

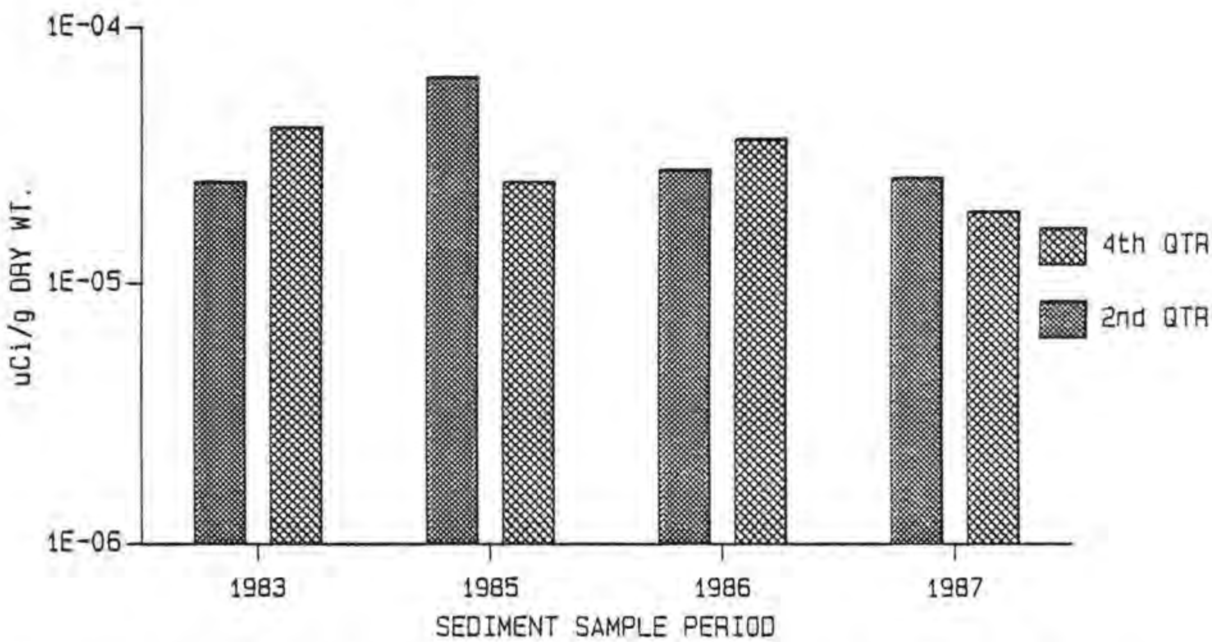


Figure 2-7. Trends of gross beta activity in sediment from Buttermilk Creek, 1983, 1985, 1986 and 1987.

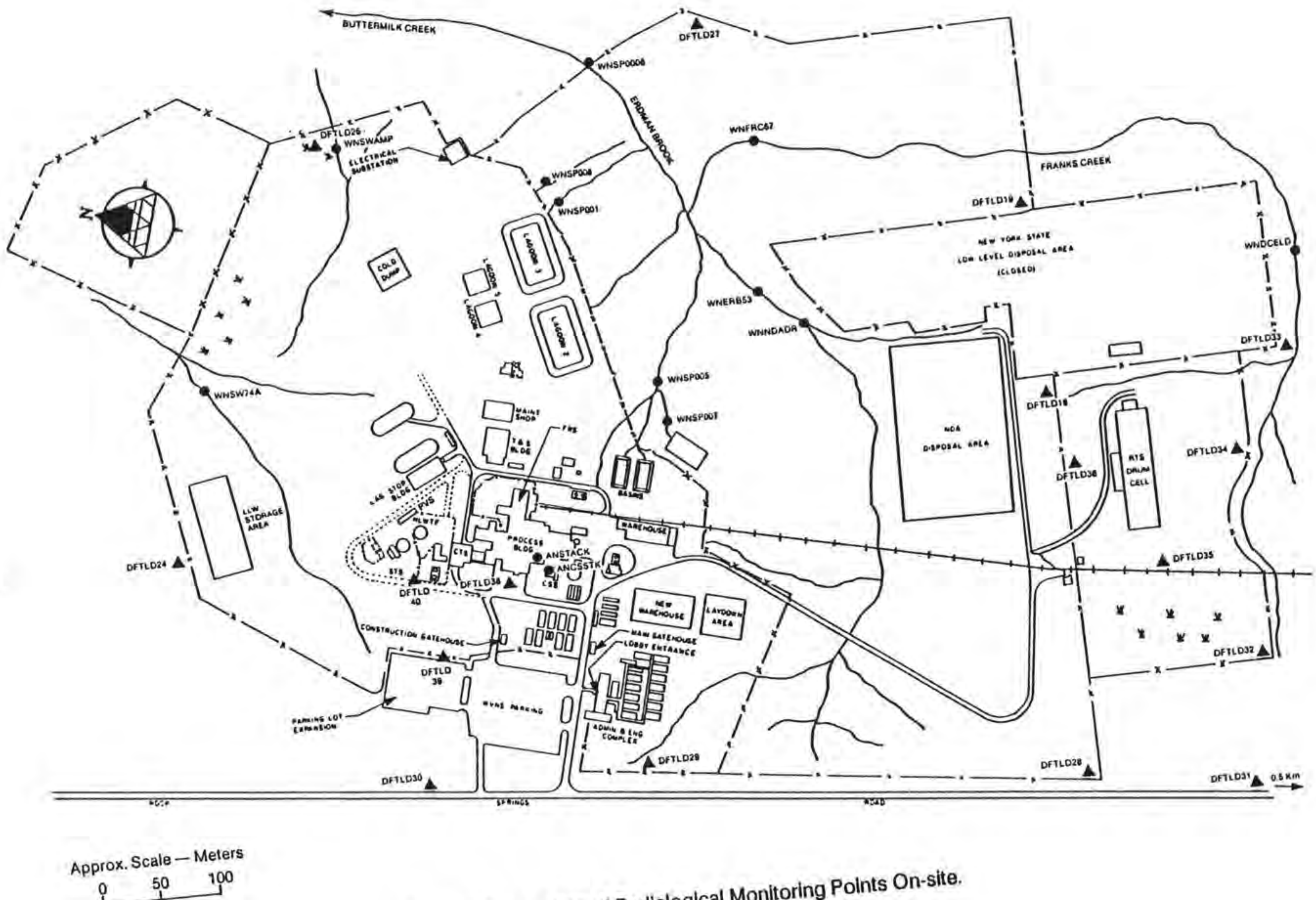


Figure 2-8. Location of Radiological Monitoring Points On-site.

2.1.3 Radioactivity in the Food Chain

Samples of fish and deer were collected both near and remote from the site during periods when they would normally be taken by sportsmen for consumption. Milk and beef from cows grazing near the site and at remote locations were also collected and analyzed during 1987. The results of these analyses are presented in Appendix C-3.

Fish samples were taken semiannually during 1987 above the Springville dam from the portion of Cattaraugus Creek which receives WNYNSC drainage (BFFCATC). Ten fish were collected from this section of the stream during each period. The Sr-90 content and gamma emitting isotopes in flesh were determined for each specimen. An equal number of fish samples (BFFCATD) were taken from Cattaraugus Creek below the dam, including species which migrate nearly 40 miles upstream from Lake Erie. These specimens were representative of sport fishing catches in the drainage downstream of the dam at Springville.

Control data provide comparisons with the concentrations found in fish taken from site-influenced drainage. For this purpose a similar number of fish were taken from waters that are not influenced by site runoff (BFFCTRL) and their edible portions were analyzed for the same isotopes. These control (natural background) samples were representative of the species collected in Cattaraugus Creek downstream from the WVDP. (Figure 2-9, Table C-3.4)

The Sr-90 concentrations in the edible flesh of all fish sampled in 1987 show a significant decrease compared to 1986 data (WVDP, 1986). At the same time, net concentrations compared to background each year since 1983 indicate a very slight, if any, trend downward for fish taken below the site drainage. The Sr-90 content in fish skeleton downstream of the site was analyzed for one sample period and appears to be the same as in the past three years (Figure 2-10). The log-normal statistical treatment of the fish data presented in Table C-3.4 is appropriate to the sample type being reported (DOE/EP-0023).

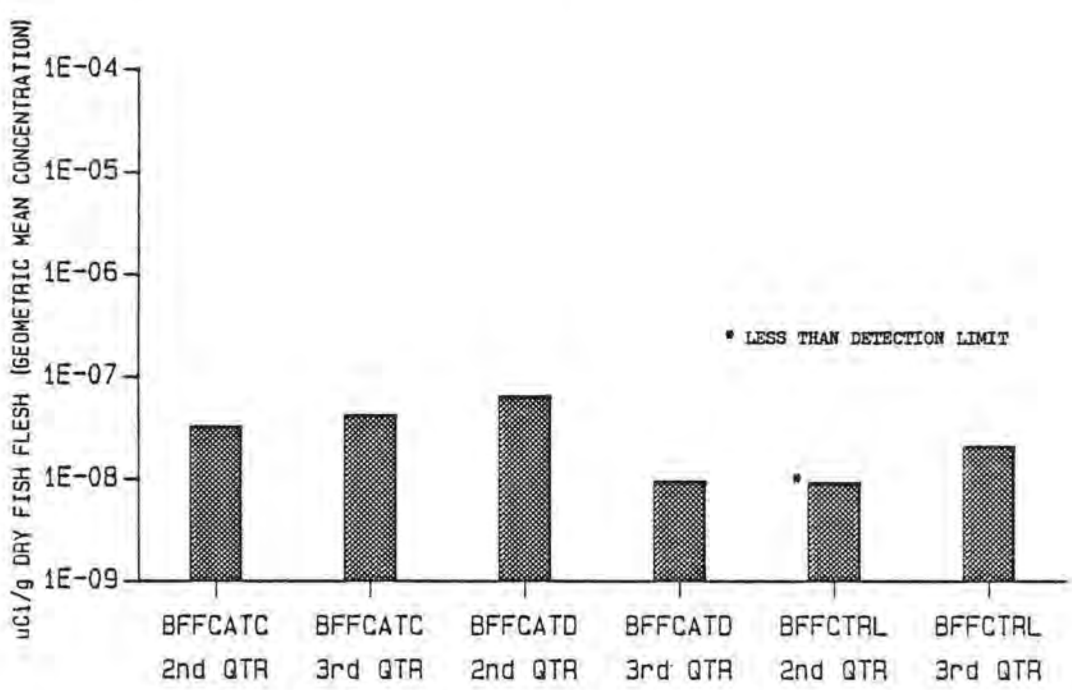


Figure 2-9. Comparison of Sr-90 in fish samples from WVDP vicinity - 1987.

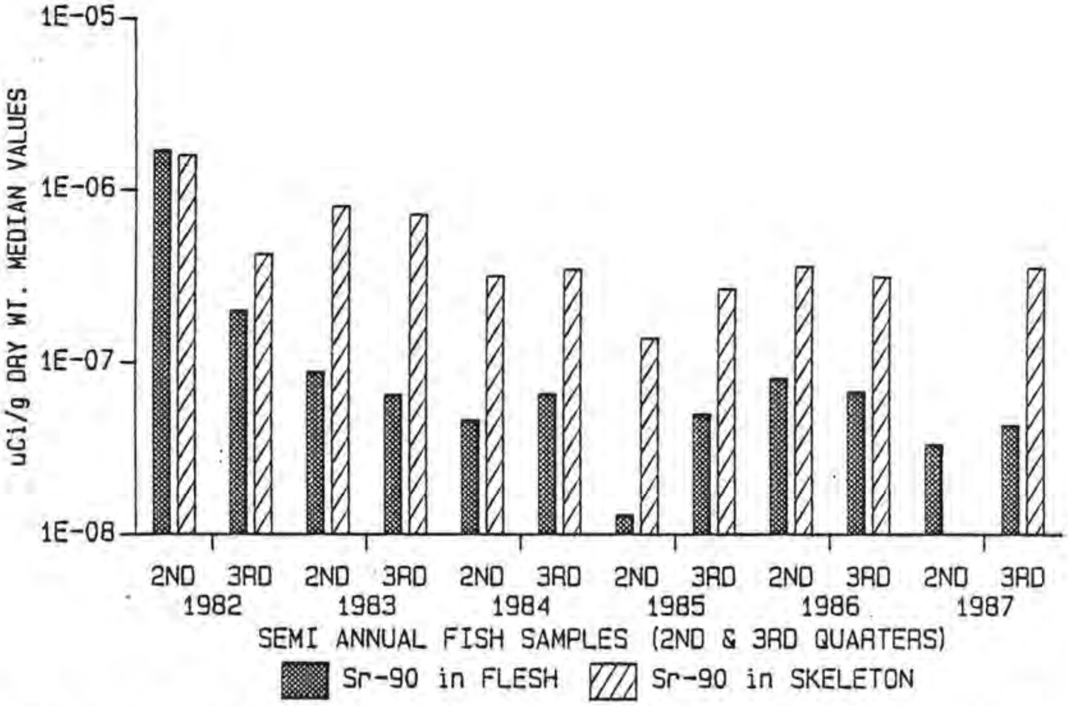


Figure 2-10. Trends of Sr-90 Concentrations in Fish from Cattaraugus Creek (BFFCATC) 1982 - 1987.

Portions were analyzed of a single deer from a resident herd on the southeast side of the WNYNSC. The concentration of Cs-137 and Sr-90 in deer flesh was a bit lower than the concentration in the previous year's sample (Figure 2-11). Data from a control, or background, deer sample collected in January 1988 from an Allegany County location 65 km southeast of the site also indicated a decrease in radioactivity, and are shown in Table C-3.2 for comparison.

The concentration of radioactivity in meat from semiannual samples of local beef animals was indistinguishable from the concentration in control samples (Table C-3.2), both showing a detectable level of isotopes associated with recent global fallout.

The dairy cattle milk sampling program continued in 1987. Besides the quarterly composite sample of the maximally exposed herd to the north (BFMREED), an additional quarterly composite of milk from a nearby herd to the northwest (BFMCOBO) and several single samples from the south (BFMWIDR), southwest (BFMHAUR), and two control herds (BFMCTRLN and BFMCTRLS) were collected. Each sample or composite was analyzed for Sr-90, H-3, I-129, and gamma-emitting isotopes (Table C-3.1). Strontium-90 in samples from near the site ranged from 1.8 to 3.0 E-9 μCi/mL (6.7 E-2 to 1.1 E-1 Bq/L) compared to the control samples at 1.5 E-9 μCi/mL (1.0 E-1 Bq/L) to 2.8 E-9 μCi/mL (5.6 E-02 Bq/L). Iodine-129 was not detected in any samples to the lower limit of detection (LLD) of 5 E-10 μCi/mL (1.9 E-2 Bq/L). Cesium-137 and other gamma-emitting fuel cycle isotopes were also not detected. Tritium was added to the analyses performed, with all results below the detection limit of 2 E-7 μCi/mL (7.4 Bq/L).

Based on the samples analyzed in 1987 (Table C-3.3), there was no detectable difference in the concentration of tritium or gamma-emitting isotopes in corn or apples grown near the site and at remote locations. Samples of apples and corn from both near the site and remote locations did not show an overall difference in Sr-90. However, hay from near the site contained Sr-90 at very low concentrations, but above those from remote samples.

Section 4 of this report discusses radionuclides present in the human food chain

	Sr-90 in FLESH	Cs-137 in FLESH
1982	4.00+/-3.0 E-09	<5.7 E-09
1983	3.60+/-0.7 E-09	2.90+/-2.1 E-08
1984	3.00+/-0.9 E-09	4.80+/-0.4 E-07
1985	2.60+/-0.4 E-09	1.80+/-0.3 E-07
1986	4.71+/-0.8 E-09	3.25+/-0.3 E-07
1987	2.73+/-0.4 E-09	6.28+/-2.7 E-08

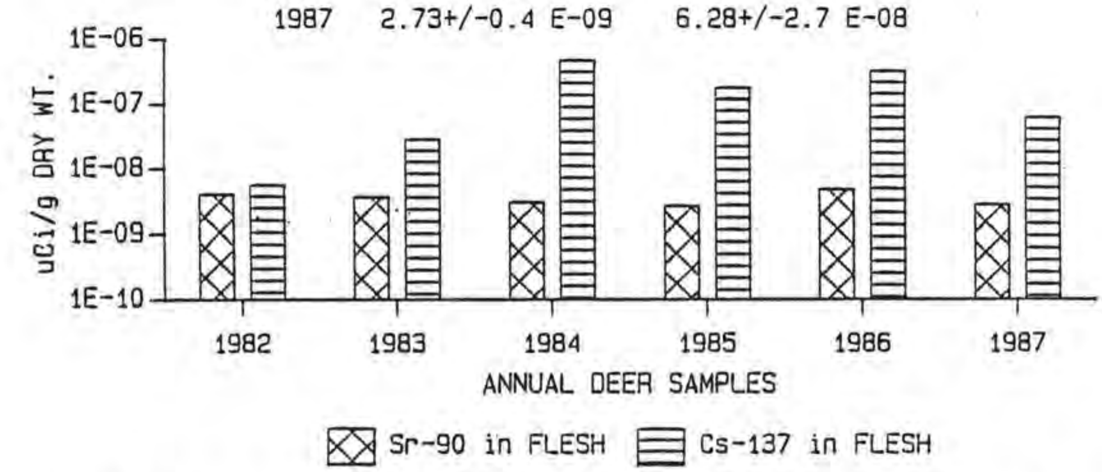


Figure 2-11. Trends of Radionuclides in Venison from Near WVDP Site (BFDNEAR) 1982 - 1987.

and assesses their contribution to the potential for radiation exposure of the public. Although the maximum concentrations of radioactivity found in some biological samples were above background levels, the potential dose associated with consumption of these samples is far below the protection standards.

2.1.4 Direct Environmental Radiation

The current monitoring year, 1987, was the fourth full year in which direct penetrating radiation was monitored at WVDP using TL-700 lithium fluoride (LiF) thermoluminescent dosimeters (TLDs) located as shown on Figures 2-1 and 2-2. The uncertainty of individual results and averages were acceptable and measured exposure rates were comparable to those of 1986. There were no significant differences in the data collected from the background TLDs (locations 17 and 23) and from those on the WNYNSC perimeter for the 1987 reporting period.

Dosimeters used to measure ambient penetrating radiation during 1987 were processed on-site. The system used Harshaw TL-700 LiF chips which are maintained solely for environmental monitoring apart from the occupational dosimetry TLDs. The environmental TLD package consists of five TLD chips laminated in a thick card bearing the location identification and other information. These cards are placed at each monitoring location for one calendar quarter (3 months) and then processed to obtain the integrated gamma radiation exposure.

Monitoring points are located around the site perimeter and access road, at the waste management units, at the inner facility fence, and at background locations remote from the WVDP site. Appendix C-4 provides a summary of the results for each of the environmental monitoring locations by calendar quarter along with averages for comparison.

The quarterly averages and individual location results show very slight differences due to seasonal variation (Figures 2-12 and 2-13). During the first quarter (January through March) of 1987 the average quarterly exposure was decreased due to snow cover. The second (April to June), third (July to September), and fourth quarters (October to December) with no snow cover had a higher quarterly average. With below-average rainfall and little snow cover, the fourth quarter average was comparable to the second quarter. Therefore, seasonal variation from rainfall and snow cover did not affect ambient penetrating radiation measurements around the site as much as in 1984 and 1985 (Figure 2-14).

Presumably because of their proximity to the LLW disposal area, the dosimeters at locations 18 and 19 showed a small elevation in radiation exposure compared to the WNYNSC perimeter locations. Location 25, on the public access road through the site north of the facility, also showed a small elevation above background due to the storage of decontamination wastes near location 24 within the site security area.

Location 24 on the north security fence, like locations 18 and 19, is not included in the environmental monitoring program; however, it is a co-location site for a U.S. Nuclear Regulatory Commission (USNRC) TLD (Table D-1.7). This point received an average exposure of 0.83 milliroentgen per hour during 1987. This exposure is primarily attributable to the nearby storage of sealed containers of radioactive components and debris from plant decontamination efforts. The storage area is well within the WNYNSC boundary (as are locations 18 and 19) and not readily accessible to the public. TLD locations 26 through 36 are located along the Project Security Fence, forming an inner ring of monitoring around the facility area. TLDs 37 through 40 were added in 1987 to monitor a third background location and to cover waste management units and site sources more effectively.

2.2 Nonradiological Monitoring

West Valley Demonstration Project effluents are regulated for nonradiological parameters by the New York State Department of Environmental Conservation (NYSDEC). Stationary sources of atmospheric pollutants are authorized by either a permit to construct or a certificate to operate. Liquid effluents are monitored as a requirement of the State Pollution Discharge Elimination System (SPDES) permit issued and enforced by NYSDEC.

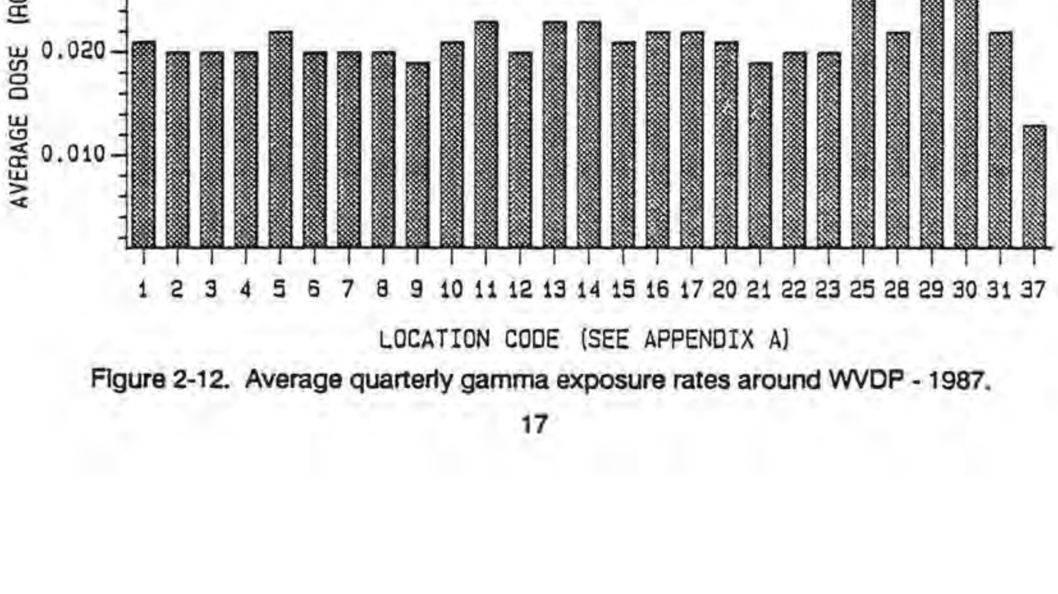


Figure 2-12. Average quarterly gamma exposure rates around WVDP - 1987.

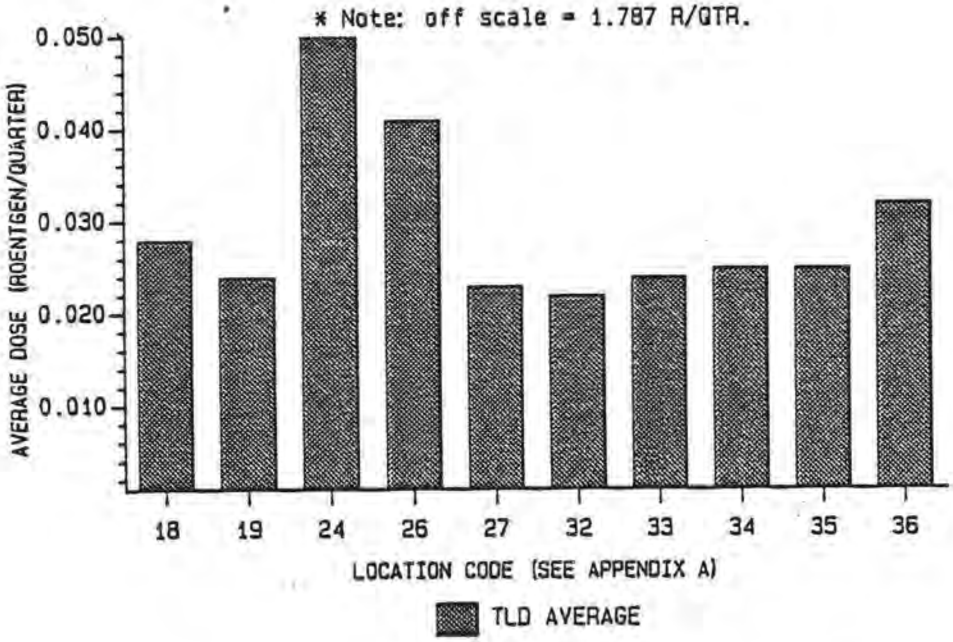


Figure 2-13. Average quarterly gamma exposure rates on-site - 1987.

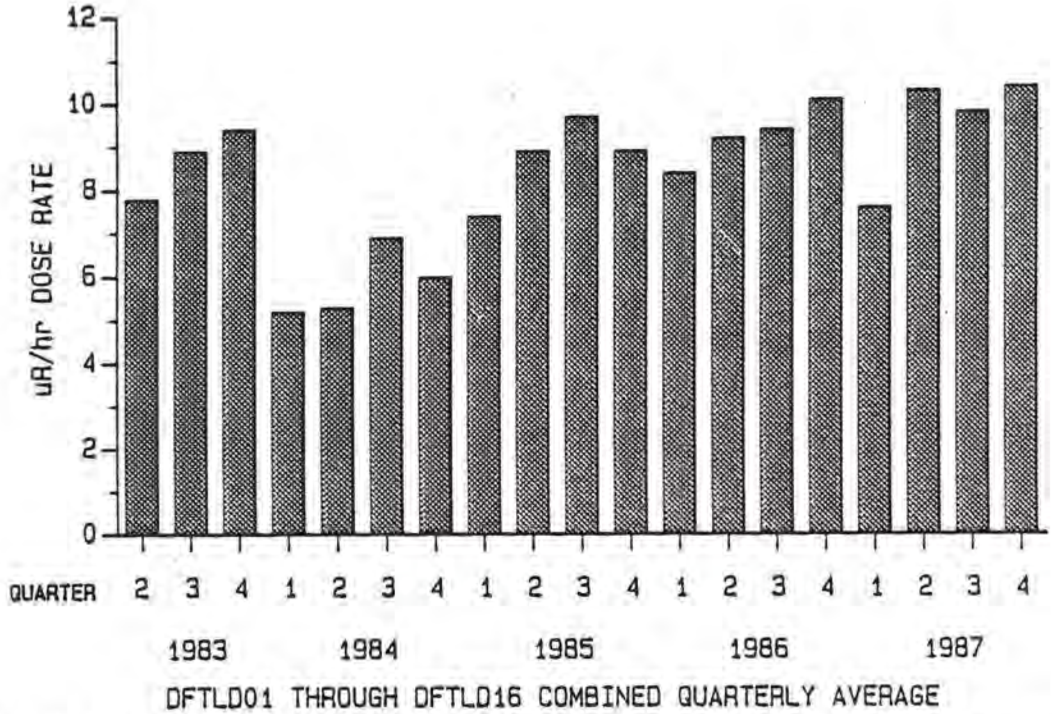


Figure 2-14. Trends of environmental gamma radiation levels, quarterly averages of 16 perimeter TLDs.

2.2.1 Air Discharges

The WVDP presently holds six certificates to operate stationary sources and one permit to construct a new source of airborne effluents. These permits are for minor sources of regulated pollutants such as particulates, nitric acid mist, and oxides of nitrogen. Monitoring these parameters is not required because of their insignificant concentrations and small mass discharge.

The individual air permits held by the WVDP are identified and described in Table C-5.1.

2.2.2 Liquid Discharges

The WVDP holds a SPDES permit which identifies the outfalls where liquid effluents are released to Erdman Brook (shown in Figures 2-15 and C-5.1) and which specifies the sampling and analytical requirements for each outfall. This permit was renewed in a substantially modified form in 1985 and 1987 is the second full year of operation under these requirements.

Three outfalls are identified on the permit: outfall 001, discharge from the low level waste treatment facility; outfall 007, discharge from the sanitary and utility effluent mixing basin; and outfall 008, effluent from the french drain on the perimeter of the low-level waste treatment facility storage lagoons. The conditions and requirements of the current new SPDES permit are summarized in Table C-5.2.

The most significant features of the SPDES permit are requirements to report data as flow-weighted concentrations and to apply a "net" discharge limit for iron. The net limit allows for subtraction of incoming (background) amounts of iron from the values reported in the Project effluent. The flow-weighted limits apply to the total discharge of Project effluents but allow maximum credit for dilute waste streams in determining compliance with effluent concentration limits specified in the permit.

2.2.3 Results

The SPDES monitoring data are displayed in Figures C-5.2 through C-5.23. Generally, these data indicate that Project effluents were within permit limits. However, the WVDP reported a total of 19 noncompliance episodes. These are discussed in Appendix C-5.

2.3 Pollution Abatement Projects

During 1987 the WVDP had four ongoing pollution control and abatement projects. Two of these continuing projects are preparation of a Preliminary Assessment and a Site Investigation of the WVDP premises under the requirements of RCRA and CERCLA. Revising and updating the WVDP Spill Prevention, Control and Countermeasures Plan is the third project and installation of a flow surge tank at the sewage treatment plant is the fourth. The latter project is scheduled for construction in spring 1988.

2.4 Closure of Landfill

Closure of the on-site nonradioactive construction and demolition debris landfill was accomplished in August 1986, although this facility had been removed from active service in 1985. The site was closed in accordance with New York State Department of Environmental Conservation (NYSDEC) requirements for construction and demolition debris landfills following a closure plan (Standish, 1985) approved by NYSDEC. Routine inspection and maintenance of the closed facility was performed in 1987 as specified by the closure requirements. These activities included checking areas for proper drainage (i.e., no obvious ponding or soil erosion) and cutting the grass planted on the soil and clay cap. Should more extensive maintenance or repair be necessary, it will be described in detail in future environmental reports.

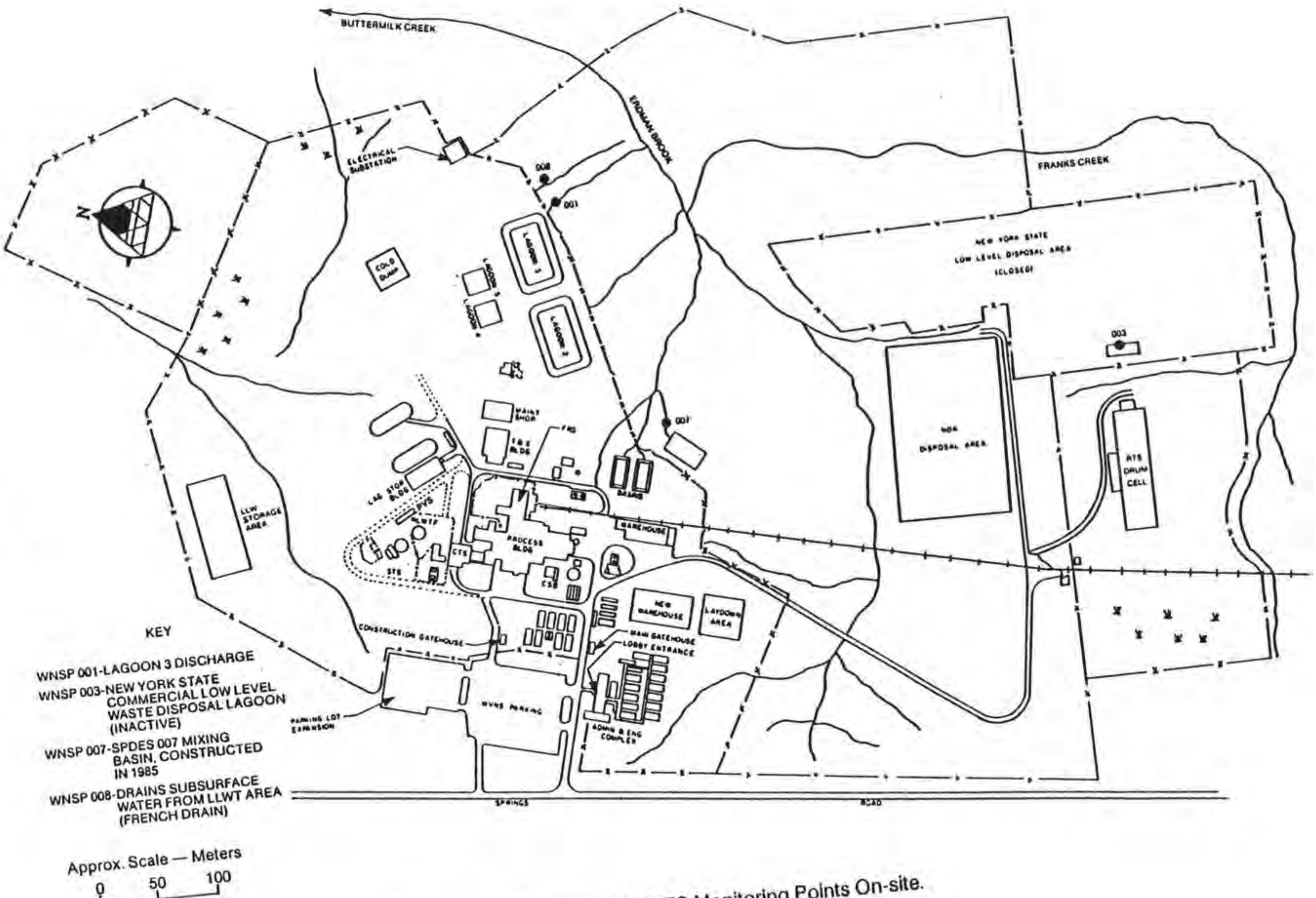


Figure 2-15. Locations of SPDES Monitoring Points On-site.

3.0 GROUNDWATER MONITORING PROGRAM

3.1 Hydrology of the Site

The WVDP site lies within the Glaciated Allegheny Plateau section of the Appalachian Plateau Physiographic Province. The section is a maturely dissected plateau with surficial bedrock units of Devonian shales and sandstones. Bedding dips gently (4 to 7.5 m/km) and uniformly to the south. The plateau has been subjected to erosion and deposits of repeated glaciations, resulting in accumulations of till, outwash, and lacustrine deposits over the area.

The site is underlain by a thick sequence of silty clay tills and more granular deposits overlying a bedrock valley that has been carved through Devonian shales by Cattaraugus Creek and its tributaries. Figure 3-1 shows a generalized east-west cross section through the site. The uppermost till unit is the Lavery, a very compact gray silty clay. The Lavery is approximately 6 m thick at the western boundary of the WVDP and thickens to the east. At the western edge of the developed portion of the WVDP, the Lavery is approximately 30 m thick. *In situ* measurements of the hydraulic conductivity in the Lavery have generally ranged between 10^{-9} and 10^{-7} cm/s.

The upper 3 m (approximately) of the Lavery have been chemically weathered by leaching and oxidation and mechanically weathered by bioturbation. The hydraulic conductivity of the weathered till is much higher than that of the underlying unweathered parent material, probably as a result of increased fracture flow.

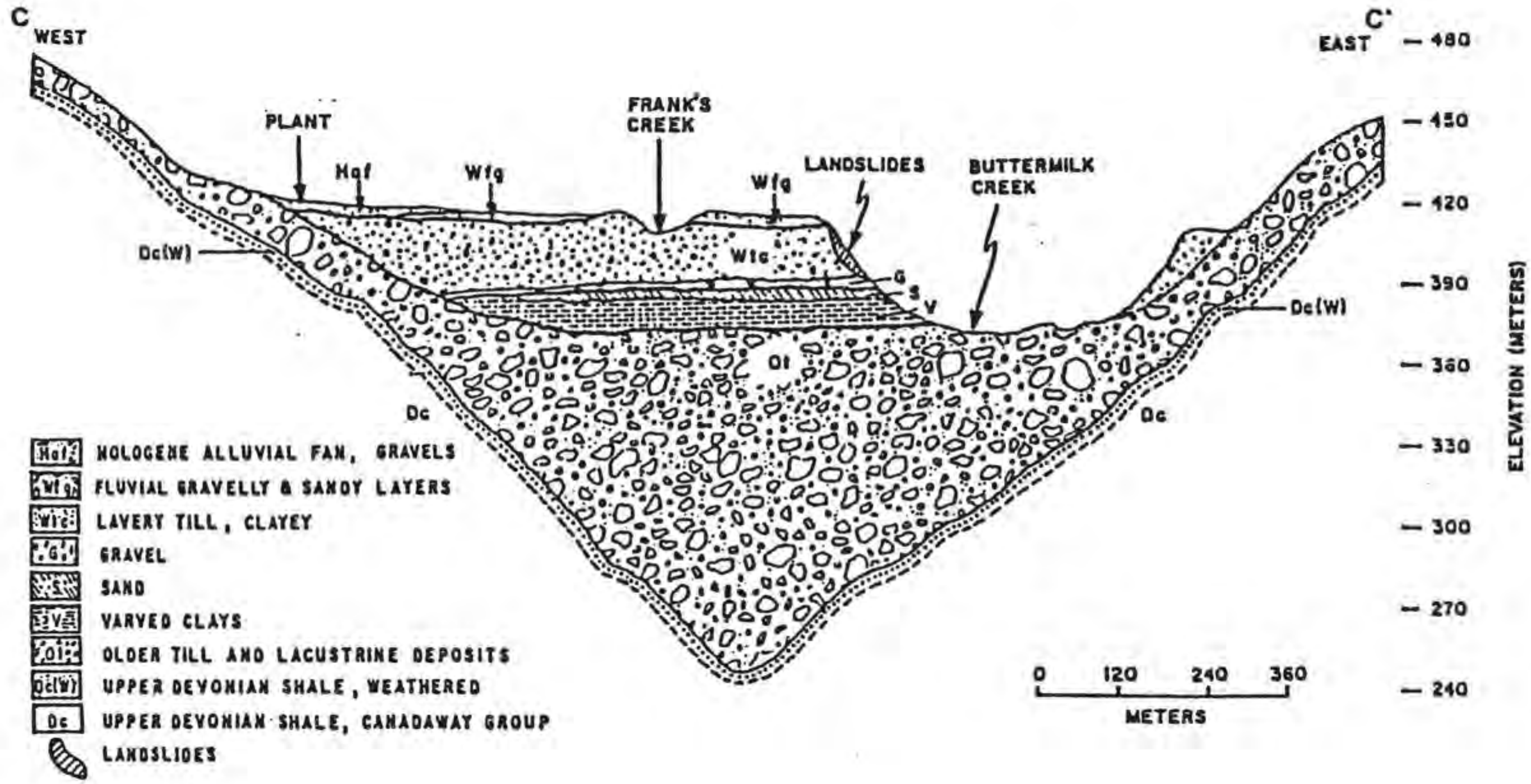
The northern portion of the WVDP site is blanketed by a layer of alluvial gravels up to 6 m thick. These gravels extend from the plant area northward.

Below the Lavery till is a more granular unit referred to locally as the Lacustrine Unit. It comprises silts, sands and, in some areas, gravels which overlie a varved clay. The Lacustrine is believed to be more permeable than the Lavery, but little permeability testing has been performed in this unit. Hydraulic conductivities on the order of 10^{-5} to 10^{-4} cm/s are assumed for this unit which are conservative in consideration of the gradation of the Lacustrine Unit materials.

Free field groundwater flow through the described geosystem occurs in two aquifers and to a considerably lesser extent in the aquiclude between them. The upper aquifer is a transient water table aquifer in the weathered till and, where it is encountered, the alluvial gravels. To a lesser extent, the highly fractured upper metre of the unweathered till is also part of this aquifer. This unit is generally unsaturated, but immediately after periods of intensive runoff, such as a spring thaw, significant quantities of groundwater are believed to flow through this unit. The primary flow occurs through the extensive system of fractures which dissects this unit.

The lower aquifer is an unconfined aquifer in the Lacustrine Unit. The piezometers embedded in this unit all exhibit phreatic heads below the top of this unit. The total recharge mechanism for the unit is not well defined because of limited data, but available data suggest that the unit is recharged from the fractured bedrock and downward seepage through the overlying Lavery till. The bedrock recharge zone to the west is recharged at outcrops in the uplands to the west of the site. Flow through this unit appears to be to the east toward Buttermilk Creek.

The aquiclude that separates these two aquifers is the Lavery. Its mass permeability is extremely low but it does permit seepage. When the weathered till is acting as a transient aquifer, a vertical gradient of unity exists in the



NOTE:
Vertical scale = 1/4 horizontal scale.
Adapted from Dana et al. (1979a).

Figure 3-1. Generalized Geologic Cross Section at the West Valley Demonstration Project.

till and causes water to move downward, but at a very low rate.

3.2 Groundwater Monitoring

The 1987 groundwater program sampled wells both on the Project site and on residential properties around its perimeter. The shallow wells in this program fall into five groups:

1. A group of dug shallow wells installed north of and immediately surrounding the main plant building which were monitored for several years before Project start-up and are therefore used for reference to examine long-term trends. These wells were not sampled in 1987.

2. The USGS series 80 wells which form an outer ring around the facility dug wells.

3. The USGS series 82 wells that are grouped around the former NRC-Licensed Disposal Area. Selected series 75 wells also fall into this category.

4. The 86 series monitoring wells which were installed by WVNS to supplement the existing groundwater monitoring network around specifically identified waste management areas.

5. Private wells around the perimeter used for drinking water by site neighbors (half of these are sampled each year).

A system of 14 wells has been designated to monitor three waste management areas. In addition, a groundwater seep and an existing monitoring station at the french drain outlet in the lagoon area are included in the monitoring program. Of the 14 wells, five were existing wells installed by the USGS as observation wells, and the remaining nine wells were installed in the summer of 1986. The locations of these wells and monitoring points are shown on Figure 3-2.

The locations of the upgradient and downgradient monitoring wells were based on known groundwater flow patterns in the given area and the presence and proximity of other potential contamination sources close to the waste management area. Wells were located so that no other possible contamination source would lie between the well (downgradient or upgradient) and the waste management area which it is to monitor.

As shown on Figure 3-2, six monitoring wells are used to assess the Low-Level Waste Lagoon System. Wells 80-5, 80-6, 86-3, and 86-4 are all downgradient wells and Well 86-6 is upgradient of the lagoon system. Two locations are existing USGS wells (80-5 and 80-6). Well 86-5 is designed to monitor the quality of groundwater flowing beneath old Lagoon 1 in the direction of Erdman Brook.

The outlet for the french drain (WNSP008) and a groundwater seep along the western bank of Frank's Creek are included in the monitoring system for this area. The outlet for the french drain is currently also a sampling point (008) under the New York State SPDES permit. This drain serves as a sink for a major portion of the surface groundwater flowing in the immediate vicinity of the lagoon system, and provides an indication of the change in the local groundwater quality over time.

The groundwater seep located on the upper western bank of Frank's Creek provides an indication of the groundwater quality in the surficial deposits, along with monitoring wells 80-5 and 80-6. It is not clear just how much groundwater flowing beneath the lagoon system escapes discharge to the french drain. However, it is believed that some of the deeper surficial groundwater, particularly on the northern sides of Lagoons 4 and 5, tends to flow eastward or northeastward toward Frank's Creek.

Four wells monitor the High-Level Waste Tank Complex. Wells 86-7, 86-8 and 86-9 are downgradient wells, while well 80-2 serves as the upgradient well. Wells 86-7 through 86-9 are located along the major flow paths passing through the tank complex as determined by Yager (1985). At the same time, they were

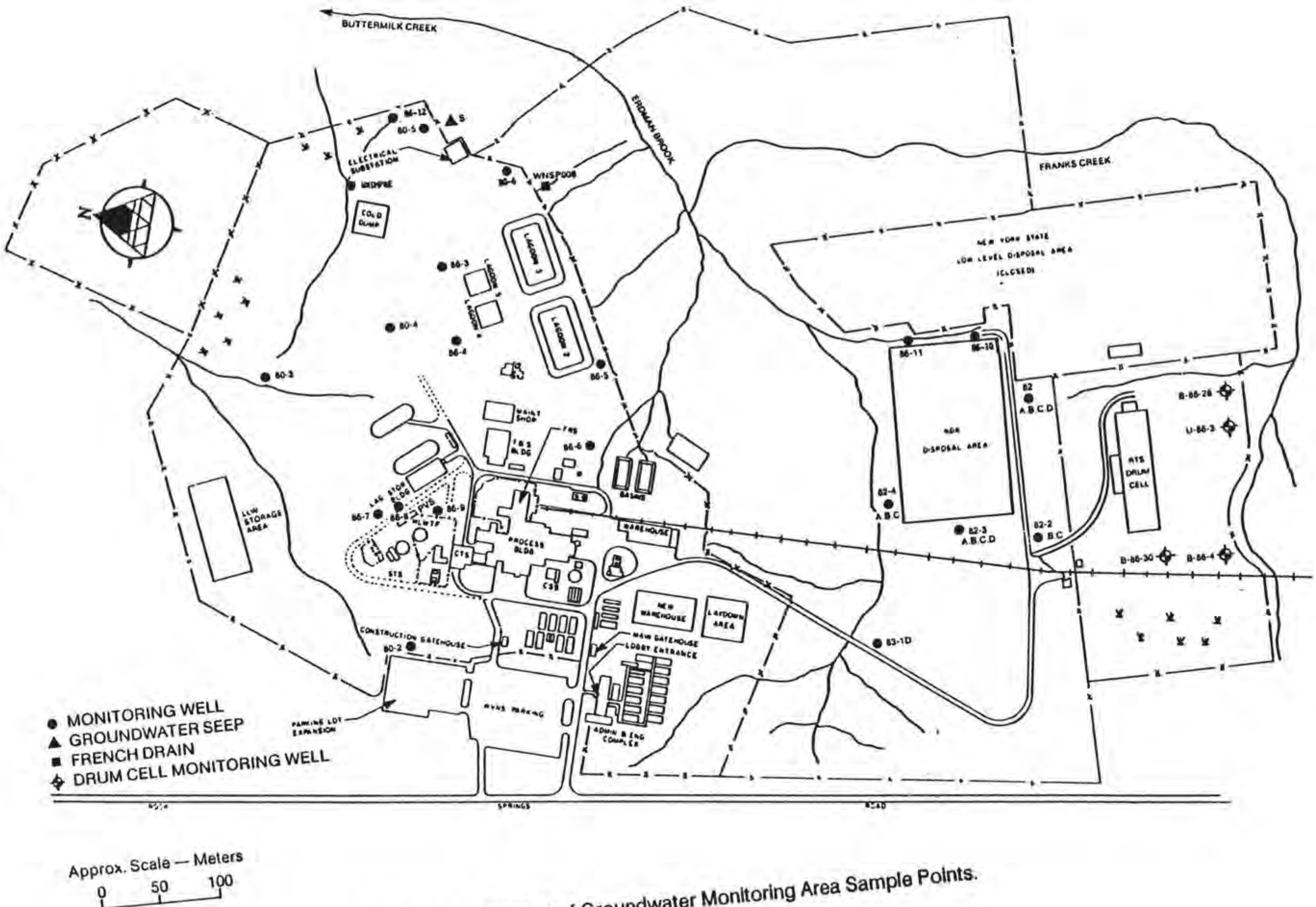


Figure 3-2. Location of Groundwater Monitoring Area Sample Points.

placed clearly upgradient of the hardstand and salvage areas.

Two groundwater monitoring locations are used to assess the former on-site nonradioactive construction and demolition debris landfill (cold dump) which was closed in 1986. Well 86-12 and a screened standpipe (WNDMPNE) were sampled along with other waste management wells. Results for these two sampling locations are included with results from the High-Level Waste Tank Complex wells to allow comparison with a representative upgradient well (80-2).

Four wells were selected to monitor the disposal unit within the NRC Licensed Disposal Area. All four tap the Lacustrine Unit. Wells 86-10 and 86-11 are downgradient wells located along the northeastern boundary of the area, and just upgradient of the New York State commercial disposal area. Well 82-1D is located downgradient of the western one-third of the NDA. Well 83-2D is located clearly upgradient of the disposal unit. However, due to difficulties in properly purging and sampling this well because of an apparently bent casing, well 83-1D was substituted as a new upgradient well for this disposal unit beginning with the second quarter of 1987.

The parameters and sampling schedule shown in Table 3-1 are used for the groundwater monitoring program. Category III parameters, Groundwater Contamination Indicators, were selected after considering the type, quantities and concentrations of constituents in the wastes of the three waste management areas, in addition to their mobility, persistence and detectability. These parameters are sensitive indicators and at the same time are representative of the wastes existing at the three areas.

At each sampling, sufficient liquid is obtained (if possible) from each well for four replicate analyses of each groundwater monitoring parameter. At each sampling event, the depth to the static water level from a leveled reference point (generally top of the well casing) is measured and recorded prior to purging the well and taking the necessary water sample.

Sampling and analysis are performed in accordance with accepted practice formalized in approved procedures to ensure the reliability and retrievability of water quality data.

Well 86-13 serves to monitor the WVDP below-ground fuel storage area for evidence of volatile organic compounds as well as selected water quality parameters and radioactivity.

In addition to monitoring the wells described above, a number of existing wells (the WNW80- and 82- series) were sampled routinely. These samples were analyzed for a variety of water quality parameters (see Appendix E) as well as for radioactivity. The location of these existing wells is shown on Figure A-2. Note that several of the wells are also included in Figure 3-2 because they were incorporated into the revised groundwater monitoring plan.

Private wells around the perimeter of the restricted area represent the nearest unrestricted use of groundwater near the Project. These potable water wells between 1.5 and 4 km away are monitored primarily for radioactivity on a biennial schedule.

3.3 Groundwater Monitoring Results

Table E-1 shows results for supporting groundwater monitoring stations sampled during the first quarter of 1987. Of greatest significance is the repeated detection of tritium in well WNW82-4A1 at levels of 2.29 E-5 to 2.48 E-5 μCi/mL. However, adjacent wells WNW82-4A2 and WNW82-4A3 which are at approximately the same depth exhibit tritium levels of 1.0 E-7 to 3.83 E-7 μCi/mL.

Table E-2 shows results of quarterly sampling of well 86-13 which monitors groundwater in the vicinity of the fuel storage area. Analyses of selected volatile organic constituents resulted in less-than-detectable concentrations

TABLE 3-1
SCHEDULE OF GROUNDWATER SAMPLING AND ANALYSIS

Category	Parameter	Frequency	Comment
I. EPA Interim Drinking Water Standards	Arsenic Barium Cadmium Chromium Fluoride Lead Mercury Nitrate (as N) Selenium Silver Radium Gross Alpha Gross Beta	Quarterly for 1st year	Annually after 1st year except coliform and pesticides
	Coliform Bacteria Endrin Lindane Methoxychlor Toxaphene 2,4-D 2,4,5-TP Silvex		These were omitted because site history does not indicate past usage
II. Groundwater Quality Indicators	Chloride Iron Manganese Phenols Sodium Sulphate	Quarterly for 1st year, annually thereafter	
III. Groundwater Contamination Indicators	Nitrate pH Conductivity Total Organic Carbon Total Organic Halogens Specific Metals Tritium Gross Alpha Gross Beta Specific Gamma Emitters	Quarterly for 1st year, semiannually thereafter	All parameters are measured in 4 replicates of each sample. Parameters selected by WVNS as indicators of waste treatment/disposal at WVDP.
IV. Groundwater Elevations		Once before collecting each well sample	

(0.2 μg/L) for all parameters of interest. Other selected parameters were not indicative of any problems in this area.

The results of groundwater monitoring for the three waste management units discussed above (including the former cold dump as a fourth unit reported with results from the High-Level Radioactive Waste Tank unit) are shown in Tables E-3 through E-14, and Figures E-2 through E-40. For the most part, values reported in tabular format represent the average of the four replicate measurements taken per quarter per parameter. Notable exceptions include data for well 83-2D from which the sample volume required for four replicates could not be obtained (Well 83-2D was replaced as the upgradient well for the NRC-Licensed Disposal Area by well 83-1D which provides adequate sample volume), and tritium results for the fourth quarter of 1987.

Non-radiological results exhibiting a mixture of detectable and less-than-detectable values were averaged using Cohen's method from "RCRA Groundwater Monitoring Technical Enforcement Guidance Document" (USEPA, 1986). All radiological averaging was performed on the actual counting results.

For aid in data interpretation, selected parameters are also shown in separate multiple Box-and-Whisker plots which allow direct visual comparison of yearly results for wells within the same waste management unit. Figure E-1 illustrates the multiple Box-and-Whisker plot for those who may be unfamiliar with this presentation format. In all cases upgradient wells are positioned to the left in the plots and at the top in tables.

Tables E-3 through E-6 and Figures E-2 through E-9 show results for wells within the High-Level Radioactive Waste Tank Complex unit (including two cold dump monitoring points). Differences between upgradient and downgradient locations do exist throughout the year (Figures E-3, E-7, E-13, and E-14). However, trends of increasing concentrations for these parameters are not evident indicating that the measured differences are fairly stable.

Data for wells monitoring the Low-Level Radioactive Waste Lagoon System are shown in Tables E-7 through E-10 and Figures E-15 through E-27.

Notable findings within this unit are elevated levels of gross beta and tritium activity in well 86-5 compared to upgradient well 86-6 (see Table E-10, and Figures E-23 and E-25). These elevated levels may be directly attributed to this well's position at the immediate downgradient edge of former Lagoon 1.

An analysis of Sr-90 on a fourth quarter sample collected from well 86-5 (7.75 E-6 μCi/mL) indicates that almost all the gross beta activity (1.61 E-5 μCi/mL) for this fourth quarter sample is accounted for by Sr-90, if it is assumed to be in equilibrium with Y-90 (total activity Sr-90 and Y-90 = 1.55 E-5 μCi/mL). The areal extent of tritium and beta contamination at this location is unknown; however, its detection here is not surprising given this area's history as Lagoon 1.

Data for wells monitoring the NRC-Licensed Disposal Area are shown in Tables E-11 through E-14 and Figures E-28 through E-40. Positive differences between upgradient and downgradient wells were noted for sulfate (Table E-11, Figure E-33) with an apparently widening trend occurring at location 86-11. However, levels of radioactivity at downgradient locations either remained approximately the same or decreased during the year (see Table E-14).

Data for the private offsite wells is given in Table C-1.6. With the exception of tritium in one well at 0.02 percent of the DCG, no fuel-cycle isotopes were detected.

4.0 RADIOLOGICAL DOSE ASSESSMENT

4.1 Methodology

The potential radiological impacts resulting from the release of radioactivity during 1987 have been estimated by calculating radiation doses received by the maximally exposed off-site individual and the population within an 80 km radius of the West Valley Demonstration Project (WVDP) facility. The potential pathways of exposure to the general public from radioactive effluents released by the WVDP operations are shown in Figure 4-1. The exposure modes considered in the dose calculations are:

- Direct exposure from immersion in air containing radionuclides,
- Direct radiation from ground surfaces contaminated by deposited radionuclides,
- Immersion in contaminated water,
- Inhalation of airborne radionuclides, and
- Ingestion of contaminated water and food produced from the land and surface waters in the area.

Because the ridges and hills in the vicinity of the WVDP frequently channel the winds, strong systematic deviations from straight-line air flow over long distance are expected. To realistically account for the terrain effects on wind flow, a fine grid, two-dimensional wind field was developed using the Dames & Moore WNDSRF3 code and meteorological data measured hourly at seven stations around the WVDP and the three nearest National Weather Service stations. The wind field data were then input into EPM3, a variable-trajectory Gaussian puff dispersion code for calculating the relative concentrations of radioactivity from routine operational releases.

The EPM3 code is formulated according to the guidelines described by the U.S. Nuclear Regulatory Commission (NRC) in Regulatory Guide 1.111. The assumption underlying the code is that a number of discrete puffs are serially released from the source to simulate a continuous plume. Each puff is assumed to have a Gaussian concentration distribution in three dimensions. Puffs expand in size as they move downwind from the source in response to spatial and temporal wind and stability conditions. Each puff is transported independently by the nonuniform wind field and is tracked until it leaves the grid region. Relative concentration and deposition are computed at each grid receptor location.

The output of the EPM3 code is then input into AIRDOS-EPA (Moore et al., 1979) which calculates the radiation doses to receptors of interest. A detailed discussion of the computer codes WNDSRF3, EPM3 and AIRDOS-EPA is given in the WVDP Safety Analysis Report, Volume 1 Supplements, Section A.3.3-C.

Results in this section are based on analyses that use relative concentration values calculated for gaseous effluents released from the WVDP plant at a height of 60 m and at ground level. Meteorological data collected continuously over a twelve-month period (August 1983 through July 1984) were used as the basis for the dispersion calculations.

The calculated annual average relative concentration values for 60-m and ground-level releases are given in Tables 4-1 and 4-2, respectively, for each of the sixteen 22.5-degree wind sectors in an 80-km radius circle centered at the WVDP main plant stack. The maximum mean annual relative concentration values at actual residences in the vicinity of the site are 1.5 E-07 sec/m^3 (at 2.1 km WSW) and 9.5 E-07 sec/m^3 (at 1.4 km NW) for stack and ground level releases, respectively.

To calculate the radiation doses to the maximally exposed individual and the population within 80 km from the plant, relative concentra-

TABLE 4-1

RELATIVE CONCENTRATION VALUES (SEC/M^3) BY SECTOR FROM 60-METRE STACK RELEASE

Azimuth (degrees)	Receptor Distance (metres) 805.0	2414.0	4023.0	5633.0	7242.0
22.50	2.02416 E-08	1.93986 E-08	1.72210 E-08	1.34912 E-08	1.20170 E-08
45.00	3.25187 E-08	6.28082 E-08	1.32191 E-07	2.44441 E-08	1.88344 E-08
67.50	3.42855 E-08	6.94581 E-08	9.40678 E-08	8.45641 E-08	5.52987 E-08
90.00	3.48094 E-08	5.50870 E-08	5.37927 E-08	5.04735 E-08	3.36123 E-08
112.50	5.93936 E-08	6.20651 E-08	1.06356 E-07	6.10075 E-08	5.09318 E-08
135.00	7.26163 E-08	4.20942 E-08	4.16789 E-08	5.56745 E-08	5.42665 E-08
157.50	5.21367 E-08	5.04154 E-08	9.01721 E-08	4.79790 E-08	3.10507 E-08
180.00	3.90285 E-08	1.56936 E-07	6.36421 E-08	3.41481 E-08	1.79095 E-08
202.50	3.36508 E-08	9.69468 E-08	4.42338 E-08	2.37874 E-08	1.69491 E-08
225.00	2.60220 E-08	1.42672 E-07	1.45403 E-08	1.38970 E-08	1.72462 E-08
247.50	1.72524 E-08	1.35143 E-07	9.31579 E-09	8.86101 E-09	9.81254 E-09
270.00	1.38976 E-08	5.95015 E-08	9.28389 E-09	4.92782 E-09	3.25826 E-09
292.50	1.82690 E-08	2.17890 E-08	7.45750 E-09	7.50383 E-09	6.06720 E-09
315.00	1.84112 E-08	1.09852 E-08	5.65960 E-09	4.14112 E-09	4.48282 E-09
337.50	1.74931 E-08	8.44696 E-09	6.69558 E-09	6.46329 E-09	1.05258 E-08
360.00	2.13821 E-08	1.97053 E-08	1.39587 E-08	1.59614 E-08	1.84509 E-08

Azimuth (Degrees)	Receptor Distance (metres) 12070.0	24140.0	40234.0	56327.0	72420.0
22.50	4.43343 E-08	5.02300 E-09	1.54200 E-09	4.66679 E-10	2.25540 E-10
45.00	1.22992 E-08	1.31197 E-08	3.73175 E-09	7.82408 E-10	3.89659 E-10
67.50	1.76386 E-08	8.88299 E-09	2.36241 E-09	7.63461 E-10	3.96656 E-10
90.00	1.30863 E-08	3.96711 E-09	1.69612 E-09	9.09068 E-10	5.38685 E-10
112.50	1.70443 E-08	3.43813 E-09	1.29261 E-09	7.80346 E-10	4.93087 E-10
135.00	2.21988 E-08	4.78107 E-09	1.67453 E-09	9.56557 E-10	7.16724 E-10
157.50	1.27633 E-08	3.65858 E-09	1.39235 E-09	8.41724 E-10	4.17164 E-10
180.00	5.46839 E-09	1.49509 E-09	6.17677 E-10	2.49661 E-10	1.80339 E-10
202.50	4.97200 E-09	1.16554 E-09	4.17297 E-10	3.26463 E-10	2.17867 E-10
225.00	3.90207 E-09	1.04904 E-09	3.62789 E-10	2.67344 E-10	2.49012 E-10
247.50	2.91434 E-09	7.44792 E-10	3.09624 E-10	2.42050 E-10	1.63484 E-10
270.00	1.99053 E-09	1.17354 E-09	5.09524 E-10	2.33294 E-10	1.34791 E-10
292.50	3.02399 E-09	8.52397 E-10	3.06939 E-10	1.84965 E-10	1.64367 E-10
315.00	4.12131 E-09	8.10527 E-10	3.61054 E-10	1.97646 E-10	1.23069 E-10
337.50	2.99186 E-08	1.68992 E-09	5.56848 E-10	3.13688 E-10	3.07107 E-10
360.00	1.22515 E-08	3.13466 E-09	9.76886 E-10	4.44199 E-10	2.44762 E-10

TABLE 4-2

RELATIVE CONCENTRATION VALUES (SEC/M^3) BY SECTOR FROM GROUND LEVEL RELEASE

	Receptor Distance (metres)				
Azimuth (degrees)	805.0	2414.0	4023.0	5633.0	7242.0
22.50	1.64432 E-06	4.55564 E-07	1.66184 E-07	1.01517 E-07	6.77884 E-08
45.00	1.56641 E-06	3.30197 E-07	1.34172 E-07	4.73194 E-08	3.59780 E-08
67.50	1.01058 E-06	1.97252 E-07	9.42588 E-08	5.81288 E-08	3.79589 E-08
90.00	1.09262 E-06	1.82835 E-07	6.67927 E-08	3.73587 E-08	2.40901 E-08
112.50	1.78994 E-06	2.74125 E-07	1.11012 E-07	5.38760 E-08	3.54571 E-08
135.00	2.15038 E-06	2.94396 E-07	1.14500 E-07	6.48315 E-08	4.33901 E-08
157.50	1.44110 E-06	2.02579 E-07	7.62755 E-08	4.02057 E-08	2.65812 E-08
180.00	8.98011 E-07	1.26039 E-07	4.46505 E-08	2.10800 E-08	1.25962 E-08
202.50	5.82938 E-07	9.09417 E-08	3.23678 E-08	1.65005 E-08	1.04614 E-08
225.00	6.20413 E-07	7.22452 E-08	2.39934 E-08	1.50882 E-08	1.07698 E-08
247.50	4.08957 E-07	6.32056 E-08	1.82285 E-08	1.04640 E-08	8.59581 E-09
270.00	8.34124 E-07	9.51694 E-08	2.16677 E-08	9.40243 E-09	5.93790 E-09
292.50	1.28776 E-06	1.80989 E-07	3.03818 E-08	2.59718 E-08	1.63193 E-08
315.00	2.31398 E-06	4.61826 E-07	6.24797 E-08	2.03703 E-08	2.54686 E-08
337.50	6.00362 E-06	1.40566 E-07	6.21634 E-08	6.63543 E-08	1.15632 E-07
360.00	4.27125 E-06	4.75757 E-07	1.16690 E-07	1.44426 E-07	1.63061 E-07
	Receptor Distance (metres)				
Azimuth (degrees)	12070.0	24140.0	40234.0	56327.0	72420.0
22.50	3.52891 E-08	3.40586 E-09	1.00542 E-09	3.49144 E-10	1.68966 E-10
45.00	2.21417 E-08	5.09350 E-09	1.70791 E-09	6.33664 E-10	3.75450 E-10
67.50	1.42588 E-08	4.70023 E-09	1.70863 E-09	7.93135 E-10	4.70601 E-10
90.00	8.93237 E-09	2.77984 E-09	1.41573 E-09	8.15443 E-10	5.13178 E-10
112.50	1.28142 E-08	3.20641 E-09	1.18574 E-09	7.40762 E-10	4.56947 E-10
135.00	1.65469 E-08	3.96052 E-09	1.37113 E-09	7.85457 E-10	5.36148 E-10
157.50	1.08235 E-08	2.93527 E-09	1.04913 E-09	5.98888 E-10	3.05173 E-10
180.00	4.28680 E-09	1.03415 E-09	3.53940 E-10	1.93388 E-10	1.56602 E-10
202.50	3.68894 E-09	8.73627 E-10	3.80441 E-10	2.51438 E-10	1.42737 E-10
225.00	3.43687 E-09	8.53510 E-10	3.15227 E-10	2.07137 E-10	1.35988 E-10
247.50	2.33436 E-09	7.21198 E-10	3.22324 E-10	2.08381 E-10	1.43584 E-10
270.00	2.40878 E-09	9.84799 E-10	4.35641 E-10	2.13476 E-10	1.41153 E-10
292.50	6.26825 E-09	1.25810 E-09	3.77333 E-10	1.91497 E-10	1.43025 E-10
315.00	2.26095 E-08	8.30861 E-10	4.30455 E-10	1.97719 E-10	1.14625 E-10
337.50	1.76978 E-08	1.68011 E-09	6.15352 E-10	3.18642 E-10	2.15773 E-10
360.00	2.66190 E-08	3.37986 E-09	9.44245 E-10	3.94326 E-10	1.87990 E-10

tion values are used as input to the AIRDOS-EPA code.

The dose estimates were made by calculating radionuclide concentrations in air, rates of deposition on ground surfaces, ground surface concentrations, intake rates via inhalation, and ingestion of meat, milk, and fresh vegetables. Site specific data on production and consumption of milk, meat, and agricultural products were used in computing the collective population dose.

The radiation dose commitment to the maximally exposed individual and the collective dose to the population within 80 km of the WVDP from the water pathway were calculated using the computer code LADTAP II (Simpson and McGill, n.d.). Both LADTAP II and AIRDOS-EPA implement the NRC Regulatory Guide 1.109 recommendations for terrestrial food chain dose assessments.

Two maps of the area surrounding the WVDP were overlaid with 16- and 80-km radius grid systems with the facility at its center. The grid systems were further divided into 10 concentric regions and 16 compass directions. For each sector formed by the grid system, the specific human populations, beef and dairy cattle populations, and agricultural areas were determined by a 1983 survey. The sector specific data are shown in Figures 4-2 through 4-9.

For each radionuclide of concern, the inhalation dose conversion factors (DCFs) used are for an activity median aerodynamic diameter (AMAD) of 0.3 micrometer. For alpha emitters, the dose conversion factors are derived by using a quality factor of 20, as recommended by the International Commission on Radiological Protection (ICRP)(Dunning, n.d.). All of the doses from internal exposure are committed dose equivalents and are calculated for the 50-year period following inhalation or ingestion using the internal dose conversion factors from Dunning.

For this report, the effective dose equivalent, as well as the dose equivalent to the thyroid, lungs, bone, liver, kidneys, and gastro-intestinal tract were calculated in order to determine the critical organs for various potential pathways of exposure. These estimates were based on parameters applicable to an average adult male (ICRP, 1975). The collective population dose estimate in person-rem is the effective dose equivalent as calculated in accordance with the recommendations of the ICRP (ICRP, 1977).

In addition to these estimates of dose commitments based on dispersion modeling, the dose was estimated to a hypothetical maximally exposed individual who consumed locally produced milk, fish, beef, and venison (deer). Measured radionuclide concentrations from local and control samples of milk, fish, beef, and venison were used in these calculations. Although state-of-the-art methods and instrumentation were used to determine concentrations, certain nuclides, if present in these samples, are often below the minimum detectable concentration (MDC). In cases where both the sample and its control were below the MDC for a specific nuclide, it was assumed that the nuclide was not present at a concentration greater than natural background.

4.2 Source Term Estimates

4.2.1 Airborne Radioactive Effluents

There are five points on the plant site from which ventilation systems released low concentrations of airborne radioactivity during 1987. These five locations are:

- Process building main stack,
- Cement Solidification System (CSS) exhaust stack,
- Contact Size Reduction Facility (CSRF) exhaust stack,
- Laundry exhaust vent, and
- Low-level Waste Treatment Facility (LLWTF) ventilation exhaust.

The air released from these vents is sampled routinely and the collected particulates are periodically analyzed. For the main plant, CSS,

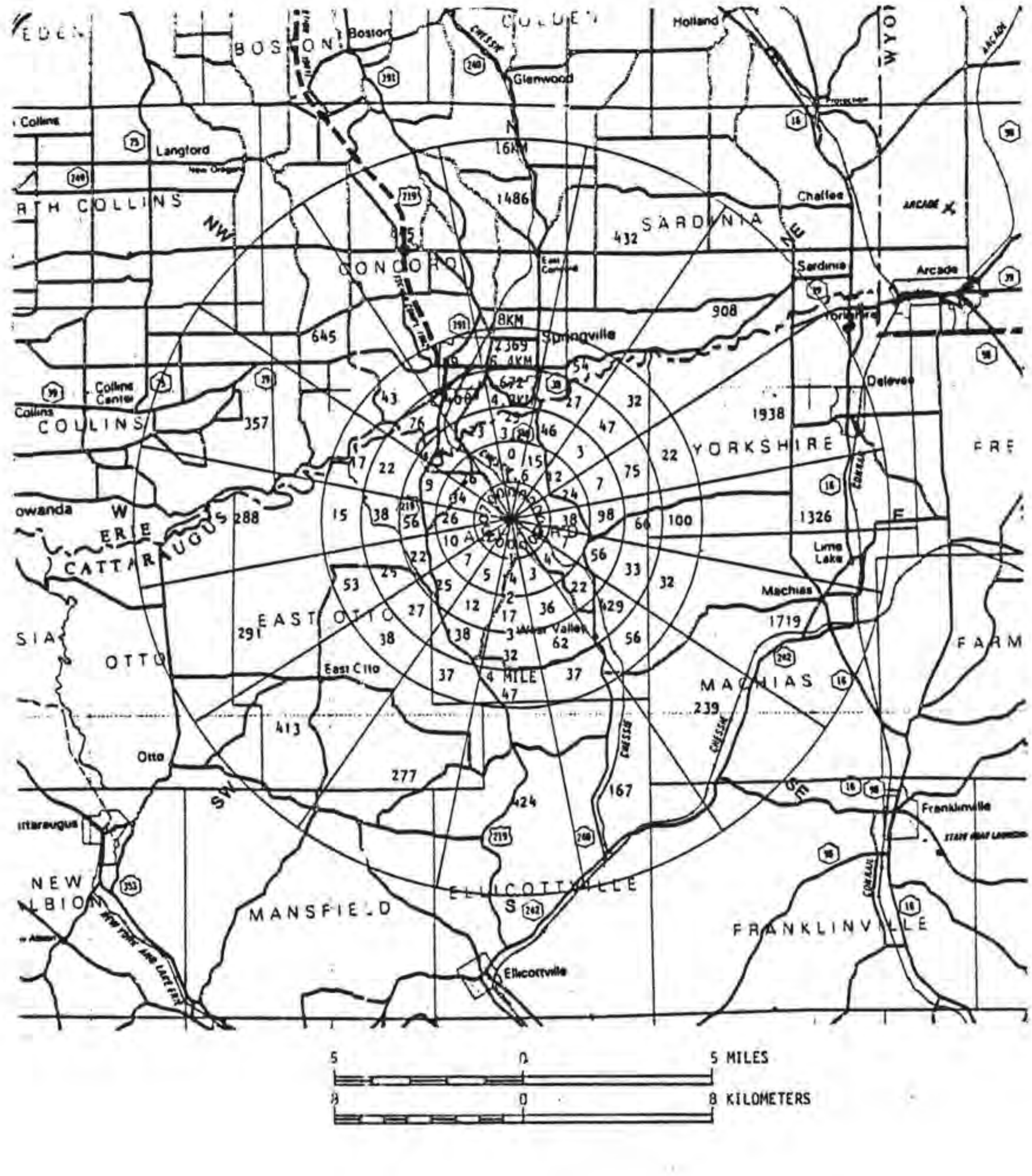


Figure 4-2. 1990 Population Projections by Sector within 16 km (10 mi) of the Site.

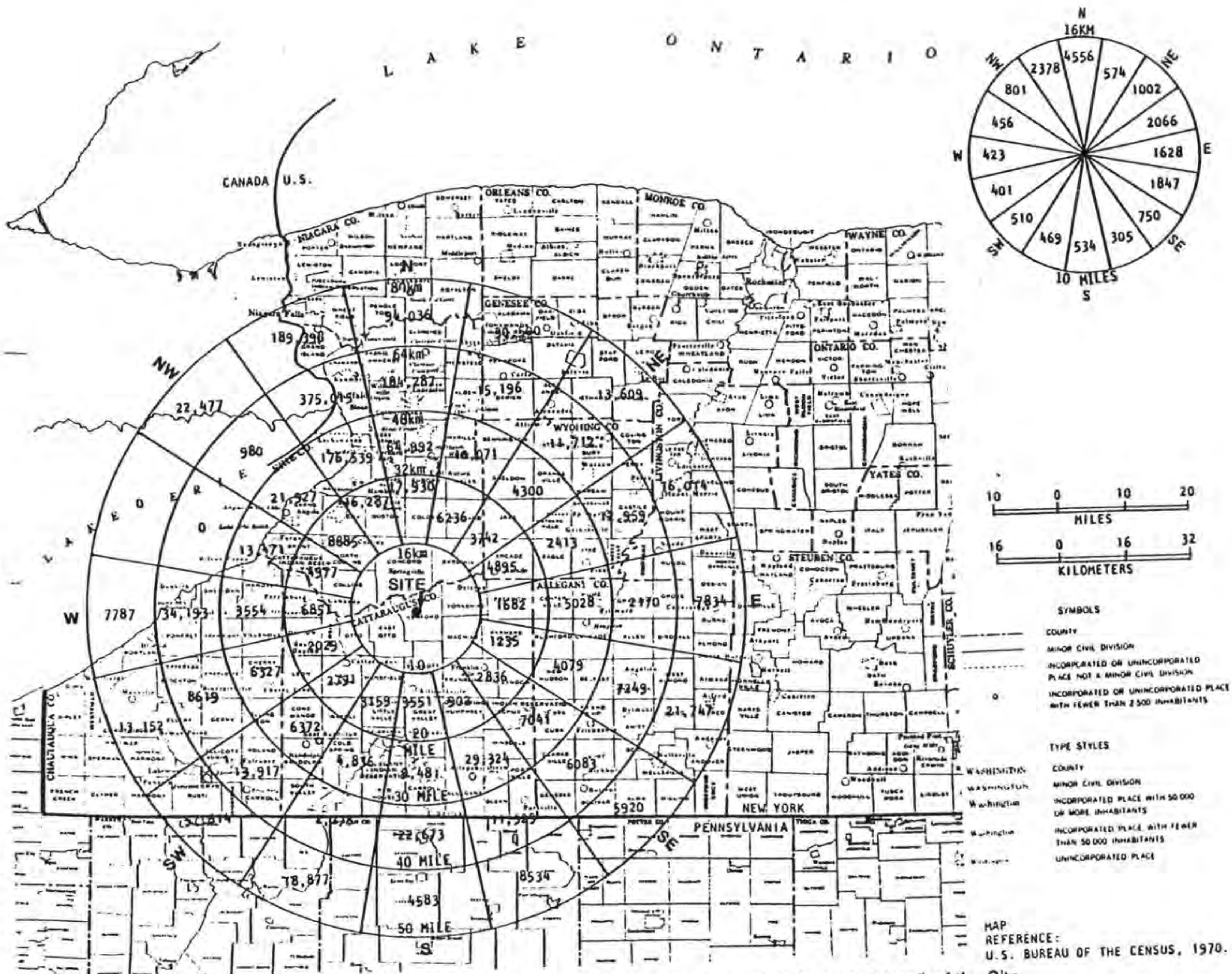


Figure 4-3. 1990 Population Projections by Sector within 16-80 km (10 - 50 mi) of the Site.

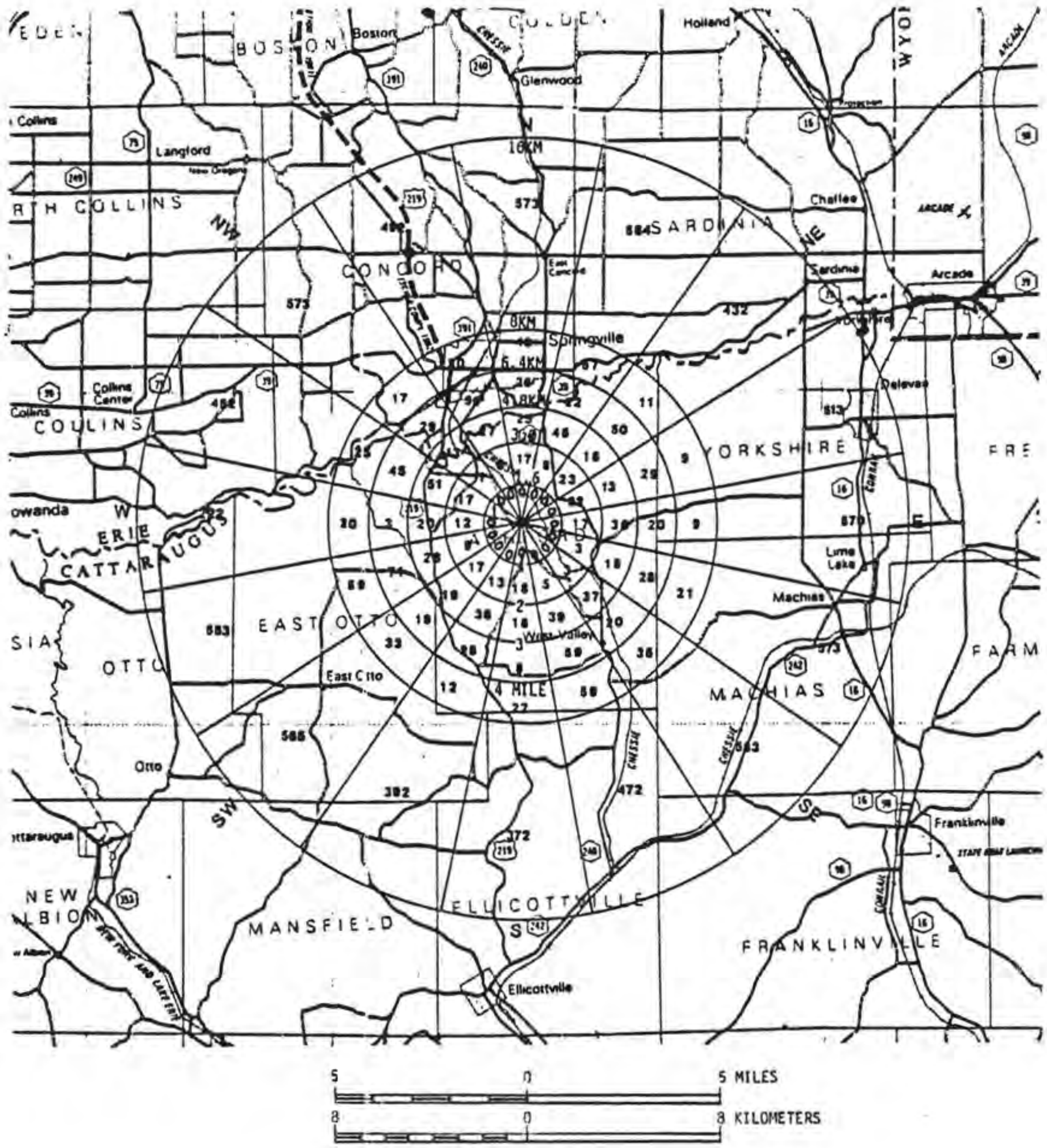


Figure 4-4. Number of Dairy Cows by Sector within 16 km (10 mi) of the Site.

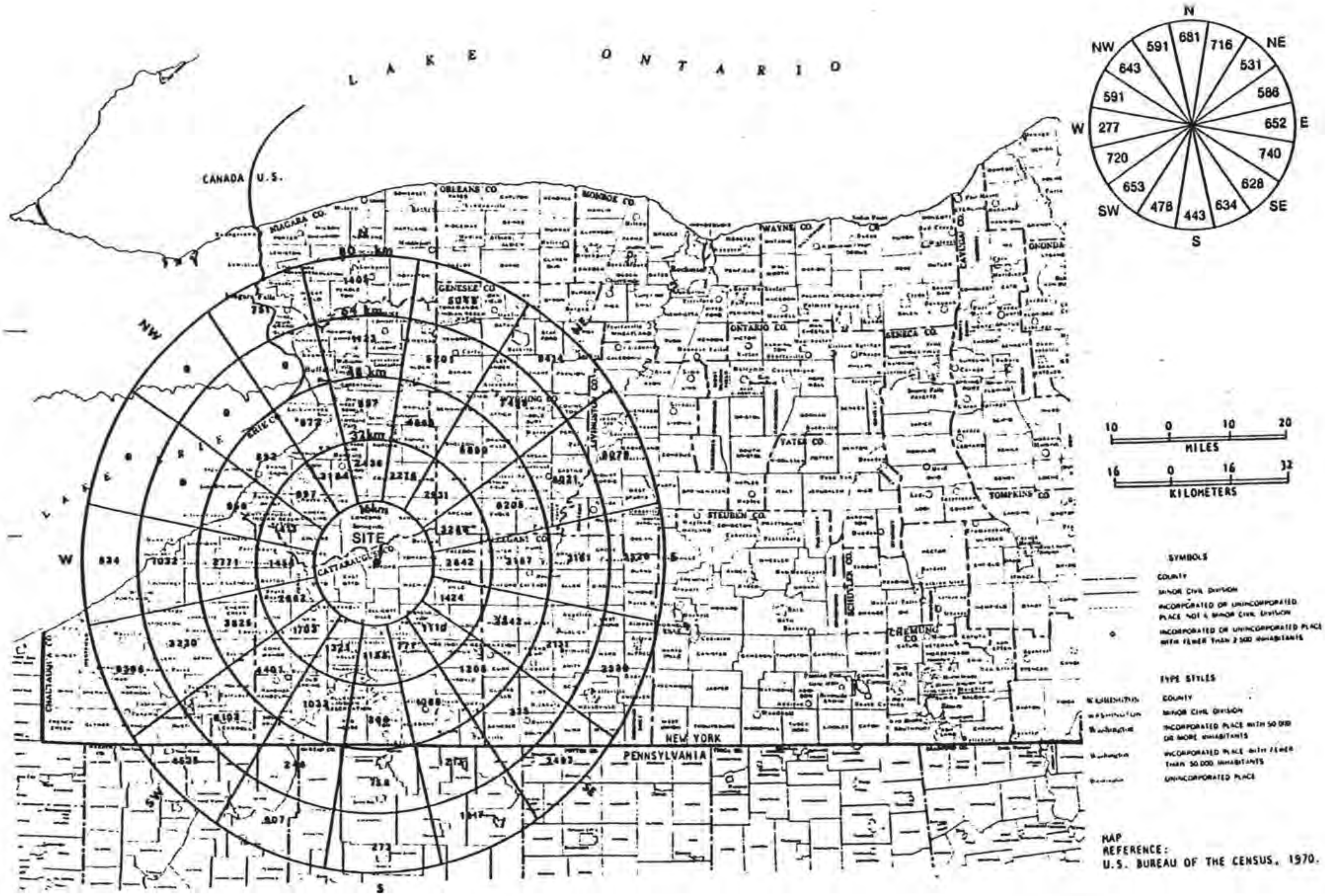


Figure 4-5. Number of Dairy Cows by Sector within 16-80 km (10 - 50 mi) of the Site.

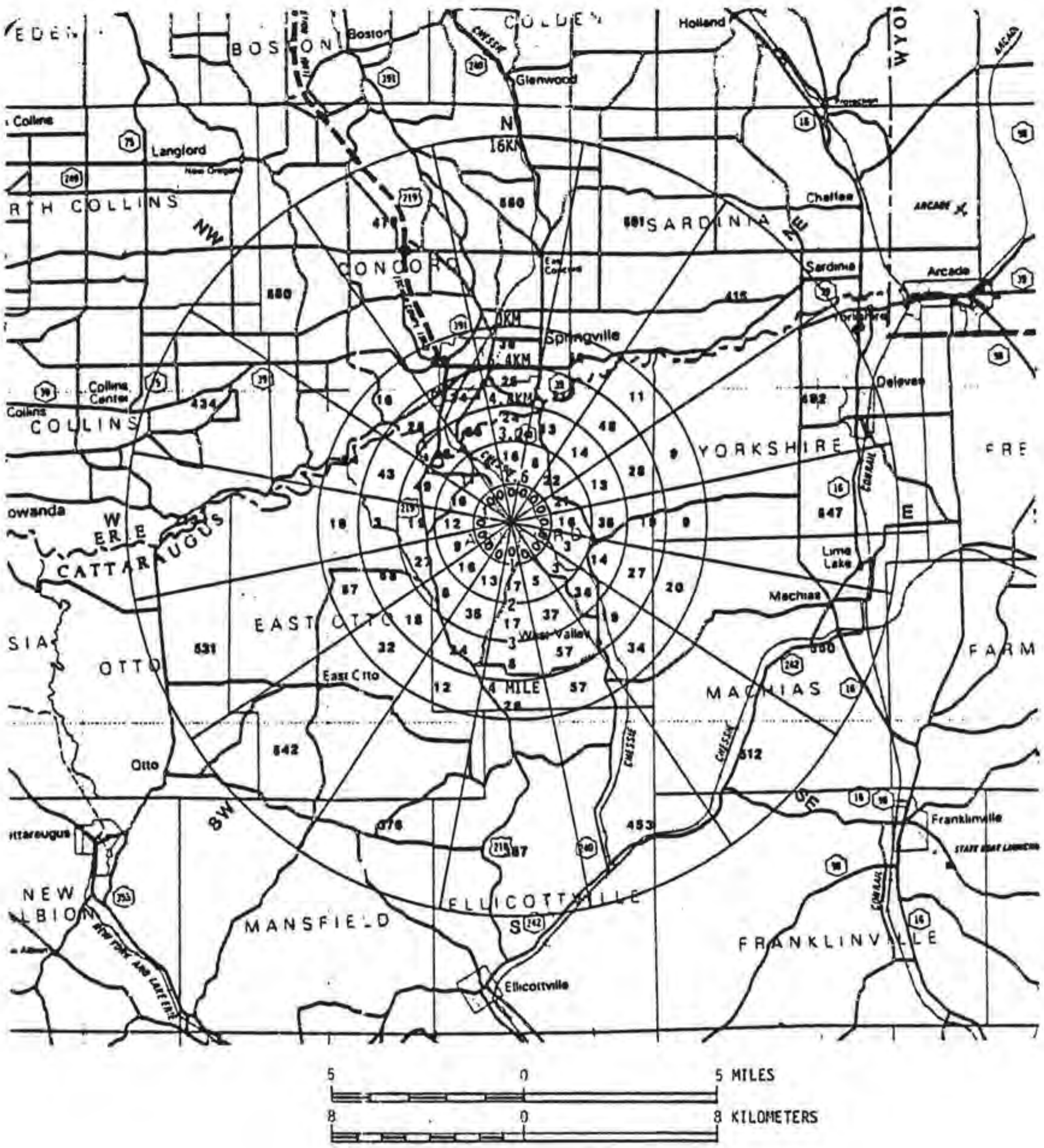


Figure 4-6. Number of Meat-producing Animals by Sector within 16 km (10 mi) of the Site.

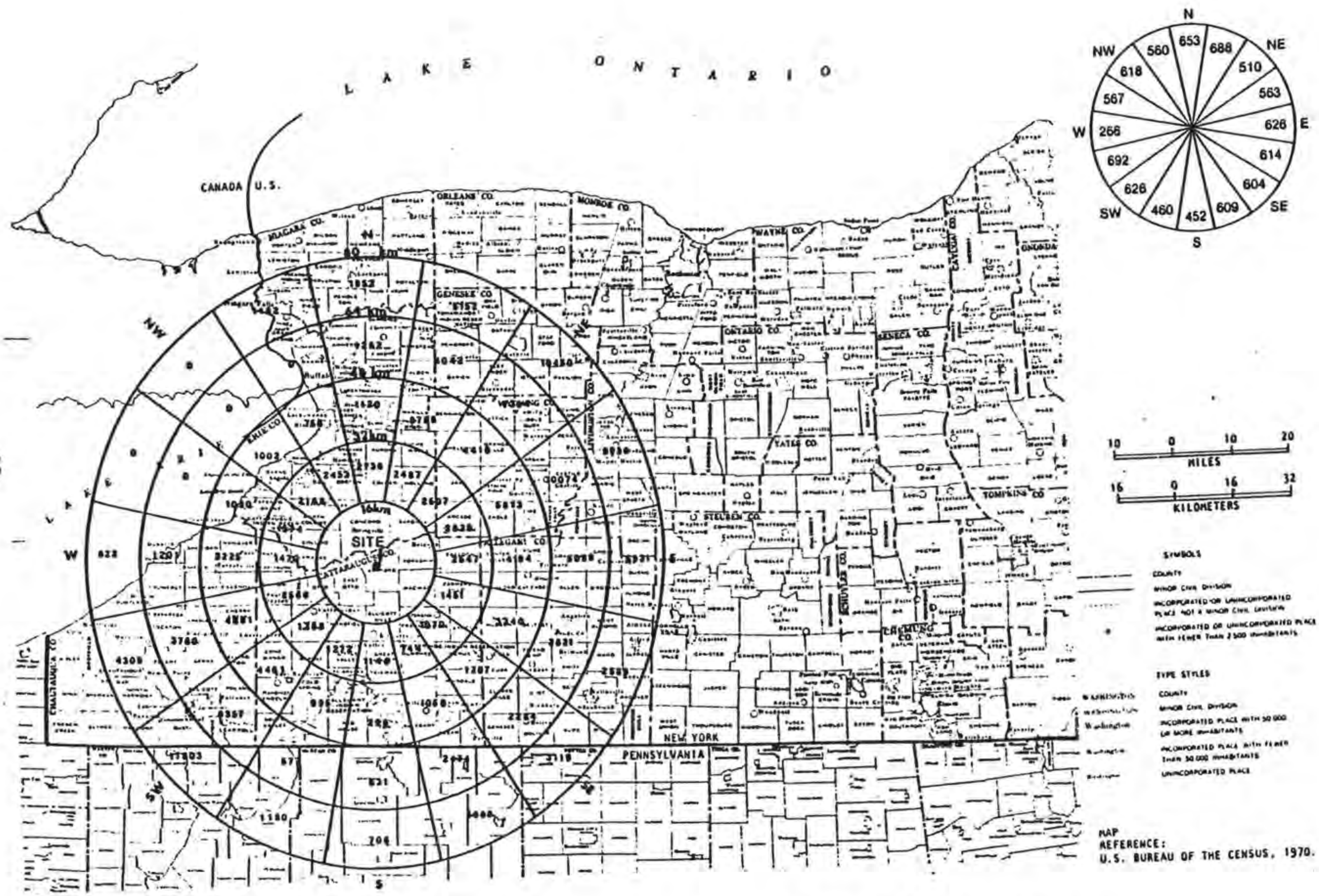


Figure 4-7. Number of Meat-Producing Animals by Sector 16 - 80 km (10 - 50 ml) of the Site.

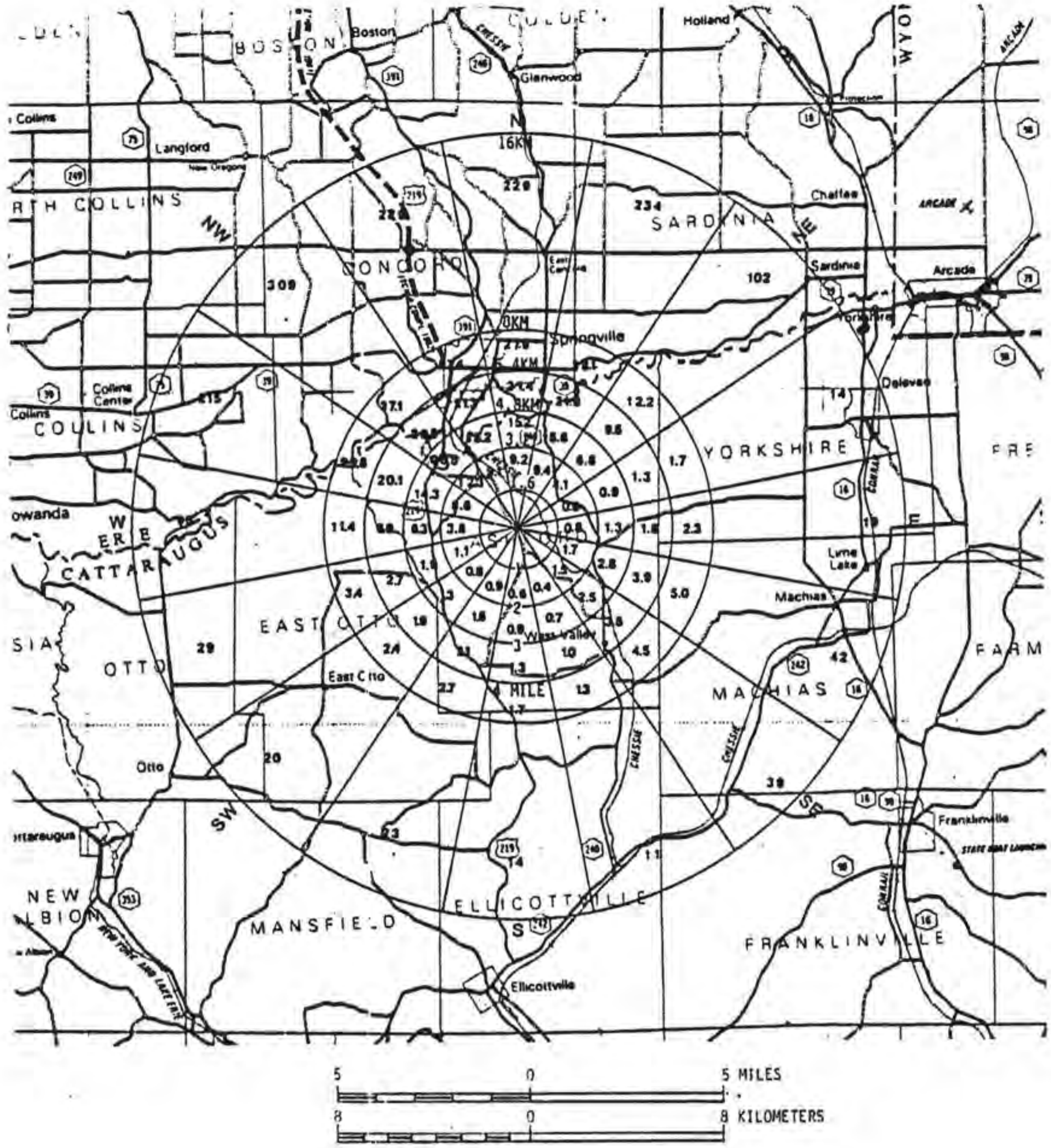


Figure 4-8. Agricultural Produce Land Area (ha) by Sector Within 16 km (10 mi) of the Site.

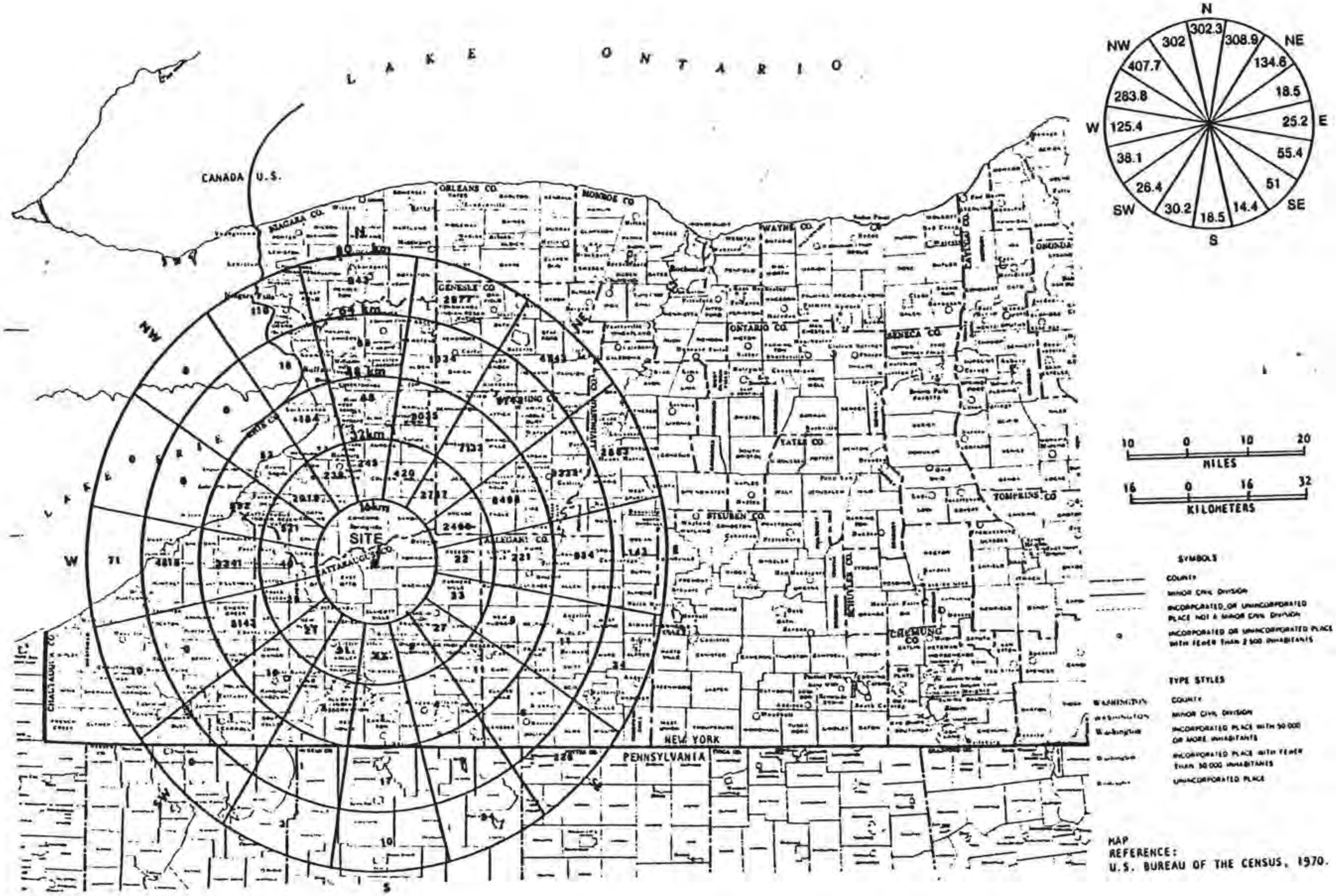


Figure 4-9. Agricultural Produce Land Area (ha) by Sector within 16 - 80 km (10 - 50 mi) of the Site.

and CSRF stacks, the sampling is continuous. The results of measurements during 1987 are summarized in Table 4-3. A total of 6.8 E-06 Ci of alpha activity and 5.5 E-04 Ci of beta/gamma activity was released from these vents during the year. Greater than ninety-eight percent of the activity released to the atmosphere was discharged through the main plant stack.

The Contact Size Reduction Facility (CSRF) began operation in October of 1987. Its exhaust is continuously monitored for radioactivity in a manner similar to that used for the main plant and CSS stacks.

4.2.2 Liquid Radioactive Effluents

There were three sources of liquid effluents from WVDP operations in 1987:

- Lagoon 3 discharges (five planned releases),
- Sewage treatment outfall (WNSP007), and
- Surface water drainage from the northeast swamp drain, the french drain, and the north swamp drain.

The volumes of the liquid effluents and the radioactivity they contained (reported in WVDP 1987 Effluent and On-Site Discharge Report, March 1988) are summarized in Table 4-4. All liquids were discharged via Buttermilk Creek. Relevant release standards and derived concentration guides (DCGs, DOE Order 5480.1) are presented in Appendix B. Collective population doses from these liquid effluents are based on the number of curies released for each identified nuclide in Table 4-4 (see Section 4.3.2). Actinide concentrations were measured only in the Lagoon 3 effluent.

4.3 Potential Radiation Doses to the Public

4.3.1 Maximum Hypothetical Individual Doses

The point of maximum potential long-term radiation exposure in the vicinity of the site from radioactivity released from the plant stack is a private residence about 2.1 km WSW of the WVDP plant. A hypothetical maximum effective dose equivalent of 0.00097 mrem was calculated as a result of WVDP airborne releases during 1987 when all possible pathways were considered. The calculated dose commitment to bone surfaces (the critical organ) at this location was 0.0069 mrem. These maximum hypothetical exposures are about 0.004 percent for whole body and 0.009 percent for the critical organ of the applicable standards for airborne releases promulgated by the U.S. Environmental Protection Agency (EPA) in 40 CFR 61.

An important potential contributor to the dose commitment from radioactivity in the terrestrial food-chain is the airborne pathway to the pasture and then to cow and to milk. Measurements of radioactivity in the milk produced at the dairy farm nearest to the WVDP facility (see Table C-3.1) indicated that no tritium, I-129, Cs-134, or Cs-137 were present in concentrations above the limits of detection. The maximum dose to an individual from ingestion of about 1 L of this milk per day was estimated from the Sr-90 concentrations in excess of the control sample. This calculation predicts a dose commitment of 0.40 mrem to bone surfaces and an effective dose equivalent of 0.038 mrem. These calculated maximum potential doses are 0.5 percent and 0.2 percent, respectively, of the allowable 40 CFR 61 standards.

If I-129 were assumed to be present in the milk at a net concentration equal to the MDC (0.6 pCi/L), the predicted, hypothetical maximum thyroid dose would be approximately 2 mrem/year. This is not considered to be a realistic assumption. It does, however, indicate

TABLE 4-3

RADIOACTIVITY RELEASED TO THE ATMOSPHERE DURING 1987

Release Point	Total Volume (m3)	Total Curies Released: Gross Alpha	Gross Beta	Specific Nuclides	
Main Plant Stack (ANSTACK)	8.9 E+08	6.65 ± 0.4 E-06	5.43 ± 0.1 E-04	H-3	4.14 ± 0.1 E-01
				Co-60	1.31 ± 0.2 E-06
				Sr-90	1.32 ± 0.1 E-04
				I-129	4.29 ± 0.4 E-05
				Cs-134	2.61 ± 2.2 E-07
				Cs-137	2.05 ± 0.01 E-04
				Eu-154	1.30 ± 0.4 E-06
				U-234	3.98 ± 0.4 E-08
				U-235	3.41 ± 1.6 E-09
				U-238	3.27 ± 0.4 E-08
				Pu-238	8.68 ± 0.5 E-07
				Pu-239	1.16 ± 0.1 E-06
				Am-241	2.21 ± 0.1 E-06
Cement Solidification System Stack (ANCSSTK)	1.5 E+08	< 2.2 E-08	1.16 ± 0.1 E-06	Co-60	< 2.9 E-08
				Sr-90	2.27 ± 0.2 E-06
				I-129	9.49 ± 4.8 E-08
				Cs-134	< 2.3 E-08
				Cs-137	3.32 ± 0.1 E-06
				Eu-154	< 9.0 E-08
				U-234	6.94 ± 0.9 E-09
				U-235	< 2.9 E-10
				U-238	5.92 ± 0.8 E-09
				Pu-238	4.61 ± 0.3 E-08
				Pu-239	4.66 ± 0.3 E-08
				Am-241	9.79 ± 0.7 E-08
Contact Size Reduction Facility Stack (ANCSRFK)	2.0 E+07	< 5.2 E-09	6.72 ± 2.0 E-08	Co-60	< 1.4 E-08
				Sr-90	5.51 ± 1.0 E-09
				I-129	1.70 ± 0.7 E-08
				Cs-134	< 1.1 E-08
				Cs-137	< 1.3 E-08
				Eu-154	< 3.2 E-08
				U-234	1.36 ± 0.4 E-09
				U-235	< 2.5 E-11
				U-238	1.10 ± 0.3 E-09
				Pu-238	1.69 ± 0.9 E-10
				Pu-239	1.23 ± 0.7 E-10
				Am-241	1.14 ± 0.6 E-10
Laundry Vent (ANLAUNV)	1.4 E+07	4.1 E-08	9.1 E-07	None Identified	
LLWTF Vent (ANLLWTV)	1.1 E+08	1.0 E-07	7.7 E-07	None Identified	

TABLE 4-4
RADIOACTIVITY RELEASED IN LIQUID EFFLUENTS DURING 1987

Release Point	Volume Released (Litres)	Released Radioactivity (Ci) Gross Alpha	Gross Beta	H-3	Sr-90	I-129	Cs-137
Lagoon 3	3.6 E+07	< 4.3 E-04	3.31 ± 0.4 E-02	5.96 ± 0.2 E-01	3.35 ± 0.1 E-03	3.31 ± 0.3 E-04	3.31 ± 0.3 E-02
Sewage Treatment Outfall (WNSP007)	1.2 E+08	< 1.0 E-04	9.81 ± 2.3 E-04	< 1.3 E-02	------	------	------
N.E. Swamp Drain	6.0 E+07	< 6.6 E-05	6.33 E-03	5.34 ± 0.4 E-02	------	------	------
French Drain	7.0 E+06	< 8.4 E-06	1.75 E-04	5.66 ± 0.2 E-02	------	------	------
N. Swamp Drain	6.0 E+06	< 5.3 E-06	3.12 E-04	1.51 E-03	------	------	------
TOTAL:	2.3 E+08	< 6.1 E-04	4.1 ± 0.4 E-02	7.2 ± 0.2 E-01	3.35 ± 0.1 E-03	3.31 ± 0.3 E-04	3.31 ± 0.3 E-02

	U-234	U-235	U-238	Pu-238	Pu-239	Am-241
Lagoon 3	5.06 ± 0.8 E-04	1.07 ± 0.5 E-05	2.18 ± 0.3 E-04	1.96 ± 1.2 E-06	3.49 ± 1.7 E-06	3.76 ± 1.1 E-06

that an extremely conservative assumption still yields a dose estimate well within regulatory limits.

Estimates were made of the hypothetical maximum dose commitments to an adult from consumption of 21 kg per year (the maximum value recommended in NRC Regulatory Guide 1.109) of fish caught in Cattaraugus Creek. From the measured concentrations of radionuclides in the edible parts of the fish (Table C-3.4) corrected for wet to dry weight ratio, the maximum organ dose commitment to an individual was estimated to be 0.47 mrem to bone surfaces. The maximum effective dose equivalent commitment to an individual was calculated to be 0.044 mrem.

The hypothetical dose commitment was also estimated for an individual who consumed 45 kg of venison taken from the local area (within 1 mile) and for an individual consuming 110 kg of locally raised beef cattle. The measured radionuclide concentrations (Table C-3.2) corrected for wet to dry weight ratio in the flesh of a deer taken about a kilometre away from the WVDP in the fourth quarter of 1987 were used as the basis for this estimate. The dose commitment to the critical organ was calculated to be 0.028 mrem to the adrenals and 0.025 mrem for an effective dose equivalent commitment. The maximum individual dose for consumption of locally raised beef cattle was based on two near-site samples taken in the second and fourth quarters of 1987. After background subtraction, the maximum individual effective dose was calculated as 0.050 mrem and the critical organ dose to the adrenals as 0.056 mrem.

Table 4-5 summarizes the potential radiation doses to individual adult members of the general public at the points of highest potential exposure from gaseous and liquid effluents from the WVDP facility operations during 1987. Although no direct pathway to drinking water from airborne or liquid effluents was found or evaluated for committed dose, drinking supply well water data are presented in Table C-1.6. Additionally, the results of the radionuclide measurements in stream sediments (Table C-1.7) and surface waters (Tables C-1.2 through C-1.5) are also presented in Appendix C1.

4.3.2 Collective Dose to the Population

The collective effective dose equivalent commitment to the population within an 80-km radius of the WVDP from operations during 1987 was estimated to be 0.009 person-rem from gaseous effluents and 0.03 person-rem from liquid effluents. These estimates are based on the releases summarized in Tables 4-3 and 4-4 and the use of the AIRDOS-EPA (CCC-357)(Moore et al., 1979) and LADTAP II codes as described in Section 4.1.

These collective doses may be compared to an estimated annual 170,000 person-rem to the same population resulting from natural background radiation. Based on the collective dose given above and a total population of 1.7 million in the region, the average effective dose equivalent to an individual residing within 80 km of the WVDP was about 0.000023 mrem during 1987, which is insignificant when compared to the average dose to each individual of approximately 100 mrem per year from natural sources.

Recent recommendations of the National Council on Radiation Protection and Measurements (NCRP, 1985) and the proposed revisions to the Title 10 Code of Federal Regulations Part 20 (NRC, 1986) define a risk level which is below regulatory concern for purposes of determining collective population doses. These agencies recommend that doses of 1 mrem/yr incurred by individual members of the public be excluded for purposes of assessing the collective dose to a population. Despite the conservatism used in assessing the dose to the maximum hypothetical individual from environmental releases of radioactivity in 1987 from the WVDP, no individual member of the public was predicted to receive a dose in excess of 1 mrem/yr above background.

TABLE 4-5

SUMMARY OF HYPOTHETICAL DOSE EQUIVALENTS
TO AN ADULT INDIVIDUAL AT LOCATIONS OF MAXIMUM EXPOSURE DURING 1987

Pathway	Location	Dose Equivalent (mrem)	
		Effective	Critical Organ**
Elevated Releases*			
Main Plant Stack (ANSTACK)	Nearby residence (2.1 km WSW)	0.00097	0.0069
Ground Level Releases*			
CSS Stack (ANCSSTK)	Nearby residence (1.4 km, NW)	0.000091	0.00084
CSRF Stack (ANSCRFK)	Nearby residence (1.4 km, NW)	0.0000017	0.000011
Laundry Vent (ANLAUNV)	Nearby residence (1.4 km, NW)	0.000015	0.00023
LLWTF Vent (ANLLWTV)	Nearby residence (1.4 km, NW)	0.000027	0.00044
Milk	Collected 3.5 km SSW	0.038	0.40
Venison	Collected within 1 km of WVDP	0.025	0.028**
Beef	Collected 4 km N of WVDP	0.050	0.056**
Fish	Collected in Cattaraugus Creek below WVDP	0.044	0.47

Notes: Annual average whole body dose from natural background sources in the U.S. is about 100 mrem.

* Estimates based on measured radioactivity in airborne effluents (Table 4-3) and dispersion and radiological dose calculations described in Section 4.1. All other values based on measured concentrations in food and consumption rates for maximally exposed individuals recommended in U.S. NRC Regulatory Guide 1.109.

** Bone surface, unless marked (**) for adrenals.

Accordingly, within the framework of the NCRP and NRC methodology, the collective population dose in excess of natural background within an 80-km radius of the WVDP would, in fact, be reported as zero as a result of radionuclide releases in 1987.

4.3.3 Dose Assessment Model Prediction Versus Actual Release Data

Dose assessment models used at WVDP for liquid and airborne effluents have been used to compare model predictions with actual sample analysis. Based on actual releases of liquid effluents in 1987, LADTAP II predicts the maximum individual dose from consumption of 21 kg of fish taken from Cattaraugus Creek to be 0.2 mrem. This is in good agreement with the predicted maximum individual dose of 0.044 mrem calculated from actual measured radionuclide concentrations in fish flesh, given the statistical error associated with the sample analyses.

The predicted maximum individual dose based on actual air sampling data collected at a nearby residence (Table C-2.2.2) turns out to be zero when the background air sample data from Great Valley (Table C-2.2.7) at 42 km from the site is subtracted. This agrees with the 0.00097 mrem predicted by AIRDOS-EPA from the measured quantity of radioactivity actually discharged from the plant, in that this dose can be considered as essentially zero.

A comparison was also made of the radioactive particulate concentrations (μCi/mL) based upon air sampler data from a nearby residence (Table C-2.2.2) with those calculated from the measured release data (Table C-2.1.3) and the site specific annual average relative concentrations (Tables 4-1 and 4-2). The concentrations predicted using the stack discharge data are more than five orders of magnitude below those measured at the perimeter air monitoring stations. This finding reinforces the observation that the air sampler at the nearby residence is essentially measuring background particulate radioactivity with 0.001 percent of the collected activity provided by airborne releases from the WVDP.

4.3.4 NESHAPS Compliance

This section has been added to the WVDP annual report to present data and discussion concerning compliance with 40 CFR 61, "National Emission Standards for Hazardous Air Pollutants, Subpart H."

Section 40 CFR 61.93 stipulates that:

"To determine compliance with the standard, radionuclide emissions shall be determined and dose equivalents to members of the public shall be calculated using EPA approved sampling procedures, EPA models AIRDOS-EPA and RADRISK, or other procedures, including those based on environmental measurements, that EPA has determined to be suitable. Compliance with this standard will be determined by calculating the dose to members of the public at the point of maximum annual air concentration in an unrestricted area where any member of the public resides or abides."

The EPA has determined that CAAC (CCC-476), which uses dose conversion factors derived from ICRP 2 (rather than the more recent ICRP 26 and 30), is the suitable version of the AIRDOS-EPA dispersion code to calculate doses to members of the public. In addition, CAAC uses simplified straight-line Gaussian methodology to describe meteorological dispersion from elevated and ground level sources.

Whole-body and critical organ dose equivalents were calculated with this EPA-approved code for all significant effluent pathways. Table 4-6 presents the calculated dosimetric data at the location of the maximum individual for both elevated and ground level releases.

The collective population dose (within 80 km of WVDP) calculated for all airborne pathways is 0.02 person-rem. As previously discussed,

TABLE 4-6

SUMMARY OF HYPOTHETICAL DOSE EQUIVALENTS CALCULATED PER 40 CFR 61
TO AN ADULT INDIVIDUAL AT LOCATIONS OF MAXIMUM EXPOSURE DURING 1987

Pathway	Location	Dose Equivalent (mrem)	
		Whole-body	Critical Organ*
Elevated Releases			
Main Plant Stack (ANSTACK)	Nearby residence (3.4 km SE)	0.000091	0.0021*
Ground Level Releases			
CSS Stack (ANCSSTK)	Nearby residence (1.9 km, NNW)	0.00021	0.0049
CSRF Stack (ANCSRFK)	Nearby residence (1.9 km, NNW)	0.0000052	0.000073
Laundry Vent (ANLAUNV)	Nearby residence (1.9 km, NNW)	0.000047	0.0011
LLWTF Vent (ANLLWTV)	Nearby residence (1.9 km, NNW)	0.0001	0.0027

Note: Annual average whole body dose from natural background sources in the U.S. is about 100 mrem.

* Bone surface, unless marked (*) for thyroid.

the hypothetical collective dose due to WVDP operations should be compared to the collective dose from natural background to the same population of 170,000 person-rem per year.

In summary, the dose calculations show that the WVDP is in compliance with the emission standard for radioactive airborne releases in that calculated doses to the maximally exposed individuals for elevated and ground level releases from the site do not exceed the applicable EPA limits.

4.3.5 Statistical Considerations

A simple one-way analysis of variance (ANOVA) statistical application was used to test whether observed differences among the various sample means can be attributed to chance or they are indicative of actual differences among the corresponding population means. The null hypothesis to be tested by the statistical application is whether or not the various population means are all equal.

In the case of the environmental air sampling data, Tables C-2.2.1 through C-2.2.7, the ANOVA test showed no statistically significant differences (at the 99 percent confidence level) in gross beta, Sr-90 or Cs-137 measurements for all possible combinations. Table 4-7 shows the statistically significant differences (a total of six out of a possible 21 combinations) for the air sampling station alpha data. The five significant differences in the Route 240 data are attributable only to background variation since the average alpha concentration predicted at the sampler as a result of WVDP stack releases is 1.2 E- 20 μCi/mL, compared to the average alpha concentration of 1.3 E-15 μCi/mL from air sample analysis. The same background variation also explains the Thomas Corners versus Rock Springs Road statistical difference in that WVDP releases would predict average concentrations of 1.5 E-21 μCi/mL compared to the average air sample analysis concentration of 1.3 E-15 μCi/mL.

TABLE 4-7
AIR SAMPLING STATIONS AROUND WVDP EXHIBITING PAIR-WISE STATISTICALLY SIGNIFICANT DIFFERENCES IN AVERAGE DETECTED ALPHA CONCENTRATIONS

	Rock Springs Road	Great Valley	Fox Valley	Route 240	Thomas Corners	Spring-ville	West Valley
Rock Springs Road	—			X	X		
Great Valley		—		X			
Fox Valley			—	X			
Route 240	X	X	X	—		X	X
Thomas Corners	X				—		
Springville				X		—	
West Valley				X			—

Note: Empty box indicates no statistically significant differences detected.

5.0 STANDARDS AND QUALITY ASSURANCE

5.1 Environmental Standards and Regulations

The following Department of Energy Orders, environmental standards and laws are applicable to the WVDP:

- DOE Order 5480.1, "Requirements for Radiation Protection," August 1981.
- DOE Order 5484.1, "Environmental Protection, Safety, and Health Protection Information Reporting Requirements," February 1981.
- Clean Air Act, 42 USC 1857 et seq., as amended.
- Federal Water Pollution Control Act (Clean Water Act), 33 USC 1251, as amended.
- Resource Conservation and Recovery Act, 42 USC 6905, as amended. (Including Hazardous and Solid Waste Amendments of 1984).
- Comprehensive Environmental Response, Compensation and Liability Act, 42 USC 960. (Including Superfund Amendments and Reauthorization Act of 1986).
- Toxic Substances Control Act, 15 USC 2601, as amended.
- Environmental Conservation Law of New York State.

The standards and guides applicable to releases of radionuclides from the WVDP are those of DOE Order 5480.1 Chapter XI, dated August 13, 1981, entitled, "Requirements for Radiation Protection." Radiation protection standards and selected radioactivity limitations from Chapter XI, as amended by the Derived Concentration Guides, are listed in Appendix B.

These listed concentrations are guidelines provided by DOE to assure compliance with the performance standard of 100 mrem effective dose equivalent to the maximally exposed individual. Ambient water quality standards contained in the SPDES permit issued for the facility are listed in Table C-5.2. Airborne discharges are also regulated by the U.S. Environmental Protection Agency, National Emission Standards for Hazardous Air Pollutants, 40 CFR 61, 1984.

5.2 Quality Assurance

Off-site laboratories performed the majority of the analyses requiring radiochemical separation or chemical pollutant analyses for the environmental samples collected during 1987. The documented quality assurance plan used by these laboratories includes periodic interlaboratory cross-checks, prepared standard and blank analyses, routine instrument calibration, and use of standardized procedures. Off-site laboratories analyze blind duplicates of approximately 10 percent of the samples analyzed on-site for the same parameters in addition to unknown cross-check samples.

Physical surveys were made of the contract laboratory facilities in conjunction with quality assurance reviews by Project personnel.

Sample collection, preparation, and most direct radiometric analyses were performed at the WVDP Environmental Laboratory for all media collected. The determination of Sr-90 in water is a routine radiochemical measurement performed in the Environmental Laboratory. For all continuous sampling equipment, measurement devices, and counting instruments, periodic calibration was maintained using standards traceable to the National Bureau of Standards.

Sampling protocols based on the EPA requirements for nonradiological analyses are established specifically for groundwater collection. Other collections, such as surface water, sediments, and biological samples are performed using appropriate techniques to meet established procedures and schedules. Sampling methods are periodically reviewed in the field by senior laboratory personnel as well as outside agencies such as the U.S. NRC and the New York State DEC.

Formal cross-check programs between the WVDP Environmental Laboratory, the DOE Radiological and Environmental Science Laboratory (RESL) at the Idaho National Engineering Laboratory (INEL), and the Environmental Measurements Laboratory (EML), New York City, included the entire range of environmental samples monitored in 1987. Comparative data from a variety of environmental materials analyzed at WVDP, off-site contract labs, and EML are summarized in Tables D-1.1 and D-1.2. Cross-check results of water and charcoal analyses for gamma-emitting isotopes are given in Table D-1.3. New York State Department of Health Environmental Laboratory Accreditation Program (NYSDOH ELAP) certification samples are reported in Tables D-1.4 and D-1.5. The U.S. Environmental Protection Agency (EPA) cross-check programs for nonradiological water quality parameters also provided audit samples in 1987 (Table D-1.6). Data in Table D-1.7 gives TLD monitoring point results from dosimeters co-located with the U.S. NRC.

The 168 blind quality assurance parameters measured and reported in 1987 showed an acceptable program, but with several areas requiring improvement or special attention. The 100 percent overall acceptability of 81 environmental media analyses in the EML cross-check program (Tables D-1.1 and D-1.2) provided a high degree of assurance that the types of environmental samples represented by the EML cross-check analyses are accurately and precisely measured.

A water sample for gamma isotopic analysis provided by INEL revealed a 10 to 13 percent inaccuracy in measurement of fresh fission product isotopes, which are normally not encountered at WVDP. The source of the discrepancy was traced to inadequate count rates due to the age of standard geometry sources, for those isotopes which did not meet the 5 percent uncertainty acceptability level. Fresh standards are being acquired and statistical smoothing was employed to improve the accuracy in regions for which adequate calibration count rates were not available. No isotopes counted and reported at WVDP were affected by the discrepancy.

A second INEL sample for gamma isotopic analysis in a charcoal cartridge showed acceptable analytical results for the mock I-131 (Ba-133) measurement for which a reference geometry was available, but the remaining isotope results were not acceptable. Although WVDP does not presently possess a standard for measuring gamma isotopes in charcoal, a correction factor was determined for reference to a standard geometry presently in use. The offset ratio reported in Table D-1.3 reflects that correction factor.

Quality assurance cross-check samples from the NYSDOH and EPA showed satisfactory results overall. Of the 78 sample results, the five unsatisfactory results have been reviewed and appropriate actions have been taken to improve these analyses.

TLDs co-located with NRC dosimeters around the WVDP perimeter and facility showed acceptable agreement for two quarters compared with the exception of one second quarter measurement at NRC TLD #11 (Table D-1.7). The apparent discrepancy is being resolved by the NRC dosimetry laboratory and is thought to have been an artifact in the measurement process.

Based on the various audit and cross-check results, the WVDP Environmental Monitoring Program is functioning well, and the areas needing improvement have been identified and are receiving appropriate attention.

5.3 Statistical Reporting Of Data

Except where noted, individual analytical results are reported with plus or minus (±) two standard deviations (2 σ) giving a value at the 95 percent confidence level. The arithmetic averages were calculated using actual results, including zero and negative values. In the final results, if the uncertainty (2 σ) was equal to or greater than the value, the measurement was considered to be below the Minimum Detectable Concentration (MDC) (see Section 5.4), and is reported as a less-than (<) value. These MDC values will vary among samples, especially in biological media where sample size cannot be easily standardized.

The total statistical uncertainty for radiological measurements, including systematic (processing and physical measurement) uncertainty plus the random radioactivity counting uncertainty, is reported as one value for the 1987 data. In most cases, systematic uncertainties (e.g., due to laboratory glassware or analytical balance variation) are a small percentage of the larger counting uncertainties at typical environmental levels of radioactivity. The notation normally used in reporting of raw laboratory data to convey the total uncertainty is in the form: (V.00 ± R.O or T.O) E-00 where "V.00" is the analytical value to three significant figures, "R.O" is the random uncertainty to two significant figures, "T.O" is the total of random plus systematic uncertainties, and "E-00" is the exponent of 10 used to signify the magnitude of the parenthetical expression.

5.4 Analytical Detection Limits

For unique or individual samples analyzed on an infrequent basis, generic minimum detection limits for the entire analytical measurement protocol have not been developed, although a Lower Limit of Detection (LLD) based solely on the counting uncertainty is calculated for each sample. For routine measurements using standardized sample sizes, equipment, and preparation techniques, an average Minimum Detectable Concentration (MDC) has been calculated for WVDP environmental samples. These are listed in Table 5-1.

Specific sample media were analyzed for radionuclides from multiple split samples using routine procedures, normal laboratory techniques, and standard counting parameters. The counting statistics determined the estimated LLD above which there was 95 percent probability that radioactivity was present. This LLD is derived from the detection efficiency of the measuring instrument for the type of activity being measured, the level of normal background signal with no sample present (determined by counting a "background" of the same material as the sample) and the length of time the background and sample were counted. For radioactive decay, these factors can be used to accurately predict what value is the lowest which can be measured at a given confidence level.

A separate calculation for systematic uncertainty, including the variation between duplicate samples, labware differences, and physical measurements, was made and added to the statistical counting LLD to obtain the minimum analytical detection limit or MDC for the entire process. Volumetric measurement of sample flow rates, calibration standard uncertainties, and pipetting device accuracy were some of the factors included in this calculation. The overall result is the average Minimum Detectable Concentration (at the 95 percent confidence level) for each type of sample treated in a uniform manner. For most sample analyses, there is little or no significant difference between the LLD and the MDC.

TABLE 5-1
MINIMUM DETECTABLE CONCENTRATIONS FOR ROUTINE SAMPLES

Measurement	Medium	Sample Size	MDC
gross alpha	water	1 L	8.1 E-10 µCi/mL
gross beta	water	1 L	7.7 E-10 µCi/mL
Cs-137	water	250 mL	2.1 E-08 µCi/mL
H-3	water	5 mL	1.0 E-07µCi/mL
Sr-90	water	1 L	1.6 E-09 µCi/mL
gross alpha	air	400 m3	1.1 E-15 µCi/mL
gross beta	air	400 m3	1.9 E-06 µCi/mL
Cs-137	air	400 m3	1.4 E-14 µCi/mL
gross alpha	soil	150 mg	5.5 E-06 µCi/g
gross beta	soil	150 mg	5.3 E-06 µCi/g
Cs-137	soil	350 g	6.3 E-08 µCi/g

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APPENDIX A
1987 EFFLUENT, ON-SITE, AND OFF-SITE MONITORING PROGRAM

1987 EFFLUENT, ON-SITE, AND OFF-SITE MONITORING PROGRAM

The following schedule represents the WVDP routine Environmental Monitoring Program which was developed for and implemented in 1987. The current schedule as modified provides the basis for the 1988 calendar year program. A summary of changes implemented in 1987 is provided on page A-4 and the changes are marked in the schedule with a heavy vertical line. Except for those sample locations noted as not yet activated, this schedule is the minimum program needed to meet the requirements of DOE Order 5484.1, Chapter III. Specific methods and recommended monitoring program elements are referenced in DOE/EP-0096 (Effluent Monitoring) and DOE/EP-0023 (Environmental Surveillance), and are the bases for selecting most of the schedule specifics. Additional monitoring is mandated by Operational Safety Requirements (OSRs) and air and water discharge permits (40 CFR 61 and SPDES), which also require formal report generation. These specific cases are identified in the schedule under Monitoring/Reporting Requirements. Samples designated as "shared with NYSDOH" are collected in replicate or duplicate to support the New York State Department of Health monitoring program where it overlaps or interfaces with the WVDP program.

Locations of the sampling points are shown on Figures A-1 through A-5 included at the end of this appendix.

Sample Location and I.D. Code - The physical location where the sample is collected is described. The I.D. is a seven-character code which identifies the sample media as Air, Water, Soil/Sediment, Biological, or Direct Measurement, On- or Off-site, and the specific location (e.g., AFGRVAL is Air Off-site at Great Valley).

Monitoring/Reporting Requirements - The basis for monitoring that location and any additional references to permits or Operational Safety Requirements are noted.

Sampling Type/Medium - Describes collection method, and the physical characteristics of the media.

Collection Frequency - Sample collection frequency.

Total Annual Samples - Discrete physical samples collected annually, not including composites of collected samples.

Analysis Performed/Composite Frequency - Describes the individual analyses on the samples or composites of samples, and the frequency analysis.

SUMMARY OF MONITORING PROGRAM CHANGES IMPLEMENTED IN 1987

The following is a summary of the significant environmental monitoring program modifications which were implemented in 1987. Some of the changes reflect readjustments due to plant process improvements and new facilities, and others are a result of program evaluation and long-term planning. The description and results of most of the on-site monitoring are not included in the scope of this report, but the following summary schedule is provided for information.

Location I.D.	Description of Changes Implemented
AFDNKRK	Placed in operation
AFBOEHN	Placed in operation
BFFCATD	Collected part of semi-annual samples from creek portion downstream of Gowanda
DFTLD Series	Added drum cell and inner facility monitoring points and Dunkirk location
ANCSRFK	Added new effluent monitoring point for contact size reduction facility ventilation
ANSUPCV	Added supercompactor effluent monitoring point (intermittent)
ANSTSTK	Added supernatant treatment system ventilation monitoring system
WNDCELD	Added drum cell drainage sampling point in south Frank's Creek
WNSP001	Added C-14 to routine analysis, changed composite from quarterly to monthly
WNSP006	Added C-14, Pu/U, and Am-241 to quarterly composite, changed collection to weekly
Onsite Groundwater	Added Total Organic Halogen (TOH)
WNNDADR	Changed scheduled analyses to monthly
WNSP003	Added sampling location
Deer Collection	Increased samples from 2 to 6
DFTLD	Added background and onsite locations

1987 EFFLUENT AND ON-SITE MONITORING PROGRAM

SAMPLE LOCATION AND I.D. CODE	MONITORING/REPORTING REQUIREMENTS	SAMPLING TYPE/MEDIUM	COLLECTION FREQUENCY	TOTAL ANNUAL SAMPLES	ANALYSES PERFORMED/ COMPOSITE FREQUENCY
Main Plant Ventilation Exhaust Stack **ANSTACK**	Airborne radioactive effluent point including LWTS and Vitrification Off-Gas	Continuous off-line air particulate monitor	Continuous measurement of fixed filter, replaced weekly	104	Real time alpha and beta monitoring
	Required by: OSR M.11.5.2.4.B OSR M.11.5.2.1.B 40 CFR 61 Reported: Monthly Environmental Monitoring Trend Analysis Annual Effluent and Onsite Discharge Report Annual Environmental Monitoring Report Air Emissions Annual Report	Continuous off-line air particulate and iodine sampler Continuous off-line tritium (as water vapor) sampler	Weekly collection of filter paper, charcoal absorber, and desiccant	156	Filters for gross alpha/ beta, gamma isotopic and H-3 weekly Quarterly composites: filters for Sr-90, Pu/U isotopic, Am-241, gamma isotopic; charcoal for I-129
Supernatant Treatment System (STS) Ventilation Exhaust **ANSTSTK**	Same as for ANSTACK				

1987 EFFLUENT AND ON-SITE MONITORING PROGRAM

SAMPLE LOCATION AND I.D. CODE	MONITORING/REPORTING REQUIREMENTS	SAMPLING TYPE/MEDIUM	COLLECTION FREQUENCY	TOTAL ANNUAL SAMPLES	ANALYSES PERFORMED/ COMPOSITE FREQUENCY
Supercompactor Exhaust **ANSUPCV**	Airborne radioactive effluent point Required by: OSR M.11.5.2.4.B OSR M.11.5.2.1.B 40 CFR 61 Reported: Annual Effluent and Onsite Discharge Report Air Emissions Annual Report	Continuous off-line air particulate monitor during operation (maximum of 26 operating weeks expected)	Continuous measurement of fixed filter, collected and replaced every seven operating days, or at least monthly when unit is operated	26	Real time beta monitoring Filters for gross alpha/ beta, gamma isotopic upon collection Quarterly composites: filters for Sr-90, Pu/U isotopic, Am-241, gamma isotopic
Analytical Lab Ventilation System Exhaust **ANANLBV** (Operation not probable in 1988, enhanced monitoring may be indicated during startup evaluations)	Same as ANSUPCV				

SAMPLE LOCATION AND I.D. CODE	MONITORING/REPORTING REQUIREMENTS	SAMPLING TYPE/MEDIUM	COLLECTION FREQUENCY	TOTAL ANNUAL SAMPLES	ANALYSES PERFORMED/ COMPOSITE FREQUENCY
Cement Solidification System (CSS) Ventilation Exhaust **ANCSSTK**	Airborne radioactive effluent point Required by: OSR M.11.5.2.1.B OSR M.11.5.2.4.B 40 CFR 61 Reported: Monthly Environmental Monitoring Trend Analysis Annual Effluent and Onsite Discharge Report Annual Environmental Monitoring Report Air Emissions Annual Report	Continuous off-line air particulate monitor	Continuous measurement of fixed filter, replaced weekly	104	Real time alpha and beta monitoring
		Continuous off-line air particulate and iodine sampler	Weekly collection of filter paper and charcoal absorber	104	Filters for gross alpha/ beta, gamma isotopic weekly Quarterly composites: filters for Sr-90, Pu/U isotopic, Am-241, gamma isotopic; charcoal for I-129
Contact Size Reduction Facility Exhaust **ANCSRFK**	Same as for ANCSSTK				
Vitrification Cell Ventilation Exhaust **ANCTSTK** (Operation not planned for 1988)	Same as for ANCSSTK				

1987 EFFLUENT AND ON-SITE MONITORING PROGRAM

SAMPLE LOCATION AND I.D. CODE	MONITORING/REPORTING REQUIREMENTS	SAMPLING TYPE/MEDIUM	COLLECTION FREQUENCY	TOTAL ANNUAL SAMPLES	ANALYSES PERFORMED/ COMPOSITE FREQUENCY
Lagoon 3 Discharge Weir WNSP001	Primary point of liquid effluent batch release Required by: OSR M.11.5.2.5.B SPDES Permit Reported: Monthly SPDES DMR Annual Effluent and Onsite Discharge Report	Grab Liquid	Daily, during Lagoon 3 discharge	40-80	Daily: gross beta, conductivity, pH. Every sixth daily sample: gross alpha/beta, H-3, Sr-90, gamma isotopic. Weighted monthly composite of daily samples: gross alpha/beta, H-3, C-14, Sr-90, I-129, gamma isotopic, Pu/U isotopic, Am-241
	Annual Environmental Monitoring Report	Composite Liquid	Twice during discharge, near start, and near end	8-10	Two 24 hour composites for Al, NH_3, As, BOD-5, Fe, Zn, pH, suspended solids;
		Grab Liquid	Twice during discharge, same as composite	8-10	Settleable solids, pH, cyanide, oil and grease
		Composite Liquid	Annually	1	Annually, a 24 hour composite for: Cd, Cr, Cu, Pb, Ni, Se

1987 EFFLUENT AND ON-SITE MONITORING PROGRAM

SAMPLE LOCATION AND I.D. CODE	MONITORING/REPORTING REQUIREMENTS	SAMPLING TYPE/MEDIUM	COLLECTION FREQUENCY	TOTAL ANNUAL SAMPLES	ANALYSES PERFORMED/ COMPOSITE FREQUENCY
Erdman Brook at Security Fence WNSP006*	Combined facility liquid discharge Required by: OSR M.11.5.2.5.B Reported: Monthly Environmental Monitoring Trend Analysis Annual Environmental Monitoring Report	Continuous proportional sample liquid	Weekly	52	Gross alpha/beta, H-3, pH, conductivity, Quarterly composite: gamma isotopic, C-14, Sr-90, I-129, Pu/U isotopic, Am-241
Sanitary Waste Discharge WNSP007	Liquid effluent point for sanitary and utility plant combined discharge Required by: SPDES Permit	24 hr composite liquid	3/month	132	Gross alpha/beta, pH, H-3, settleable solids, suspended solids, NH_3, BOD-5, Fe
	Reported: Monthly SPDES DMR Monthly Environmental Monitoring Trend Analysis Annual Effluent and Onsite Discharge Report Annual Environmental Monitoring Report	Grab	Annually	1	Chloroform

*Samples to be split (shared with NYSDOH)

1987 EFFLUENT AND ON-SITE MONITORING PROGRAM

SAMPLE LOCATION AND I.D. CODE	MONITORING/REPORTING REQUIREMENTS	SAMPLING TYPE/MEDIUM	COLLECTION FREQUENCY	TOTAL ANNUAL SAMPLES	ANALYSES PERFORMED/ COMPOSITE FREQUENCY
N.E. Swamp Drainage WNSWAMP*	Site surface drainage	Grab liquid	Monthly	24	Gross alpha/beta, H-3, pH
	Reported:				
North Swamp Drainage WNSW74A	Annual Effluent and Onsite Discharge Report				
French Drain WNSP008	Drains subsurface water from LLWT lagoon area	Grab liquid	3/month	36	pH, conductivity, BOD-5, Fe
	Reported:				
	Monthly SPDES DMR		Monthly	12	Gross alpha/beta, H-3
	Annual Effluent and Onsite Discharge Report		Annually	1	Ag, Zn

*Samples to be split with NYSDOH

1987 EFFLUENT AND ON-SITE MONITORING PROGRAM

SAMPLE LOCATION AND I.D. CODE	MONITORING/REPORTING REQUIREMENTS	SAMPLING TYPE/MEDIUM	COLLECTION FREQUENCY	TOTAL ANNUAL SAMPLES	ANALYSES PERFORMED/ COMPOSITE FREQUENCY
On-site ground-water HLW Tank GW Monitoring Unit - Wells: WNW 80-2 86-7 86-8 86-9 86-12* Surface: WNDMPNE* Lagoon GW Monitoring Unit - Wells: WNW 86-6 86-3 86-4 86-5 80-5 80-6 Surface: WNGSEEP WNSP008 NDA GW Monitoring Unit - 83-1D 86-10 86-11 82-1D	Groundwater monitoring wells around site waste management units Reported: Annual Environmental Monitoring Report	Grab liquid	Semiannual	144	Gross alpha/beta, H-3, gamma isotopic, pH conductivity, chloride, sulfate, phenols, nitrate, TOC, TOH, As, Ba, Cd, Cr, Fe, Pb, Mn, Hg, Se, Ag, Na

*Serves former Cold Dump

1987 EFFLUENT AND ON-SITE MONITORING PROGRAM

SAMPLE LOCATION AND I.D. CODE	MONITORING/REPORTING REQUIREMENTS	SAMPLING TYPE/MEDIUM	COLLECTION FREQUENCY	TOTAL ANNUAL SAMPLES	ANALYSES PERFORMED/ COMPOSITE FREQUENCY
On-site groundwater Facility/Plant Area Wells: WNW 80-3 80-4	Groundwater monitoring wells around site facilities Reported: Annual Environmental Monitoring Report	Grab liquid	Semiannual	88	Gross alpha/beta, H-3, gamma isotopic, pH conductivity
NDA Area Wells: WNW 82-1A 82-1B 82-1C 82-2B 82-2C 82-3A 82-4A1 82-4A2 82-4A3					
Gas Tank Subsurface Monitoring Well: WNW 86-13				4	Gross alpha/beta, H-3, gamma isotopic, pH, conductivity, phenols, TOC, benzene, toluene, xylene

1987 EFFLUENT AND ON-SITE MONITORING PROGRAM

SAMPLE LOCATION AND I.D. CODE	MONITORING/REPORTING REQUIREMENTS	SAMPLING TYPE/MEDIUM	COLLECTION FREQUENCY	TOTAL ANNUAL SAMPLES	ANALYSES PERFORMED/ COMPOSITE FREQUENCY
Franks Creek E of SDA **WNFRC67***	Drains NYS Low-Level Waste Disposal Area Reported: Internal review NYSERDA	Grab liquid	Monthly	12	Gross alpha/beta, H-3, pH
Erdman Brook N of Disposal Areas **WNERB53***	Drains NYS and WVDP disposal areas Reported: Internal Review NYSERDA	Grab liquid	Weekly	52	Gross alpha/beta, H-3, pH
Ditch N of WVDP NDA & SDA **WNNDADR**	Drains WVDP disposal and storage area Reported: Internal Review	Composite continuous liquid	Weekly	104	Monthly gross alpha/beta composite - gamma isotopic, H-3, pH, quarterly composite: Sr-90, I-129
Drainage S of Drum Cell **WNDCELD**	Same as WNNDADR, except sample collection is weekly grab				

*Samples to be split (shared with NYSDOH), WNFRC67 collected weekly.

1987 EFFLUENT AND ON-SITE MONITORING PROGRAM

SAMPLE LOCATION AND I.D. CODE	MONITORING/REPORTING REQUIREMENTS	SAMPLING TYPE/MEDIUM	COLLECTION FREQUENCY	TOTAL ANNUAL SAMPLES	ANALYSES PERFORMED/ COMPOSITE FREQUENCY
On-site Standing Water (ponds not receiving effluent)* Test Pit N of HLW Area **WNSTAW1** Slough SW of RTS Drum Cell **WNSTAW2** Pond SE of Heinz Road **WNSTAW3** Border Pond S of AFRT240 **WNSTAW4** Border Pond SW of DFTLD13 **WNSTAW5** Borrow Pit NE of Project Facilities **WNSTAW6** Pond SW of Project Facilities W of Rock Springs Road **WNSTAW7** Slough N of Quarry Creek **WNSTAW8** North Reservoir Near Intake **WNSTAW9** Background Pond at Sprague Brook Maintenance Building **WNSTAWB**	Water within vicinity of plant airborne or ground water effluent <u>Reported</u>: Internal Review	Grab liquid	Annually	7-10	Gross alpha/beta, H-3, pH, conductivity, chloride, Fe, Mn, Na, phenols, sulfate

*Number of points sampled will depend upon on-site ponding conditions during the year.

1987 EFFLUENT AND ON-SITE MONITORING PROGRAM

SAMPLE LOCATION AND I.D. CODE	MONITORING/REPORTING REQUIREMENTS	SAMPLING TYPE/MEDIUM	COLLECTION FREQUENCY	TOTAL ANNUAL SAMPLES	ANALYSES PERFORMED/ COMPOSITE FREQUENCY
Condensate and Cooling Water Ditch WNSP005	Combined drainage from facility yard area Reported: Internal Review	Grab liquid	Monthly	12	Gross alpha/beta, H-3, pH
Cooling Tower Basin WNCOOLW	Cools plant utility steam system water Reported: Internal Review	Grab liquid	Monthly	12	Gross alpha/beta, H-3, pH
Site potable water WNDRNKW	Source of water within site perimeter	Grab liquid	Monthly	12	Gross alpha/beta, H-3, pH, conductivity
	Reported Internal Review		Annually	2	Toxic metals, pesticides chemical pollutants
SDA Holding Lagoon WNSP003	State disposal area holding lagoon Reported: Annual Environmental Monitoring Report NYSERDA	Grab liquid	Annually (as required)	1	Gross alpha/beta, H-3, C-14, pH, gamma isotopic, Sr-90, I-129, Pu/U isotopic

1987 OFF-SITE MONITORING PROGRAM

SAMPLE LOCATION AND I.D. CODE	MONITORING/REPORTING REQUIREMENTS	SAMPLING TYPE/MEDIUM	COLLECTION FREQUENCY	TOTAL ANNUAL SAMPLES	ANALYSES PERFORMED/ COMPOSITE FREQUENCY
Cattaraugus Creek at Felton Bridge **WFFELBR***	Unrestricted surface waters receiving plant effluents Reported: Monthly Environmental Monitoring Trend Analysis Annual Environmental Monitoring Report	Flow weighted continuous liquid	Weekly	52	Weekly for gross alpha/beta, H-3, pH; Monthly composite for gamma isotopic and Sr-90
Buttermilk Creek, Upstream of Cattaraugus Creek Confluence at Thomas Corners Road **WFBCTCB**	Restricted surface waters receiving plant effluents Reported: Annual Environmental Monitoring Report	Composite continuous liquid	Biweekly	26	Monthly for gross alpha/beta, H-3, pH; Quarterly composite for gamma isotopic and Sr-90
Buttermilk Creek near Fox Valley **WFBCBKG**	Restricted surface water background Reported: Monthly Environmental Monitoring Trend Analysis Annual Environmental Monitoring Report	Composite continuous liquid	Biweekly	26	Monthly for gross alpha/beta, H-3; Quarterly composite for gamma isotopic and Sr-90

*Samples to be split (shared with NYSDOH)

1987 OFF-SITE MONITORING PROGRAM

SAMPLE LOCATION AND I.D. CODE	MONITORING/REPORTING REQUIREMENTS	SAMPLING TYPE/MEDIUM	COLLECTION FREQUENCY	TOTAL ANNUAL SAMPLES	ANALYSES PERFORMED/ COMPOSITE FREQUENCY
Wells near WVDP outside WNYNSC Perimeter 3.0 km WNW WFWEL01 1.5 km NW WFWEL02 4.0 km NW WFWEL03 3.0 km NW WFWEL04 2.5 km SW WFWEL06 4.0 km NNE WFWEL07 2.5 km ENE WFWEL08 3.0 km SE WFWEL09 7.0 km N WFWEL10	Drinking supply ground water near facility Reported: Annual Environmental Monitoring Report	Grab liquid	Biennially	6 (5 + Background well each year of collection)	Gross alpha/beta, H-3, gamma isotopic, pH, conductivity

1987 OFF-SITE MONITORING PROGRAM

SAMPLE LOCATION AND I.D. CODE	MONITORING/REPORTING REQUIREMENTS	SAMPLING TYPE/MEDIUM	COLLECTION FREQUENCY	TOTAL ANNUAL SAMPLES	ANALYSES PERFORMED/ COMPOSITE FREQUENCY
3.0 km SSE at Fox Valley **AFFXVRD**	Particulate air samples around WNYNSC perimeter Required by: DOE 5484.1 Reported: Annual Environmental Report Monthly Environmental Monitoring Trend Analysis*	Continuous air particulate Continuous H-3, charcoal**	Weekly	660	Weekly (each filter) gross alpha/beta, H-3 (on 3 stations) Quarterly: (Each station) composite filters for Sr-90, gamma isotopic; I-129 (on 3 stations)
3.7 km NNW at Thomas Corners Road **AFTCORD**					
2.0 km NE on Route 240 **AFRT240*,** **					
1.5 km NW on Rock Springs Road **AFRSPRD** **					
29 km S at Great Valley (background) **AFGRVAL** **					
7 km at Springville **AFSPRVL**					
6 km SSE at West Valley **AFWEVAL**					
50 km W at Dunkirk (background, added in 1987) **AFDNKRK**					
2.3 km SW on Boberg Road (added in 1987) **AFBOEHN** **					

Note: AFRT240 is co-located with NYSDOH air sampler.

1987 OFF-SITE MONITORING PROGRAM

SAMPLE LOCATION AND I.D. CODE	MONITORING/REPORTING REQUIREMENTS	SAMPLING TYPE/MEDIUM	COLLECTION FREQUENCY	TOTAL ANNUAL SAMPLES	ANALYSES PERFORMED/ COMPOSITE FREQUENCY
2.5 km SW **AFDHFOP** 3.0 km SSE **AFFXFOP** 3.7 km NNW **AFTCFOP** 2.0 km NE **AF24FOP**	Collection of fallout particulate and precipitation around WNYNSC perimeter Reported: Annual Environmental Report	Integrating liquid	Monthly	48	Gross alpha/beta, H-3, pH
Surface soil (at each of nine air samplers plus 26 km SSW at Little Valley) **SFSOL-Series**	Long-term fallout accumulation Reported: Annual Environmental Monitoring Report	Surface plug composite soil	Triennially	10 (year of collection)	Gamma isotopic, Sr-90, Pu-239, Am-241
Buttermilk Creek at Thomas Corners Road **SFTCSED**** Buttermilk Creek at Fox Valley Road (background) **SFBCSED***,** Cattaraugus Creek at Springville Dam **SFSDSED*** Cattaraugus Creek at Bigelow Bridge (background **SFBISED**	Deposition in sediment downstream of facility effluents Reported: Annual Environmental Monitoring Report	Grab stream sediment	Semiannually Annually**	10 2	Gross alpha/beta, isotopic gamma and Sr-90 U/Pu isotopic, Am-241

*Samples to be split (shared with NYSDOH) **Analysis on one of two semiannual collections

1987 OFF-SITE MONITORING PROGRAM

SAMPLE LOCATION AND I.D. CODE	MONITORING/REPORTING REQUIREMENTS	SAMPLING TYPE/MEDIUM	COLLECTION FREQUENCY	TOTAL ANNUAL SAMPLES	ANALYSES PERFORMED/ COMPOSITE FREQUENCY
Cattaraugus Creek downstream of the Buttermilk Creek confluence **BFFCATC*** Cattaraugus Creek downstream of Springville Dam **BFFCATD*** Control Sample from nearby stream not affected by WVDP (7 km or more upstream of site effluent point) **BFFCTRL***	Fish in waters downstream of facility effluents Reported: Annual Environmental Monitoring Report	Individual collection, biological	Semiannually	6 (each sample is 10 fish)	Isotopic gamma and Sr-90 in edible portions of each individual fish.
Dairy Farm, 3.8* km NNW **BFMREED** Dairy Farm, 1.9 km WNW **BFMCOBO** Dairy Farm SE of site **BFMWIDR** Dairy Farm 2.5 km SSW **BFMHAUR** Control location 25 km S **BFMCTLS** Control location, 30 km N **BFMCTLN**	Milk from animals foraging around facility perimeter Reported: Annual Environmental Monitoring Report	Grab biological	Monthly (BFMREED, BFMCOBO, BFMCTLS, BFMCTLN) Annual (BFMWIDR, BFMHAUR)	48 2	Gamma isotopic, Sr-90, H-3 and I-129 on annual samples and quarterly composites of monthly samples

*Replicate samples to be collected (shared with NYSDOH)

1987 OFF-SITE MONITORING PROGRAM

SAMPLE LOCATION AND I.D. CODE	MONITORING/REPORTING REQUIREMENTS	SAMPLING TYPE/MEDIUM	COLLECTION FREQUENCY	TOTAL ANNUAL SAMPLES	ANALYSES PERFORMED/ COMPOSITE FREQUENCY
(3) Nearby locations **BFVNEAR***	Fruit and vegetables grown near facility perimeter downwind if possible	Grab biological	Annually,* at harvest	6	Gamma isotopic and Sr-90 analysis of edible portions, H-3 in free moisture
(3) Remote locations (16 km or more from facility) **BFVCTRL***	Reported: Annual Environmental Monitoring Report				
Beef cattle forage from near site location N **BFHNEAR**		Grab biological	Annually	2	Gamma isotopic, Sr-90
Milk cow forage from control south location or north location **BFHCTLS** or **BFHCTLN**					
Beef animal from nearby farm in downwind direction **BFBNEAR**	Meat-Beef foraging near facility perimeter, downwind if possible	Grab biological	Semiannually*	4	Gamma isotopic and Sr-90 analysis of meat
Beef animal from control location (16 km or more from facility) **BFBCTRL**	Reported: Annual Environmental Monitoring Report				
In vicinity of the site (3) **BFDNEAR**	Meat-Deer foraging near facility perimeter	Individual collection biological	Annually, during hunting season*	3	Gamma isotopic and Sr-90 analysis of meat
Control animals (3) (16 km or more from facility) **BFDCTRL**	Reported: Annual Environmental Monitoring Report		During year as available*	3	

*Samples to be split (shared with NYSDOH)

1987 OFF-SITE MONITORING PROGRAM

SAMPLE LOCATION AND I.D. CODE	MONITORING/REPORTING REQUIREMENTS	SAMPLING TYPE/MEDIUM	COLLECTION FREQUENCY	TOTAL ANNUAL SAMPLES	ANALYSES PERFORMED/ COMPOSITE FREQUENCY
DFTLD Series Thermoluminescent Dosimetry (TLD) (16) at each of 16 compass sectors, at nearest accessible perimeter point (3) at corners of SDA (11) at security fence around site (3) On-site near operational areas (DNTLD) Rock Springs Road 500 m NNW of plant 1500 m NW (nearest downwind receptor) "5 Points" landfill, 19 km SW (background) Great Valley, 29 km S (background) Springville 7 km N West Valley 5 km SSE Dunkirk, 50 km W (background)	Direct radiaiton around facility Reported: Annual Environmental Monitoring Report	Integrating LiF TLD	Quarterly	160	Quarterly gamma radiation exposure

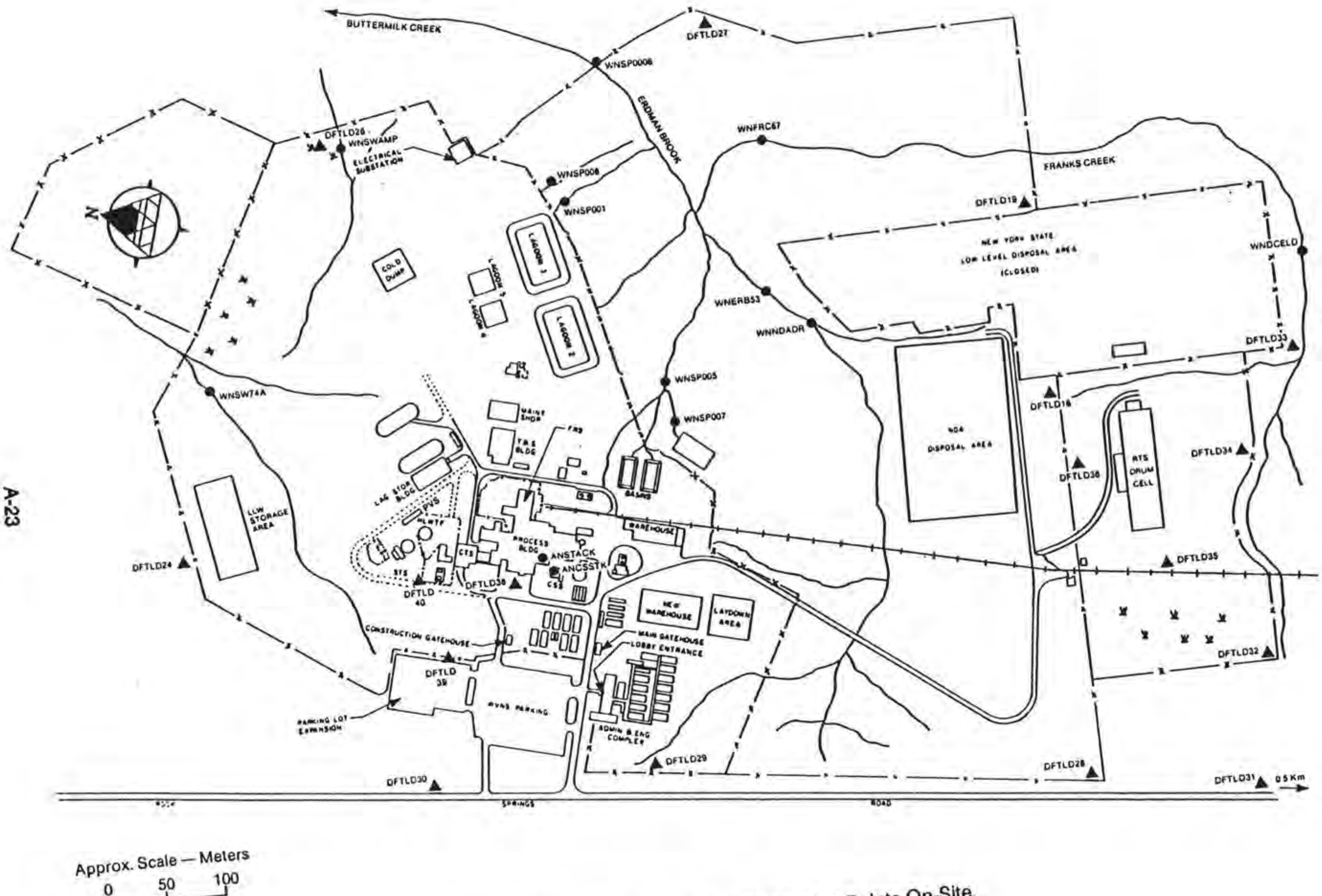


Figure A-1. Location of Radiological Monitoring Points On-Site.

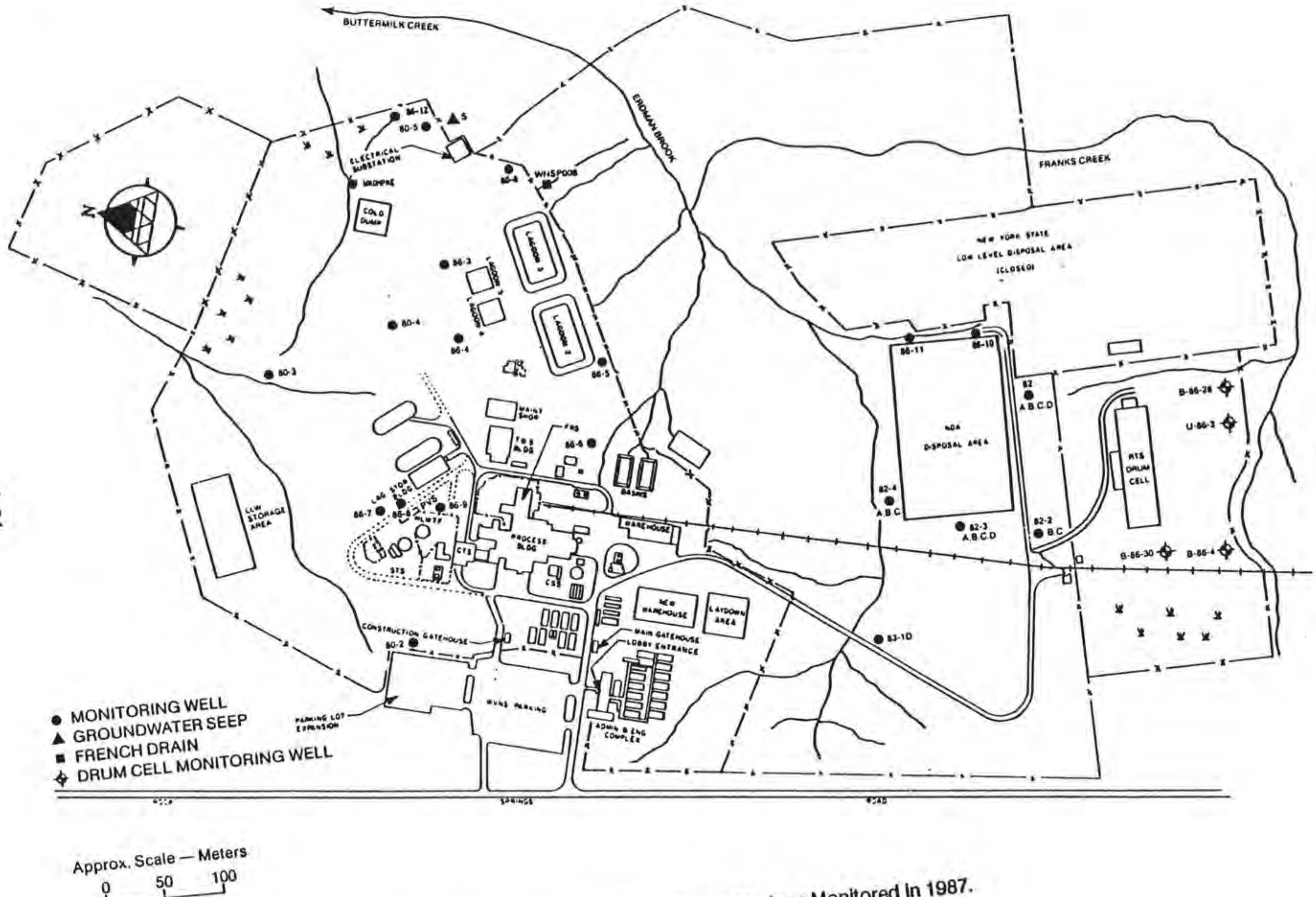


Figure A-2. Location of Groundwater Stations Monitored in 1987.

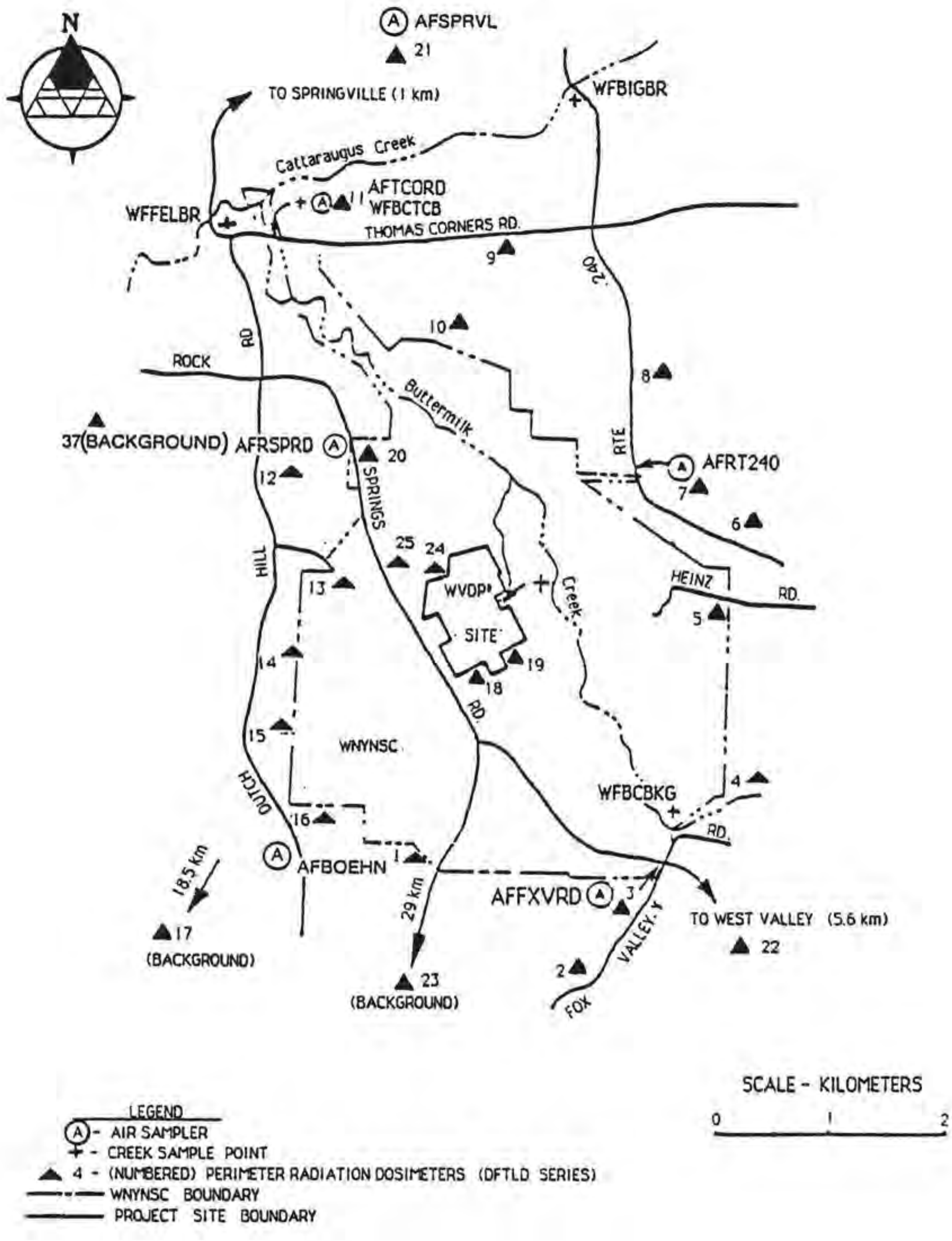


Figure A-3. Locations of Perimeter Environmental Monitoring Stations.

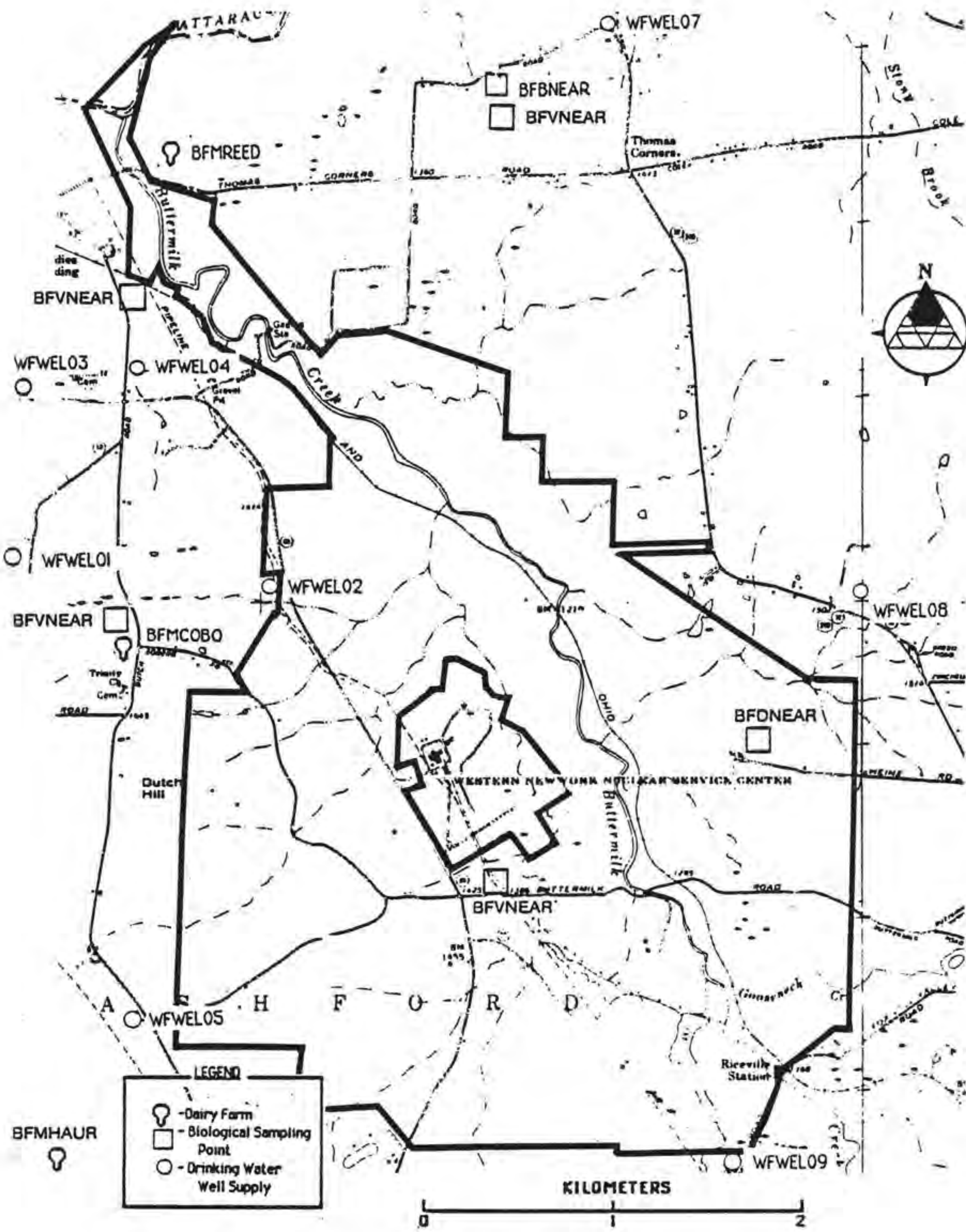
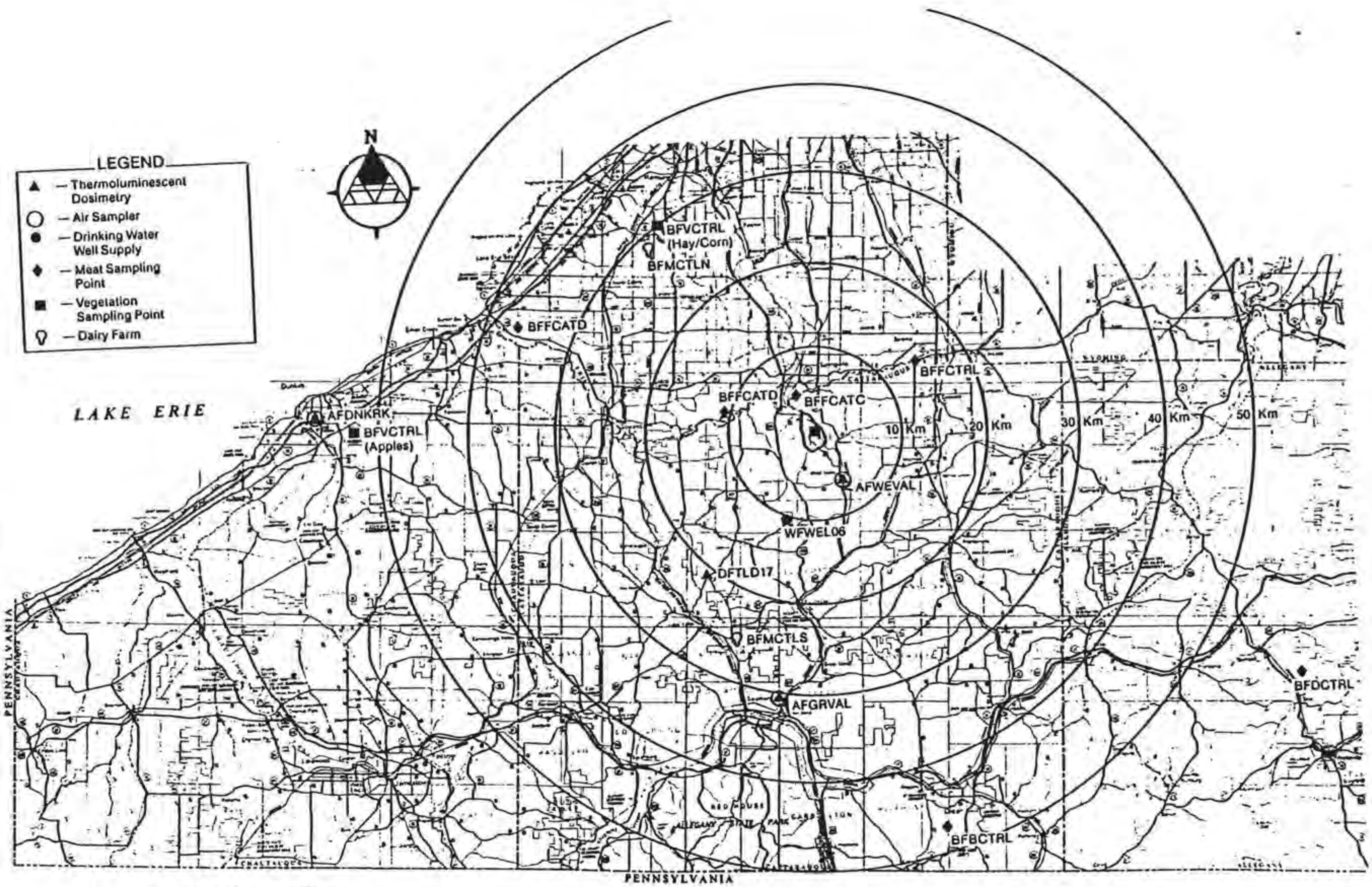


Figure A-4. Near-site Drinking Water and Biological Points - 1987.



REF: NYSDOT, New York State Map — West Sheet, 1:250,000, Revised 1982

0 5 10 15 20 25K

Figure A-5. Environmental Sampling Points More than 5 km from WVDP Site.

APPENDIX B
DEPARTMENT OF ENERGY RADIATION PROTECTION STANDARDS AND CONCENTRATION GUIDES

DEPARTMENT OF ENERGY RADIATION PROTECTION STANDARDS AND CONCENTRATION GUIDES

Annual Effective Dose Equivalent Radiation Standards for Protection of the Public*

Continuous Exposure of Any Member of the Public	100 mrem/yr (1 mSv/yr)
Occasional Annual Exposure (less than 5 years duration)	500 mrem/yr (5 mSv/yr)

DOE Derived Concentration Guides (DCG) for Drinking Water and Inhaled Air
(μCi/mL)

Radionuclide	In Air	In Water	Radionuclide	In Air	In Water
H-3	1 E-07	2 E-03	Eu-152	5 E-11	2 E-05
C-14	6 E-09	7 E-05	Eu-154	5 E-11	2 E-05
Fe-55	5 E-09	2 E-04	Eu-155	3 E-10	1 E-04
Co-60	8 E-11	5 E-06	Th-232	7 E-15	5 E-08
Ni-63	2 E-09	3 E-04	U-233	9 E-14	5 E-07
Sr-90	9 E-12	1 E-06	U-234	9 E-14	5 E-07
Zr-93	4 E-11	9 E-05	U-235	1 E-13	6 E-07
Nb-93m	4 E-10	3 E-04	U-236	1 E-13	5 E-07
Tc-99	2 E-09	1-E-04	U-238	1 E-13	6 E-07
Ru-106	3 E-11	6 E-06	Np-239	5 E-09	5 E-05
Rh-106m	6 E-08	2 E-04	Pu-238	3 E-14	4 E-08
Sb-125	1E-09	5 E-05	Pu-239	2 E-14	3 E-08
Te-125m	2 E-09	4 E-05	Pu-240	2 E-14	3 E-08
I-129	7 E-11	5 E-07	Pu-241	1 E-12	2 E-06
Cs-134	2 E-10	2 E-06	Am-241	2 E-14	3 E-08
Cs-135	3 E-09	2 E-05	Am-243	2 E-14	3 E-08
Cs-137	4 E-10	3 E-06	Cm-243	3 E-14	5 E-08
Pm-147	3 E-10	1 E-04	Cm-244	4 E-14	6 E-08
Sm-151	4 E-10	4 E-04	Gross Alpha (as Am-241)	2 E-14	3 E-08
			Gross Beta (as Ra-228)	3 E-12	1 E-07

* As transmitted by memorandum from John C. Tseng, Acting Director, Office of Environmental Guidance and Compliance, U.S. Department of Energy, dated November 4, 1987.

APPENDIX D
SUMMARY OF QUALITY ASSURANCE CROSS-CHECK ANALYSES

TABLE D-1.1

COMPARISON OF RADIOLOGICAL CONCENTRATIONS IN QUALITY ASSURANCE SAMPLES BETWEEN WVDP AND EML FOR QAP 8705 SAMPLES

Sample	Isotope	Actual	Reported	Ratio Rep/Act	Accept
air	Be-7	4.64E+03	3.75E+03	0.81	yes
air	Mn-54	4.55E+02	4.02E+02	0.88	yes
air	Co-60	4.44E+02	3.93E+02	0.89	yes
air	Sr-90	9.55E+00	8.94E+00	0.94	yes
air	Cs-137	4.70E+02	4.09E+02	0.87	yes
air	Pu-239	5.68E+00	5.23E+00	0.92	yes
air	Am-241	4.41E+00	4.46E+00	1.01	yes
air	U-234	2.39E+00	2.45E+00	1.03	yes
air	U-238	2.39E+00	2.44E+00	1.02	yes
air	U-ug	6.92E+00	7.30E+00	1.05	yes
soil	K-40	1.05E+00	1.06E+00	1.01	yes
soil	Sr-90	1.84E-01	1.75E-01	0.95	yes
soil	Cs-137	4.80E-01	5.15E-01	1.07	yes
soil	Ra-226	7.90E-01	4.76E-01	0.60	pass
soil	Pu-239	1.88E+00	1.74E+00	0.93	yes
tissue	K-40	6.08E-01	0.00E+00	0.00	below det.
tissue	Sr-90	2.87E+00	2.68E+00	0.93	yes
tissue	Cs-137	4.20E-02	0.00E+00	0.00	below det.
tissue	Ra-226	4.00E-01	2.32E-01	0.58	pass
tissue	U-234	1.00E-02	1.37E-02	1.37	pass
tissue	U-238	1.00E-02	1.40E-02	1.40	pass
tissue	U-ug	3.00E-02	4.30E-02	1.43	pass
vegetn	K-40	3.17E+01	2.44E+01	0.77	pass
vegetn	Co-60	2.14E+00	1.68E+00	0.79	pass
vegetn	Sr-90	2.06E+01	2.23E+01	1.08	yes
vegetn	Cs-137	1.45E+01	1.22E+01	0.84	yes
vegetn	Pu-239	1.17E-01	1.16E-01	0.99	yes
vegetn	Am-241	4.00E-02	5.84E-02	1.46	pass
water	H-3	3.37E+01	2.82E+01	0.84	yes
water	Mn-54	4.72E+00	5.28E+00	1.12	yes
water	Co-60	4.59E+00	4.90E+00	1.07	yes
water	Sr-90	1.33E+00	1.25E+00	0.94	yes
water	Cs-137	2.34E+00	2.56E+00	1.09	yes
water	Pu-239	1.37E-01	7.51E-02	0.55	pass
water	Am-241	1.31E-01	1.31E-01	1.00	yes
water	U-234	7.10E-02	7.12E-02	1.00	yes
water	U-238	7.10E-02	6.81E-02	0.96	yes
water	U-ug	2.06E-01	2.14E-01	1.04	yes

Ratio: 1.2 - 0.8 acceptable; 1.5 - 0.5 pass

TABLE D-1.2

COMPARISON OF RADIOLOGICAL CONCENTRATIONS IN QUALITY ASSURANCE SAMPLES BETWEEN WVDP AND EML FOR QAP 8709 SAMPLES

Sample	Isotope	Actual	Reported	Ratio Rep/Act	Accept
air	Be-7	1.91E+01	1.42E+01	0.74	pass
air	Zr-95	1.88E+02	1.62E+02	0.86	yes
air	Sr-89	3.83E+01	3.20E+01	0.84	yes
air	Sr-90	3.69E+01	3.52E+01	0.95	yes
air	Ru-106	2.51E+02	1.46E+02	0.58	pass
air	Sb-125	9.63E+02	6.82E+02	0.71	pass
air	Cs-137	2.90E+02	2.70E+02	0.93	yes
air	Ce-144	4.06E+02	3.54E+02	0.87	yes
air	Pu-239	5.23E+00	5.77E+00	1.10	yes
air	Am-241	5.18E+00	5.65E+00	1.09	yes
air	U-234	1.70E+00	2.14E+00	1.26	pass
air	U-238	1.71E+00	2.00E+00	1.17	yes
air	U-pCi	4.94E+00	6.00E+00	1.21	pass
soil	K-40	2.00E+01	2.23E+01	1.12	yes
soil	Sr-90	1.27E+01	1.19E+01	0.94	yes
soil	Cs-137	2.11E-01	1.87E-01	0.89	yes
soil	Ra-226	6.36E-01	5.48E-01	0.86	yes
soil	Pu-239	2.90E-02	3.67E-02	1.27	pass
soil	U-234	1.24E+00	1.22E+00	0.98	yes
soil	U-238	1.20E+00	1.30E+00	1.08	yes
soil	U-pCi	2.44E+00	3.89E+00	1.59	no
tissue	K-40	2.68E+00	2.09E+00	0.78	pass
tissue	Sr-90	1.29E+01	1.23E+01	0.95	yes
tissue	Cs-137	1.90E-01	1.71E-01	0.90	yes
tissue	Ra-226	3.50E-01	2.85E-01	0.81	yes
vegetn	K-40	1.63E+02	1.73E+02	1.06	yes
vegetn	Sr-90	1.50E+01	1.34E+01	0.89	yes
vegetn	Cs-137	1.82E+00	1.88E+00	1.03	yes
vegetn	Ra-226	2.40E-01	1.97E-01	0.82	yes
vegetn	Pu-239	1.80E-02	1.95E-02	1.08	yes
vegetn	U-234	8.00E-02	6.67E-02	0.83	yes
vegetn	U-238	9.00E-02	6.69E-02	0.74	pass
vegetn	U-pCi	1.70E-01	2.01E-01	1.18	yes
water	H-3	1.91E+01	1.42E+01	0.74	pass
water	Mn-54	2.28E+00	2.24E+00	0.98	yes
water	Fe-55	1.48E+00	1.12E+00	0.76	pass
water	Co-57	1.42E-01	1.44E-01	1.01	yes
water	Co-60	2.27E+00	2.20E+00	0.97	yes
water	Sr-90	2.52E-01	2.31E-01	0.92	yes
water	Cs-137	2.28E+00	2.24E+00	0.98	yes
water	Pu-239	2.26E-01	2.09E-01	0.92	yes
water	Am-241	1.40E-01	1.60E-01	1.14	yes
water	U-234	5.40E-02	3.89E-02	0.72	pass
water	U-238	5.40E-02	4.12E-02	0.76	pass
water	U-pCi	1.08E-01	1.23E-01	1.14	yes

Ratio: 1.2 - 0.8 acceptable; 1.5 - 0.5 pass

TABLE D-1.3

COMPARISON OF RADIOLOGICAL CONCENTRATIONS IN QUALITY ASSURANCE SAMPLES BETWEEN WVDP AND INEL FOR 1987 INEL QA SAMPLES

Sample	INEL QA 20 Isotope	Gamma in Water Actual	Reported	Ratio WV/INEL	Accept
water	Ce-141	3.76E-03	3.70E-03	0.98	yes
water	Cr-51	6.64E-02	5.96E-02	0.90	no
water	Cs-137	1.32E-02	1.34E-02	1.02	yes
water	Co-58	8.82E-03	8.10E-03	0.92	no
water	Mn-54	3.53E-03	3.08E-03	0.87	no
water	Fe-59	8.60E-03	8.60E-03	1.00	yes
water	Zn-65	1.31E-02	1.29E-02	0.98	yes
water	Co-60	4.81E-03	5.08E-03	1.06	no

Sample	INEL QA 21 Isotope	Gamma in Charcoal Actual	Reported	Ratio WV/INEL	Accept
cartridge	Ba-133	5.63E-02	5.80E-02	1.03	yes
cartridge	Cs-137	6.66E-03	1.38E-02	2.07	no
cartridge	Co-58	3.10E-03	5.20E-03	1.68	no
cartridge	Mn-54	1.59E-03	3.00E-03	1.89	no
cartridge	Zn-65	5.96E-03	1.20E-02	2.01	no
cartridge	Co-60	2.44E-03	5.36E-03	2.20	no

Note: Acceptable ratio range is 1.00 ± 0.05.

TABLE D-1.4

COMPARISON OF WATER QUALITY PARAMETERS IN

QUALITY ASSURANCE SAMPLES BETWEEN WVDP AND NYSDOH, JANUARY 1987

Sample	Analyte	Actual	Reported	Ratio Rep/Act	Accept
water	Ag	49.5	52.0	1.05	yes
water	Ag	247.6	224.0	0.90	pass
water	Al	158.4	156.0	0.98	yes
water	Al	453.7	476.0	1.05	yes
water	As	80.4	88.0	1.09	yes
water	As	318.3	338.0	1.06	yes
water	BOD-5	39.7	40.5	1.02	yes
water	BOD-5	74.3	79.3	1.07	yes
water	CN	1.0	1.2	1.24	yes
water	CN	2.3	2.6	1.13	yes
water	Fe	103.2	104.0	1.01	yes
water	Fe	273.3	277.0	1.01	yes
water	NH-3(as N)	1.6	1.5	0.96	yes
water	NH-3(as N)	3.9	3.9	0.99	yes
water	Ni	99.5	96.0	0.96	yes
water	Ni	451.0	470.0	1.04	yes
water	Oil&Grease	23.8	23.9	1.00	yes
water	Oil&Grease	90.5	84.6	0.93	yes
water	Pb	121.2	128.0	1.06	yes
water	Pb	402.3	409.0	1.02	yes
water	pH	4.5	4.5	1.00	yes
water	pH	7.4	7.4	1.00	yes
water	Sus Solids	72.8	72.4	0.99	yes
water	Sus Solids	40.2	40.5	1.01	yes
water	Se	152.6	144.0	0.94	yes
water	Se	308.9	303.0	0.98	yes
water	Zn	495.8	495.0	1.00	yes
water	Zn	1984.2	2000.0	1.01	yes

Note: Acceptable range determined by NYSDOH

TABLE D-1.5

COMPARISON OF WATER QUALITY PARAMETERS

IN QUALITY ASSURANCE SAMPLES BETWEEN WVDP AND NYSDOH, JUNE 1987

Sample	Analyte	Actual	Reported	Ratio Rep/Act	Accept
water	Ag	102.3	119.0	1.16	no
water	Ag	307.7	344.0	1.12	pass
water	Al	120.4	140.0	1.16	yes
water	Al	357.7	411.0	1.15	yes
water	Cd	39.2	43.8	1.12	yes
water	Cd	97.3	102.0	1.05	yes
water	BOD-5	35.7	36.8	1.03	yes
water	BOD-5	60.3	62.5	1.04	yes
water	CN	1.0	1.0	1.07	yes
water	CN	1.7	1.6	0.96	yes
water	Cr	105.2	158.0	1.50	no
water	Cr	264.3	311.0	1.18	no
water	Cu	107.4	120.0	1.12	yes
water	Cu	480.1	530.0	1.10	pass
water	Fe	81.2	87.5	1.08	yes
water	Fe	394.9	436.0	1.10	yes
water	NH-3(as N)	1.0	1.0	1.01	yes
water	NH-3(as N)	3.0	3.0	0.99	yes
water	Ni	150.8	172.0	1.14	pass
water	Ni	405.4	464.0	1.14	no
water	Oil&Grease	32.8	27.6	0.84	yes
water	Oil&Grease	113.1	98.0	0.87	yes
water	Pb	154.6	165.0	1.07	yes
water	Pb	307.7	342.0	1.11	yes
water	pH	8.0	8.0	1.00	yes
water	pH	4.0	4.0	1.00	yes
water	Sus Solids	28.7	28.9	1.01	yes
water	Sus Solids	77.4	74.7	0.96	yes
water	Se	82.0	104.0	1.27	pass
water	Se	201.2	231.0	1.15	yes
water	Zn	759.8	820.0	1.08	yes
water	Zn	3056.4	3200.0	1.05	yes

Note: Acceptable range determined by NYSDOH

TABLE D-1.6

COMPARISON OF WATER QUALITY PARAMETERS

IN QUALITY ASSURANCE SAMPLES BETWEEN WVDP AND USEPA, JULY 1987

Sample	Analyte	Actual	Reported	Ratio Rep/Act	Accept
water	Al	220.0	209.0	0.95	yes
water	As	150.0	140.0	0.93	yes
water	Cd	55.0	50.0	0.91	yes
water	Cr	514.0	540.0	1.05	yes
water	Cu	953.0	960.0	1.01	yes
water	Fe	1096.0	1070.0	0.98	yes
water	Pb	685.0	715.0	1.04	yes
water	Ni	762.0	780.0	1.02	yes
water	Se	20.0	9.0	0.45	no
water	Zn	1059.0	1080.0	1.02	yes
water	pH	5.2	5.2	0.99	yes
water	Sus Solids	80.9	65.6	0.81	yes
water	Oil&Grease	8.0	7.3	0.91	yes
water	NH-3(as N)	12.5	12.0	0.96	yes
water	NO-3(as N)	4.0	3.6	0.89	yes
water	TOC	21.5	20.0	0.93	yes
water	BOD-5	35.0	39.7	1.13	yes
water	CN	0.1	0.1	0.86	yes

Note: Acceptable range determined by USEPA

TABLE D-1.7

COMPARISON OF WVDP TO USNRC CO-LOCATED

ENVIRONMENTAL TLD DOSIMETERS 1ST HALF OF 1987

FIRST QTR TLDs 1987

NRC TLD #	WVDP TLD #	µR/hr NRC	µR/hr WVDP	WV/NRC	Accept
2	22	8.2	7.3	0.89	yes
3	5	7.8	7.6	0.97	yes
4	7	7.4	6.8	0.92	yes
5	9	9.0	7.1	0.79	pass
7	14	8.9	8.1	0.91	yes
8	15	8.7	8.1	0.93	yes
9	25	19.0	16.7	0.88	yes
11	24	747.7	882.2	1.18	yes

SECOND QTR TLDs 1987

NRC TLD #	WVDP TLD #	µR/hr NRC	µR/hr WVDP	WV/NRC	Accept
2	22	8.2	9.6	1.18	yes
3	5	10.0	10.4	1.04	yes
4	7	8.1	11.4	1.41	pass
5	9	10.0	9.5	0.95	yes
7	14	8.7	10.9	1.25	pass
8	15	8.6	10.2	1.19	yes
9	25	22.5	19.9	0.89	yes
11	24	451.4	817.3	1.81	no

Ratio: 1.2 - 0.8 acceptable; 1.5 - 0.5 pass

APPENDIX C-1
SUMMARY OF WATER AND SEDIMENT MONITORING DATA

TABLE C-1.1.1

TOTAL RADIOACTIVITY OF LIQUID EFFLUENTS RELEASED
FROM WVDP LAGOON 3 IN 1987
(CURIES)

	ALPHA	BETA	H-3	Sr-90	I-129	Cs-137
1ST QTR	< 2.4 E-04	6.46 ± 1.5 E-03	1.30 ± 0.1 E-01	9.21 ± 0.7 E-04	1.30 ± 0.2 E-04	6.52 ± 1.2 E-03
2ND QTR	< 2.2 E-04	6.55 ± 1.3 E-03	1.18 ± 0.1 E-01	5.32 ± 0.5 E-04	4.92 ± 1.3 E-05	6.02 ± 1.4 E-03
3RD QTR	< 2.8 E-04	2.01 ± 0.3 E-02	3.48 ± 0.1 E-01	1.90 ± 0.1 E-03	1.52 ± 0.1 E-04	2.06 ± 0.2 E-02
4TH QTR			***NO RELEASE THIS PERIOD***			
1987 TOTALS	< 4.3 E-04	3.31 ± 0.4 E-02	5.96 ± 0.2 E-01	3.35 ± 0.1 E-03	3.31 ± 0.3 E-04	3.31 ± 0.3 E-02
AVERAGE CONCENTRATION (µCi/mL)	1.20 E-08	9.25 E-07	1.67 E-05	9.36 E-08	9.25 E-09	9.25 E-07

	U-234	U-235	U-238	Pu-238	Pu-239	Am-241
1ST QTR	1.56 ± 0.2 E-04	4.62 ± 1.6 E-06	7.61 ± 0.9 E-05	1.41 ± 1.4 E-07	1.02 ± 0.4 E-06	1.55 ± 0.4 E-06
2ND QTR	5.14 ± 1.4 E-05	< 1.2 E-06	2.43 ± 0.8 E-05	2.30 ± 2.3 E-07	< 3.0 E-07	4.41 ± 2.9 E-07
3RD QTR	2.99 ± 0.8 E-04	5.42 ± 4.1 E-06	1.18 ± 0.3 E-04	1.59 ± 1.2 E-06	2.39 ± 1.6 E-06	1.77 ± 0.8 E-06
4TH QTR			***NO RELEASE THIS PERIOD***			
1987 TOTALS	5.06 ± 0.8 E-04	1.07 ± 0.5 E-05	2.18 ± 0.3 E-04	1.96 ± 1.2 E-06	3.49 ± 1.7 E-06	3.76 ± 1.1 E-06
AVERAGE CONCENTRATION (µCi/mL)	1.41 E-08	2.99 E-10	6.09 E-09	5.48 E-11	9.75 E-11	1.05 E-10

TABLE C-1.1.2

COMPARISON OF 1987 LAGOON 3 LIQUID EFFLUENT RADIOACTIVITY CONCENTRATIONS WITH DOE GUIDELINES

ISOTOPE	TOTAL µCi RELEASED	AVG CONC (µCi/mL)	DCG (µCi/mL)	PERCENT OF DCG
Alpha	<4.3 E+02	1.20 E-08	3.0 E-08[a]	40
Beta	3.31 E+04	9.25 E-07	1.0 E-06[b]	93
H-3	5.96 E+05	1.67 E-05	2.0 E-03	0.8
Sr-90	3.35 E+03	9.36 E-08	1.0 E-06	9.4
I-129	3.31 E+02	9.25 E-09	5.0 E-07	1.9
Cs-137	3.31 E+04	9.25 E-07	3.0 E-06	30.8
U-234[c]	5.06 E+02	1.41 E-08	5.0 E-07	2.8
U-235[c]	1.07 E+01	2.99 E-10	6.0 E-07	<0.1
U-238[c]	2.18 E+02	6.09 E-09	6.0 E-07	1.0
Pu-238	1.96 E+00	5.48 E-11	4.0 E-08	0.1
Pu-239	3.49 E+00	9.75 E-11	3.0 E-08	0.3
Am-241	3.76 E+00	1.05 E-10	3.0 E-08	0.4
Total				47.6[d]

Notes:

Total Volume Released = 3.58 E+10 mL, measured at actual on-site release point.

[a] Am-241
[b] Sr-90
[c] Total U(µgm) = 6.56 E+08 Avg U(mg/L) = 1.83 E-02
[d] Total percent DCG for specific measured radionuclides

TABLE C-1.2

RADIOACTIVITY CONCENTRATIONS IN SURFACE WATER
UPSTREAM OF WVDP AT FOX VALLEY (WFBCBKG)
(μCi/mL)

1987	ALPHA	BETA	H-3	SR-90	CS-137
JAN	< 6.0 E-10	2.01 ± 1.0 E-09	< 1.0 E-07		
FEB	< 4.5 E-10	4.76 ± 1.4 E-09	1.74 ± 1.0 E-07		
MAR	< 6.5 E-10	2.75 ± 1.2 E-09	< 1.0 E-07		
1ST QTR				3.86 ± 2.5 E-09	5.52 ± 4.7 E-08
APR	< 8.5 E-10	4.55 ± 1.3 E-09	3.19 ± 1.2 E-07		
MAY	< 3.4 E-10	< 2.7 E-09	1.00 ± 1.0 E-07		
JUN	< 1.4 E-09	5.67 ± 1.3 E-09	< 1.0 E-07		
2ND QTR				4.06 ± 2.0 E-09	< 2.1 E-08
JUL	1.46 ± 1.2 E-09	4.17 ± 1.2 E-09	< 1.0 E-07		
AUG	< 9.3 E-10	3.39 ± 2.1 E-09	< 1.0 E-07		
SEP	< 6.8 E-10	5.02 ± 1.3 E-09	< 1.0 E-07		
3RD QTR				5.73 ± 2.6 E-09	< 2.1 E-08
OCT	< 3.6 E-10	4.02 ± 1.2 E-09	< 1.0 E-07		
NOV	< 6.1 E-10	1.51 ± 1.0 E-09	< 1.0 E-07		
DEC	< 6.9 E-10	2.45 ± 1.2 E-09	1.02 ± 1.0 E-07		
4TH QTR				< 1.5 E-09	< 2.1 E-08

TABLE C-1.3

RADIOACTIVITY CONCENTRATIONS IN SURFACE WATER
DOWNSTREAM OF WVDP AT THOMAS CORNERS (WFBCTCB)
(μCi/mL)

1987	ALPHA	BETA	H-3	SR-90	CS-137
JAN	< 5.9 E-10	4.01 ± 1.3 E-09	< 1.0 E-07		
FEB	< 1.0 E-09	6.81 ± 1.7 E-09	3.11 ± 1.2 E-07		
MAR	< 1.4 E-09	7.09 ± 1.7 E-09	< 1.0 E-07		
1ST QTR				3.99 ± 2.2 E-09	< 2.1 E-08
APR	< 7.2 E-10	5.42 ± 1.4 E-09	< 1.0 E-07		
MAY	< 6.5 E-10	1.87 ± 1.3 E-09	2.80 ± 1.3 E-07		
JUN	< 1.6 E-09	7.68 ± 1.6 E-09	< 1.0 E-07		
2ND QTR				4.50 ± 1.9 E-09	< 2.1 E-08
JUL	1.21 ± 1.2 E-09	7.56 ± 1.6 E-09	< 1.0 E-07		
AUG	1.61 ± 1.4 E-09	6.21 ± 1.5 E-09	< 1.0 E-07		
SEP	1.88 ± 1.5 E-09	8.54 ± 1.7 E-09	< 1.0 E-07		
3RD QTR				5.77 ± 2.2 E-09	< 2.1 E-08
OCT	< 1.1 E-09	5.74 ± 1.4 E-09	< 1.0 E-07		
NOV	< 1.1 E-09	5.23 ± 1.4 E-09	< 1.0 E-07		
DEC	< 9.8 E-10	3.24 ± 1.3 E-09	< 1.0 E-07		
4TH QTR				6.85 ± 2.2 E-09	4.43± 3.6 E-08

TABLE C-1.4

RADIOACTIVITY CONCENTRATIONS IN SURFACE WATER
DOWNSTREAM OF WVDP AT FRANKS CREEK (WNSP006)
(µCi/mL)

1987	ALPHA	BETA	H-3	SR-90	CS-137
JAN	< 6.2 E-10	1.69 ± 0.2 E-08	1.13 ± 1.0 E-07		
FEB	< 4.2 E-09	1.04 ± 0.1 E-07	4.73 ± 0.4 E-06		
MAR	2.63 ± 2.6 E-09	5.48 ± 0.5 E-08	9.53 ± 1.6 E-07		
1ST QTR				2.78 ± 0.4 E-08	1.96 ± 0.7 E-07
APR	< 1.1 E-09	2.34 ± 0.3 E-08	7.67 ± 1.5 E-07		
MAY	< 1.0 E-09	3.29 ± 0.4 E-08	2.45 ± 0.3 E-06		
JUN	3.52 ± 3.0 E-09	6.32 ± 0.6 E-08	< 1.0 E-07		
2ND QTR				1.61 ± 0.3 E-08	1.62 ± 0.4 E-07
JUL	< 2.1 E-09	4.86 ± 0.5 E-08	9.86 ± 1.6 E-07		
AUG	< 3.4 E-09	4.67 ± 0.4 E-08	1.50 ± 0.1 E-06		
SEP	< 4.2 E-09	7.67 ± 0.7 E-08	2.24 ± 0.3 E-06		
3RD QTR				3.48 ± 0.6 E-08	3.98 ± 0.7 E-07
OCT	< 1.5 E-09	3.11 ± 0.4 E-08	< 1.0 E-07		
NOV	< 9.2 E-10	1.86 ± 0.2 E-08	< 1.1 E-07		
DEC	< 7.3 E-10	1.29 ± 0.2 E-08	3.21 ± 1.2 E-07		
4TH QTR				8.15 ± 2.6 E-09	< 2.1 E-08

TABLE C-1.5

RADIOACTIVITY CONCENTRATIONS IN SURFACE WATER
DOWNSTREAM OF BUTTERMILK CREEK AT FELTON BRIDGE (WFFELBR)
(μCi/mL)

1987	ALPHA	BETA	H-3	SR-90	CS-137
JAN	< 1.1 E-09	3.76 ± 1.4 E-09	1.29 ± 1.0 E-07	5.09 ± 1.1 E-09	< 2.1 E-08
FEB	< 1.2 E-09	3.25 ± 1.3 E-09	< 1.0 E-07	8.95 ± 3.4 E-09	< 2.1 E-08
MAR	< 6.1 E-10	4.33 ± 1.5 E-09	< 1.0 E-07	7.35 ± 2.3 E-09	< 2.1 E-08
APR	< 5.9 E-10	5.23 ± 1.4 E-09	< 1.0 E-07	5.37 ± 2.1 E-09	< 2.1 E-08
MAY	< 1.1 E-09	3.29 ± 1.2 E-09	< 1.0 E-07	3.60 ± 1.7 E-09	< 2.1 E-08
JUN	< 7.6 E-10	3.11 ± 1.1 E-09	< 1.0 E-07	3.38 ± 1.9 E-09	< 2.1 E-08
JUL	9.27 ± 8.9 E-10	5.71 ± 1.3 E-09	< 1.0 E-07	7.00 ± 2.2 E-09	< 2.1 E-08
AUG	< 8.7 E-10	7.42 ± 1.6 E-09	< 1.0 E-07	4.00 ± 1.6 E-09	< 2.1 E-08
SEP	< 5.1 E-10	6.62 ± 1.5 E-09	< 1.0 E-07	6.86 ± 2.3 E-09	< 2.1 E-08
OCT	< 7.1 E-10	7.34 ± 1.6 E-09	< 1.0 E-07	7.70 ± 2.5 E-09	< 2.1 E-08
NOV	< 6.3 E-10	2.20 ± 1.2 E-09	< 1.0 E-07	2.50 ± 1.8 E-09	< 2.1 E-08
DEC	< 9.9 E-10	2.43 ± 1.2 E-09	< 1.0 E-07	< 1.5 E-09	< 2.1 E-08

TABLE C-1.6
RADIOACTIVITY CONCENTRATIONS IN POTABLE WELL WATER
AROUND THE WVDP SITE - 1987
(μCi/mL)

Sample I.D.	Alpha	Beta	Tritium	Cs-137
WFWEL 02	< 6.9 E-10	1.40 ± 1.0 E-09	4.00 ± 1.1 E-07	< 2.1 E-08
WFWEL 05	< 6.6 E-10	3.10 ± 1.2 E-09	< 1.0 E-07	< 2.1 E-08
WFWEL 06	< 4.9 E-10	< 9.2 E-10	< 1.0 E-07	< 2.1 E-08
WFWEL 08	< 7.1 E-10	1.91 ± 1.1 E-09	< 1.0 E-07	< 2.1 E-08
WFWEL 09	< 1.1 E-09	1.33 ± 1.0 E-09	< 1.0 E-07	< 2.1 E-08
WFWEL 10	< 1.5 E-09	1.46 ± 1.0 E-09	< 1.0 E-07	< 2.1 E-08

TABLE C-1.7
RADIOACTIVITY CONCENTRATIONS IN STREAM SEDIMENT AROUND WVDP SITE IN 1987
(μCi/mL, dry weight from upper 15 cm)

Location	Date	Gross Alpha	Gross Beta	K-40	Sr-90	Cs-137
SFBCSED	June 1987	8.7 ± 5.5 E-06	1.51 ± 0.7 E-05	1.28 ± 0.1 E-05	< 5.3 E-08	< 7.4 E-08
SFSDSED	June 1987	< 9.0 E-06	3.00 ± 0.8 E-05	1.39 ± 0.1 E-05	< 2.0 E-07	5.23 ± 0.6 E-07
SFTCSED	June 1987	< 1.7 E-05	2.58 ± 0.9 E-05	1.62 ± 0.1 E-05	< 5.0 E-08	2.71 ± 0.1 E-06
SFCCSED	June 1987	6.7 ± 5.6 E-06	1.60 ± 0.8 E-05	1.38 ± 0.1 E-05	< 4.1 E-08	6.10 ± 1.0 E-07
SFBISED	June 1987	< 4.1 E-06	1.93 ± 0.8 E-05	1.34 ± 0.1 E-05	< 2.0 E-07	< 6.5 E-08
SFBCSED	Nov. 1987	< 5.6 E-06	2.14 ± 0.7 E-05	1.49 ± 0.1 E-05	1.02 ± 0.2 E-07	7.56 ± 4.0 E-08
SFSDSED	Nov. 1987	7.7 ± 6.0 E-06	3.37 ± 0.9 E-05	1.60 ± 0.1 E-05	< 1.2 E-07	4.92 ± 0.7 E-07
SFTCSED	Nov. 1987	5.4 ± 3.5 E-06	1.90 ± 0.7 E-05	1.57 ± 0.1 E-05	2.29 ± 0.4 E-07	2.59 ± 0.1 E-06
SFCCSED	Nov. 1987	3.6 ± 2.9 E-06	1.60 ± 0.8 E-05	1.48 ± 0.1 E-05	< 8.0 E-08	4.56 ± 0.8 E-07
SFBISED	Nov. 1987	3.6 ± 3.6 E-06	3.16 ± 0.9 E-05	1.36 ± 0.1 E-05	< 1.7 E-07	< 3.4 E-08

Location	Date	U-234	U-235	U-238	Pu-238	Pu-239	Am-241
SFBCSED	Nov. 1987	6.89 ± 0.7 E-07	3.59 ± 0.9 E-08	6.91 ± 0.7 E-07	3.39 ± 2.5 E-09	3.81 ± 3.4 E-09	6.24 ± 1.4 E-09
SFTCSED	Nov. 1987	5.56 ± 0.5 E-07	2.87 ± 0.7 E-08	6.14 ± 0.6 E-07	< 5.9 E-10	3.55 ± 2.4 E-09	3.92 ± 3.0 E-09

TABLE C-1.8

1987 CONTRIBUTION BY NEW YORK STATE LOW-LEVEL WASTE DISPOSAL AREA TO RADIOACTIVITY IN WVDP LIQUID EFFLUENTS (Ci)

	Gross Alpha	Gross Beta	Tritium	Sr-90	I-129	Cs-137
1987 Totals	< 8.8 E-07	6.58 ± 0.1 E-04	6.40 ± 0.2 E-02	4.68 ± 0.1 E-04	1.31 ± 0.6 E-06	< 7.7 E-06

	U-234	U-235	U-238	Pu-238	Pu-239
1987 Totals	2.18 ± 0.3 E-07	1.16 ± 0.6 E-08	1.97 ± 0.2 E-07	1.80 ± 0.2 E-07	4.90 ± 4.1 E-09

APPENDIX C-2
SUMMARY OF AIR MONITORING DATA

TABLE C-2.1.1

1987 AIRBORNE RADIOACTIVE EFFLUENT ACTIVITY MONTHLY TOTALS
FROM MAIN VENTILATION STACK (ANSTACK)
(CURIES)

MONTH	ALPHA	BETA	TRITIUM (H-3)
JAN	2.00 ± 0.8 E-07	5.19 ± 0.3 E-05	2.94 ± 0.3 E-02
FEB	4.09 ± 1.0 E-07	4.00 ± 0.2 E-05	3.12 ± 0.3 E-02
MAR	4.12 ± 1.0 E-07	3.19 ± 0.2 E-05	9.45 ± 0.9 E-02
APR	2.08 ± 0.7 E-07	1.52 ± 0.2 E-05	3.71 ± 0.3 E-02
MAY	2.32 ± 0.9 E-07	4.35 ± 0.3 E-05	4.09 ± 0.3 E-02
JUN	2.58 ± 0.8 E-07	2.56 ± 0.2 E-05	2.01 ± 0.2 E-02
JUL	1.66 ± 0.6 E-07	3.28 ± 0.2 E-05	3.14 ± 0.3 E-02
AUG	1.69 ± 0.2 E-06	8.73 ± 0.5 E-05	3.06 ± 0.3 E-02
SEP	1.70 ± 0.2 E-06	7.84 ± 0.5 E-05	2.51 ± 0.3 E-02
OCT	7.22 ± 1.4 E-07	6.60 ± 0.3 E-05	1.78 ± 0.2 E-02
NOV	3.69 ± 1.1 E-07	5.65 ± 0.3 E-05	2.81 ± 0.3 E-02
DEC	2.83 ± 0.9 E-07	1.36 ± 0.2 E-05	2.75 ± 0.3 E-02
TOTAL FOR 1987	6.65 ± 0.4 E-06	5.43 ± 0.1 E-04	4.14 ± 0.1 E-01

TABLE C-2.1.2

1987 AIRBORNE RADIOACTIVE EFFLUENT ACTIVITY QUARTERLY TOTALS
FROM MAIN VENTILATION STACK (ANSTACK)
(CURIES)

	CO-60	SR-90	I-129	CS-134	CS-137	EU-154
1ST QTR	6.33 ± 1.1 E-07	2.24 ± 0.3 E-05	5.97 ± 0.8 E-06	< 1.1 E-07	5.20 ± 0.05 E-05	2.57 ± 1.7 E-07
2ND QTR	2.35 ± 0.9 E-07	1.97 ± 0.2 E-05	9.89 ± 1.4 E-06	< 8.4 E-08	3.08 ± 0.04 E-05	< 2.7 E-07
3RD QTR	2.82 ± 0.6 E-07	5.23 ± 0.6 E-05	1.20 ± 0.2 E-05	1.12 ± 0.7 E-07	5.36 ± 0.04 E-05	4.67 ± 1.7 E-07
4TH QTR	1.55 ± 0.8 E-07	3.72 ± 0.4 E-05	1.50 ± 0.3 E-05	< 1.5 E-07	6.86 ± 0.07 E-05	3.08 ± 1.4 E-07
1987 TOTALS	1.31 ± 0.2 E-06	1.32 ± 0.1 E-04	4.29 ± 0.4 E-05	2.61 ± 2.2 E-07	2.05 ± 0.01 E-04	1.30 ± 0.4 E-06

	U-234	U-235	U-238	PU-238	PU-239	AM-241
1ST QTR	7.05 ± 1.9 E-09	9.88 ± 7.4 E-10	6.21 ± 1.7 E-09	9.98 ± 1.0 E-08	2.33 ± 0.2 E-07	2.72 ± 0.2 E-07
2ND QTR	9.51 ± 1.7 E-09	9.26 ± 6.5 E-10	5.91 ± 1.3 E-09	7.51 ± 0.7 E-08	1.43 ± 0.1 E-07	1.72 ± 0.2 E-07
3RD QTR	8.37 ± 1.8 E-09	8.63 ± 8.5 E-10	6.86 ± 1.6 E-09	4.91 ± 0.4 E-07	5.35 ± 0.4 E-07	1.16 ± 0.1 E-06
4TH QTR	1.49 ± 0.3 E-08	<9.23 E-10	1.37 ± 0.3 E-08	2.02 ± 0.2 E-07	2.51 ± 0.2 E-07	6.02 ± 0.5 E-07
1987 TOTALS	3.98 ± 0.4 E-08	3.41 ± 1.6 E-09	3.27 ± 0.4 E-08	8.68 ± 0.5 E-07	1.16 ± 0.1 E-06	2.21 ± 0.1 E-06

TABLE C-2.1.3

COMPARISON OF 1987 MAIN STACK EXHAUST RADIOACTIVITY CONCENTRATIONS WITH DOE GUIDELINES

ISOTOPE	TOTAL µCi RELEASED	AVG CONC (µCi/mL)	DCG (µCi/mL)	PERCENT OF DCG
Alpha	6.65 E+00	7.4 E-15	2 E-14[a]	37
Beta	5.43 E+02	6.1 E-13	9 E-12[b]	6.8
H-3	4.14 E+05	4.6 E-10	1 E-07	0.4
Co-60	1.31 E+00	1.5 E-15	8 E-11	<0.1
Sr-90	1.32 E+02	1.5 E-13	9 E-12	1.7
I-129	4.29 E+01	4.8 E-14	7 E-11	<0.1
Cs-134	2.61 E-01	2.9 E-16	2 E-10	<0.1
Cs-137	2.05 E+02	2.3 E-13	4 E-10	<0.1
Eu-154	1.30 E+00	1.5 E-15	5 E-11	<0.1
U-234[c]	3.98 E-02	4.5 E-17	9 E-14	<0.1
U-235[c]	3.41 E-03	3.8 E-18	1 E-13	<0.1
U-238[c]	3.27 E-02	3.7 E-17	1 E-13	<0.1
Pu-238	8.68 E-01	9.7 E-16	3 E-14	3.2
Pu-239	1.16 E+00	1.3 E-15	2 E-14	6.5
Am-241	2.21 E+00	2.5 E-15	2 E-14	12.5

				24.6[d]

Notes:

Total volume released at 60,000 cfm = 8.93 E+14 mL/yr

[a] Am-241
[b] Sr-90
[c] U total (µg) = 9.888 E+4   Avg U $\mu g/m^3$ = 1.107 E-04
[d] Total percent DCG for specific measured radionuclides

TABLE C-2.1.4

1987 AIRBORNE RADIOACTIVE EFFLUENT ACTIVITY MONTHLY TOTALS
FROM CEMENT SOLIDIFICATION SYSTEM VENTILATION STACK (ANCSSTK)
(CURIES)

MONTH	ALPHA	BETA
JAN	< 7.8 E-09	1.64 ± 0.4 E-07
FEB	< 4.2 E-09	6.87 ± 2.4 E-08
MAR	< 5.4 E-09	1.43 ± 0.3 E-07
APR	< 5.0 E-09	1.09 ± 0.3 E-07
MAY	< 7.4 E-09	1.13 ± 0.3 E-07
JUN	< 4.8 E-09	4.42 ± 1.8 E-08
JUL	< 5.6 E-09	8.10 ± 2.2 E-08
AUG	< 6.8 E-09	1.43 ± 0.3 E-07
SEP	< 5.0 E-09	1.35 ± 0.3 E-07
OCT	< 7.1 E-09	6.86 ± 2.6 E-08
NOV	< 7.3 E-09	8.04 ± 2.7 E-08
DEC	< 7.8 E-09	< 1.9 E-08
TOTAL FOR 1987	< 2.2 E-08	1.16 ± 0.1 E-06

TABLE C-2.1.5

1987 AIRBORNE RADIOACTIVE EFFLUENT ACTIVITY QUARTERLY TOTALS
FROM CEMENT SOLIDIFICATION SYSTEM VENTILATION STACK (ANCSSTK)
(CURIES)

	CO-60	SR-90	I-129	CS-134	CS-137	EU-154
1ST QTR	1.90 ± 1.4 E-08	5.58 ± 0.7 E-07	9.49 ± 2.6 E-08	< 1.2 E-08	4.57 ± 0.3 E-07	< 3.8 E-08
2ND QTR	< 1.2 E-08	1.90 ± 0.2 E-07	< 1.9 E-08	< 1.1 E-08	2.14 ± 0.2 E-07	< 4.0 E-08
3RD QTR	< 1.4 E-08	1.48 ± 0.2 E-06	< 3.1 E-08	< 1.1 E-08	2.65 ± 0.1 E-06	< 4.5 E-08
4TH QTR	< 1.7 E-08	4.62 ± 0.8 E-08	< 1.7 E-08	< 1.2 E-08	< 2.3 E-08	< 5.5 E-08
1987 TOTALS	< 2.9 E-08	2.27 ± 0.2 E-06	9.49 ± 4.8 E-08	< 2.3 E-08	3.32 ± 0.1 E-06	< 9.0 E-08

	U-234	U-235	U-238	PU-238	PU-239	AM-241
1ST QTR	1.69 ± 0.5 E-09	< 6.7 E-11	1.35 ± 0.4 E-09	1.43 ± 0.3 E-09	2.21 ± 0.4 E-09	9.15 ± 1.1 E-09
2ND QTR	1.84 ± 0.4 E-09	< 1.4 E-10	1.80 ± 0.4 E-09	3.04 ± 1.8 E-10	6.07 ± 2.1 E-10	1.70 ± 0.5 E-09
3RD QTR	1.76 ± 0.4 E-09	2.29 ± 1.9 E-10	1.59 ± 0.4 E-09	4.40 ± 0.3 E-08	4.34 ± 0.3 E-08	8.65 ± 0.7 E-08
4TH QTR	1.65 ± 0.5 E-09	< 1.5 E-10	1.18 ± 0.4 E-09	3.90 ± 2.1 E-10	3.38 ± 2.1 E-10	5.00 ± 2.6 E-10
1987 TOTALS	6.94 ± 0.9 E-09	< 2.9 E-10	5.92 ± 0.8 E-09	4.61 ± 0.3 E-08	4.66 ± 0.3 E-08	9.79 ± 0.7 E-08

TABLE C-2.1.6

1987 AIRBORNE RADIOACTIVE EFFLUENT ACTIVITY MONTHLY TOTALS
FROM CONTACT SIZE REDUCTION FACILITY VENTILATION STACK (ANCSRFK)
(CURIES)

MONTH	ALPHA	BETA
JAN		
FEB	***NOT IN OPERATION***	
MAR		
APR		
MAY	***NOT IN OPERATION***	
JUN		
JUL		
AUG	***NOT IN OPERATION***	
SEP		
OCT	< 2.5 E-09	2.97 ± 0.9 E-08
NOV	< 3.2 E-09	3.75 ± 1.3 E-08
DEC	< 3.2 E-09	< 1.2 E-08
TOTAL FOR 1987	< 5.2 E-09	6.72 ± 2.0 E-08

TABLE C-2.1.7

1987 AIRBORNE RADIOACTIVE EFFLUENT ACTIVITY QUARTERLY TOTALS
FROM CONTACT SIZE REDUCTION FACILITY VENTILATION STACK (ANCSRFK)
(CURIES)

	CO-60	SR-90	I-129	CS-134	CS-137	EU-154
1ST QTR			***NOT IN OPERATION***			
2ND QTR			***NOT IN OPERATION***			
3RD QTR			***NOT IN OPERATION***			
4TH QTR	< 1.4 E-08	5.51 ± 1.0 E-09	1.70 ± 0.7 E-08	< 1.1 E-08	< 1.3 E-08	< 3.2 E-08
1987 TOTALS	< 1.4 E-08	5.51 ± 1.0 E-09	1.70 ± 0.7 E-08	< 1.1 E-08	< 1.3 E-08	< 3.2 E-08

	U-234	U-235	U-238	PU-238	PU-239	AM-241
1ST QTR			***NOT IN OPERATION***			
2ND QTR			***NOT IN OPERATION***			
3RD QTR			***NOT IN OPERATION***			
4TH QTR	1.36 ± 0.4 E-09	< 2.5 E-11	1.10 ± 0.3 E-09	1.69 ± 0.9 E-10	1.23 ± 0.7 E-10	1.14 ± 0.6 E-10
1987 TOTALS	1.36 ± 0.4 E-09	< 2.5 E-11	1.10 ± 0.3 E-09	1.69 ± 0.9 E-10	1.23 ± 0.7 E-10	1.14 ± 0.6 E-10

TABLE C-2.2.1
1987 RADIOACTIVITY CONCENTRATIONS IN AIRBORNE PARTICULATE
AT FOX VALLEY AIR SAMPLER (AFFXVRD)
µCi/mL

	ALPHA	BETA	SR-90	CS-137
JAN	< 9.1 E-16	2.82 ± 0.5 E-14		
FEB	< 1.1 E-15	1.68 ± 0.5 E-14		
MAR	1.25 ± 1.2 E-15	2.59 ± 0.5 E-14		
1ST QTR			9.42 ± 2.8 E-17	< 6.5 E-16
APR	< 1.0 E-15	1.43 ± 0.5 E-14		
MAY	< 9.7 E-16	1.27 ± 0.3 E-14		
JUNE	< 1.0 E-15	1.94 ± 0.5 E-14		
2ND QTR			4.61 ± 2.7 E-17	6.27 ± 3.3 E-16
JUL	< 1.0 E-15	1.85 ± 0.4 E-14		
AUG	< 8.9 E-16	2.27 ± 0.5 E-14		
SEP	< 8.0 E-16	1.93 ± 0.4 E-14		
3RD QTR			9.74 ± 4.6 E-17	< 4.6 E-16
OCT	< 9.0 E-16	2.30 ± 0.5 E-14		
NOV	< 9.3 E-16	2.07 ± 0.4 E-14		
DEC	< 9.1 E-16	1.40 ± 0.5 E-14		
4TH QTR			6.91 ± 2.3 E-17	< 2.7 E-16

TABLE C-2.2.2
1987 RADIOACTIVITY CONCENTRATIONS IN AIRBORNE PARTICULATE
AT ROCK SPRINGS ROAD AIR SAMPLER (AFRSPRD)
µCi/mL

	ALPHA	BETA	SR-90	I-129	CS-137
JAN	< 8.1 E-16	2.41 ± 0.5 E-14			
FEB	1.06 ± 1.0 E-15	1.84 ± 0.5 E-14			
MAR	< 9.9 E-16	2.37 ± 0.5 E-14			
1ST QTR			5.02 ± 2.5 E-17	< 6.8 E-16	< 6.1 E-16
APR	< 6.8 E-16	1.42 ± 0.4 E-14			
MAY	< 1.0 E-15	1.86 ± 0.4 E-14			
JUNE	1.04 ± 1.0 E-15	1.67 ± 0.4 E-14			
2ND QTR			< 2.4 E-17	< 5.9 E-16	< 5.8 E-16
JUL	< 8.4 E-16	2.16 ± 0.4 E-14			
AUG	< 6.6 E-16	1.83 ± 0.4 E-14			
SEP	< 8.4 E-16	2.02 ± 0.4 E-14			
3RD QTR			1.40 ± 0.2 E-16	< 6.8 E-16	< 4.0 E-16
OCT	< 1.0 E-15	2.65 ± 0.5 E-14			
NOV	< 1.1 E-15	2.39 ± 0.5 E-14			
DEC	< 8.2 E-16	1.79 ± 0.5 E-14			
4TH QTR			< 4.0 E-17	< 4.6 E-16	< 5.3 E-16

TABLE C-2.2.3
1987 RADIOACTIVITY CONCENTRATIONS IN AIRBORNE PARTICULATE
AT ROUTE 240 AIR SAMPLER (AFRT240)
µCi/mL

	ALPHA	BETA	SR-90	CS-137
JAN	< 1.6 E-15	3.07 ± 0.7 E-14		
FEB	< 1.2 E-15	2.05 ± 0.6 E-14		
MAR	< 1.2 E-15	3.44 ± 0.7 E-14		
1ST QTR			1.22 ± 0.9 E-16	< 6.4 E-16
APR	< 1.5 E-15	1.95 ± 0.6 E-14		
MAY	< 1.6 E-15	2.98 ± 0.6 E-14		
JUNE	< 1.5 E-15	2.30 ± 0.6 E-14		
2ND QTR			5.31 ± 4.0 E-17	< 8.4 E-16
JUL	< 9.6 E-16	2.12 ± 0.5 E-14		
AUG	1.43 ± 1.4 E-15	2.92 ± 0.6 E-14		
SEP	< 9.7 E-16	1.94 ± 0.5 E-14		
3RD QTR			4.39 ± 0.9 E-16	5.70 ± 5.0 E-16
OCT	1.0 ± 1.0 E-15	2.20 ± 0.5 E-14		
NOV	< 1.2 E-15	1.88 ± 0.5 E-14		
DEC	< 9.4 E-16	1.06 ± 0.3 E-14		
4TH QTR			< 8.3 E-17	< 6.9 E-16

TABLE C-2.2.4
1987 RADIOACTIVITY CONCENTRATIONS IN AIRBORNE PARTICULATE
AT SPRINGVILLE AIR SAMPLER (AFSPRVL)
µCi/mL

	ALPHA	BETA	SR-90	CS-137
JAN	< 8.8 E-16	2.62 ± 0.5 E-14		
FEB	< 9.0 E-16	1.97 ± 0.4 E-14		
MAR	1.09 ± 1.0 E-15	2.13 ± 0.5 E-14		
1ST QTR			6.20 ± 2.4 E-17	< 4.4 E-16
APR	< 8.0 E-16	1.59 ± 0.4 E-14		
MAY	< 1.0 E-15	2.15 ± 0.4 E-14		
JUNE	1.01 ± 1.0 E-15	1.95 ± 0.4 E-14		
2ND QTR			4.70 ± 2.1 E-17	< 3.5 E-16
JUL	< 8.3 E-16	2.03 ± 0.4 E-14		
AUG	< 9.2 E-16	2.05 ± 0.4 E-14		
SEP	< 9.1 E-16	2.43 ± 0.4 E-14		
3RD QTR			1.48 ± 0.4 E-16	< 4.6 E-16
OCT	1.11 ± 1.1 E-15	2.28 ± 0.4 E-14		
NOV	1.10 ± 1.1 E-15	2.62 ± 0.5 E-14		
DEC	< 1.0 E-15	1.63 ± 0.4 E-14		
4TH QTR			< 3.7 E-17	< 3.9 E-16

TABLE C-2.2.5

1987 RADIOACTIVITY CONCENTRATIONS IN AIRBORNE PARTICULATE

AT THOMAS CORNERS AIR SAMPLER (AFTCORD)

µCi/mL

	ALPHA	BETA	SR-90	CS-137
JAN	< 1.3 E-15	3.61 ± 0.7 E-14		
FEB	< 1.5 E-15	2.25 ± 0.5 E-14		
MAR	< 1.7 E-15	3.06 ± 0.7 E-14		
1ST QTR			< 9.7 E-17	< 6.0 E-16
APR	< 1.9 E-15	3.60 ± 0.5 E-14		
MAY	< 1.2 E-15	2.27 ± 0.5 E-14		
JUNE	2.18 ± 1.8 E-15	2.50 ± 0.5 E-14		
2ND QTR			< 5.2 E-17	< 6.2 E-16
JUL	1.03 ± 1.0 E-15	1.95 ± 0.4 E-14		
AUG	< 9.0 E-16	1.69 ± 0.4 E-14		
SEP	< 8.6 E-16	1.89 ± 0.4 E-14		
3RD QTR			4.90 ± 1.5 E-17	< 3.9 E-16
OCT	< 8.7 E-16	2.10 ± 0.4 E-14		
NOV	1.06 ± 1.0 E-15	2.14 ± 0.5 E-14		
DEC	< 1.1 E-15	1.55 ± 0.5 E-14		
4TH QTR			< 3.9 E-17	< 4.3 E-16

TABLE C-2.2.6

1987 RADIOACTIVITY CONCENTRATIONS IN AIRBORNE PARTICULATE

AT WEST VALLEY AIR SAMPLER (AFWEVAL)

µCi/mL

	ALPHA	BETA	SR-90	CS-137
JAN	< 9.7 E-16	2.49 ± 0.5 E-14		
FEB	< 8.0 E-16	2.00 ± 0.5 E-14		
MAR	< 1.0 E-15	2.36 ± 0.5 E-14		
1ST QTR			5.28 ± 2.3 E-17	< 4.4 E-16
APR	< 9.1 E-16	1.32 ± 0.3 E-14		
MAY	< 1.0 E-15	1.83 ± 0.4 E-14		
JUNE	1.38 ± 1.2 E-15	2.34 ± 0.5 E-14		
2ND QTR			4.73 ± 2.2 E-17	< 4.5 E-16
JUL	< 7.5 E-16	2.29 ± 0.4 E-14		
AUG	< 8.3 E-16	2.04 ± 0.4 E-14		
SEP	9.30 ± 9.3 E-16	2.17 ± 0.4 E-14		
3RD QTR			< 3.1 E-17	< 5.3 E-16
OCT	9.91 ± 9.5 E-16	1.98 ± 0.5 E-14		
NOV	1.42 ± 1.3 E-15	2.48 ± 0.5 E-14		
DEC	< 7.3 E-16	1.50 ± 0.4 E-14		
4TH QTR			< 3.7 E-17	< 5.5 E-16

TABLE C-2.2.7
1987 RADIOACTIVITY CONCENTRATIONS IN AIRBORNE PARTICULATE
AT GREAT VALLEY AIR SAMPLER (AFGRVAL)
µCi/mL

	ALPHA	BETA	SR-90	I-129	CS-137
JAN	< 1.0 E-15	2.41 ± 0.5 E-14			
FEB	< 8.3 E-16	1.90 ± 0.5 E-14			
MAR	< 1.2 E-15	1.97 ± 0.5 E-14			
1ST QTR			4.60 ± 2.2 E-17	< 6.9 E-16	< 4.9 E-16
APR	< 9.5 E-16	2.00 ± 0.5 E-14			
MAY	1.06 ± 1.0 E-15	1.67 ± 0.4 E-14			
JUNE	1.24 ± 1.1 E-15	1.90 ± 0.4 E-14			
2ND QTR			< 3.7 E-17	< 5.7 E-16	5.38 ± 3.2 E-16
JUL	< 7.9 E-16	2.29 ± 0.4 E-14			
AUG	< 8.2 E-16	2.07 ± 0.4 E-14			
SEP	< 8.6 E-16	1.99 ± 0.4 E-14			
3RD QTR			5.53 ± 1.6 E-17	< 7.7 E-16	< 3.1 E-16
OCT	< 9.5 E-16	2.90 ± 0.5 E-14			
NOV	1.05 ± 1.0 E-15	2.79 ± 0.5 E-14			
DEC	< 1.1 E-15	1.82 ± 0.4 E-14			
4TH QTR			3.96 ± 2.1 E-17	< 5.7 E-16	< 5.0 E-16

TABLE C-2.2.8
1987 RADIOACTIVITY CONCENTRATIONS IN AIRBORNE PARTICULATE
AT DUNKIRK AIR SAMPLER (AFDNKRK)
µCi/mL

	ALPHA	BETA	SR-90	CS-137
JAN				
FEB		***NOT IN OPERATION***		
MAR				
1ST QTR				
APR				
MAY		***NOT IN OPERATION***		
JUNE				
2ND QTR				
JUL				
AUG		***NOT IN OPERATION***		
SEP				
3RD QTR				
OCT	9.13 ± 9.1 E-16	1.85 ± 0.4 E-14		
NOV	< 8.7 E-16	2.17 ± 0.4 E-14		
DEC	< 7.1 E-16	1.29 ± 0.3 E-14		
4TH QTR			3.56 ± 2.0 E-17	< 5.4 E-16

TABLE C-2.3.1

RADIOACTIVITY IN FALLOUT DURING 1987
(nCi/m²/mo)

DUTCH HILL (AFDHFOP)

MONTH - 1987	GROSS ALPHA	GROSS BETA	H-3 (µCi/mL)
JANUARY	4.11 E-02	0.28 ± 0.04	1.11 ± 0.1 E-06
FEBRUARY	1.44 E-02	0.10 ± 0.02	1.74 ± 1.2 E-07
MARCH	1.20 E-02	0.14 ± 0.02	< 1.0 E-07
APRIL	1.23 E-02	0.22 ± 0.04	< 1.0 E-07
MAY	1.22 E-02	0.13 ± 0.02	< 1.0 E-07
JUNE	6.63 E-02	0.47 ± 0.05	< 1.0 E-07
JULY	1.05 E-01	0.94 ± 0.07	< 1.0 E-07
AUGUST	2.00 E-02	0.25 ± 0.04	< 1.0 E-07
SEPTEMBER	2.26 E-02	0.22 ± 0.04	< 1.0 E-07
OCTOBER	2.49 E-02	0.26 ± 0.04	< 1.0 E-07
NOVEMBER	2.67 E-02	0.24 ± 0.04	< 1.0 E-07
DECEMBER	2.10 E-02	0.13 ± 0.02	2.54 ± 1.2 E-07

FOX VALLEY ROAD (AFFXFOP)

MONTH - 1987	GROSS ALPHA	GROSS BETA	H-3 (µCi/mL)
JANUARY	7.17 E-02	0.49 ± 0.05	4.80 ± 1.3 E-07
FEBRUARY	4.40 E-02	0.20 ± 0.04	2.16 ± 1.2 E-07
MARCH	3.21 E-02	0.14 ± 0.03	< 1.0 E-07
APRIL	1.53 E-02	0.24 ± 0.04	4.05 ± 1.2 E-07
MAY	2.67 E-02	0.21 ± 0.04	1.19 ± 1.1 E-07
JUNE	5.08 E-02	0.44 ± 0.05	< 1.0 E-07
JULY	1.02 E-01	0.48 ± 0.05	< 1.0 E-07
AUGUST	1.41 E-02	0.14 ± 0.02	< 1.0 E-07
SEPTEMBER	2.96 E-02	0.21 ± 0.03	< 1.0 E-07
OCTOBER	2.40 E-02	0.33 ± 0.04	< 1.0 E-07
NOVEMBER	1.48 E-02	0.21 ± 0.04	< 1.0 E-07
DECEMBER	5.01 E-02	0.34 ± 0.04	6.24 ± 1.5 E-07

ROUTE 240 (AF24FOP)

MONTH - 1987	GROSS ALPHA	GROSS BETA	H-3 (µCi/mL)
JANUARY	4.37 E-02	0.40 ± 0.04	1.10 ± 1.0 E-07
FEBRUARY	2.27 E-02	0.12 ± 0.02	1.50 ± 1.1 E-07
MARCH	1.11 E-02	0.10 ± 0.02	< 1.0 E-07
APRIL	8.77 E-03	0.18 ± 0.02	4.26 ± 1.2 E-07
MAY	2.38 E-02	0.11 ± 0.02	< 1.0 E-07
JUNE	4.29 E-02	0.59 ± 0.05	1.30 ± 1.2 E-07
JULY	5.70 E-02	0.51 ± 0.05	< 1.0 E-07
AUGUST	4.80 E-02	0.71 ± 0.07	< 1.0 E-07
SEPTEMBER	2.73 E-02	0.54 ± 0.05	< 1.0 E-07
OCTOBER	3.44 E-02	0.46 ± 0.05	< 1.0 E-07
NOVEMBER	2.15 E-02	0.31 ± 0.04	< 1.0 E-07
DECEMBER	2.75 E-02	0.26 ± 0.04	< 1.0 E-07

THOMAS CORNERS ROAD (AFTCFOP)

MONTH - 1987	GROSS ALPHA	GROSS BETA	H-3 (µCi/mL)
JANUARY	8.29 E-02	0.53 ± 0.05	1.07 ± 1.0 E-07
FEBRUARY	5.25 E-02	0.27 ± 0.04	2.32 ± 1.2 E-07
MARCH	2.93 E-02	0.16 ± 0.02	< 1.0 E-07
APRIL	2.58 E-02	0.29 ± 0.04	6.18 ± 1.4 E-07
MAY	3.14 E-02	0.21 ± 0.03	< 1.0 E-07
JUNE	8.34 E-02	0.50 ± 0.05	< 1.0 E-07
JULY	7.85 E-02	0.66 ± 0.06	< 1.0 E-07
AUGUST	1.56 E-02	0.19 ± 0.02	< 1.0 E-07
SEPTEMBER	5.51 E-02	0.38 ± 0.04	1.18 ± 1.1 E-07
OCTOBER	3.26 E-02	0.42 ± 0.05	< 1.0 E-07
NOVEMBER	1.45 E-02	0.22 ± 0.04	2.29 ± 1.2 E-07
DECEMBER	4.62 E-02	0.32 ± 0.04	4.51 ± 1.2 E-07

TABLE C - 2.3.2
pH OF PRECIPITATION FALLOUT COLLECTIONS

MONTH - 1987	DUTCH HILL (AFDHFOP)	FOX VALLEY ROAD (AFFXFOP)	ROUTE 240 (AF24FOP)	THOMAS CORNERS ROAD (AFTCFOP)
JANUARY	4.03	4.13	3.99	4.04
FEBRUARY	4.43	5.51	4.71	5.96
MARCH	4.39	6.08	4.69	6.31
APRIL	3.44	4.65	3.73	5.69
MAY	3.75	3.97	4.76	4.14
JUNE	3.72	4.00	3.77	3.85
JULY	6.69	4.01	3.68	4.08
AUGUST	4.27	4.11	6.71	3.94
SEPTEMBER	4.27	4.12	5.92	3.95
OCTOBER	4.19	4.83	6.65	3.97
NOVEMBER	4.16	4.70	4.28	4.28
DECEMBER	4.03	4.57	4.05	4.52

APPENDIX C-3
SUMMARY OF BIOLOGICAL SAMPLE DATA

TABLE C-3.1
RADIOACTIVITY CONCENTRATIONS IN MILK - 1987
(μCi/mL)

LOCATION	H-3	Sr-90	I-129	Cs-134	Cs-137
NNW Farm (BFMREED) 1st Qtr 1987	< 2.0 E-07	2.61 ± 0.4 E-09	< 5.0 E-10	< 1.27 E-08	< 1.51 E-08
WNW Farm (BFMCOBO) 1st Qtr 1987	< 2.0 E-07	1.89 ± 0.4 E-09	< 6.0 E-10	< 8.14 E-09	< 9.68 E-09
NNW Farm (BFMREED) 2nd Qtr 1987	< 2.0 E-07	1.79 ± 0.2 E-09	< 5.0 E-10	< 1.05 E-08	< 1.31 E-08
WNW Farm (BFMCOBO) 2nd Qtr 1987	< 2.0 E-07	2.90 ± 0.5 E-09	< 7.0 E-10	< 1.02 E-08	< 1.12 E-08
Control (BFMCTRL-S) 1st Half 1987	< 1.8 E-07	1.46 ± 0.3 E-09	< 6.0 E-10	< 1.19 E-08	< 1.49 E-08
Control (BFMCTRL-N) 1st Half 1987	< 1.8 E-07	2.23 ± 0.3 E-09	< 6.0 E-10	< 1.11 E-08	< 1.09 E-08
NNW Farm (BFMREED) 3rd Qtr 1987	< 3.0 E-07	2.29 ± 0.4 E-09	< 5.0 E-10	< 9.53 E-09	< 1.16 E-08
WNW Farm (BFMCOBO) 3rd Qtr 1987	< 3.0 E-07	1.67 ± 0.3 E-09	< 7.0 E-10	< 1.08 E-08	< 9.27 E-09
Control (BFMCTRL-S) 3rd Qtr 1987	< 3.0 E-07	2.05 ± 0.3 E-09	< 5.0 E-10	< 6.47 E-09	< 8.44 E-09
Control (BFMCTRL-N) 3rd Qtr 1987	< 3.0 E-07	2.76 ± 0.4 E-09	< 5.0 E-10	< 1.17 E-08	< 1.24 E-08
NNW Farm (BFMREED) 4th Qtr 1987	< 2.0 E-07	3.04 ± 0.4 E-09	< 6.0 E-10	< 1.13 E-08	< 1.34 E-08
WNW Farm (BFMCOBO) 4th Qtr 1987	< 2.0 E-07	1.41 ± 0.2 E-09	< 8.0 E-10	< 1.39 E-08	< 1.42 E-08
Control (BFMCTRL-S) 4th Qtr 1987	< 2.0 E-07	2.52 ± 0.3 E-09	< 7.0 E-10	< 1.13 E-08	< 1.31 E-08
Control (BFMCTRL-N) 4th Qtr 1987	< 2.0 E-07	2.51 ± 0.3 E-09	< 6.0 E-10	< 1.46 E-08	< 1.35 E-08
SE Farm (BFMWIDR) December 1987	< 2.0 E-07	2.09 ± 0.3 E-09	< 7.0 E-10	< 1.14 E-08	< 1.31 E-08
SSW Farm (BFMHAUR) December 1987	< 2.0 E-07	3.10 ± 0.4 E-09	< 6.0 E-10	< 9.34 E-09	< 1.04 E-08

TABLE C-3.2

RADIOACTIVITY CONCENTRATIONS IN MEAT - 1987

(μCi/g)

LOCATION	Sr-89	Sr-90	Cs-134	Cs-137
Deer Flesh - Near Site (BFDNEAR) 12/87	---	2.73 ± 0.4 E-09	< 2.8 E-08	6.28 ± 2.7 E-08
Deer Skeleton - Near Site (BFDNEAR) 12/87	< 1.7 E-06	2.09 ± 0.3 E-06	---	---
Deer Flesh - Background (BFDCTRL) 1/88	---	2.33 ± 0.5 E-09	< 1.9 E-08	< 2.5 E-08
Beef Flesh - Near Site (BFBNEAR) 6/87	---	---	< 1.6 E-08	4.53 ± 1.5 E-08
Beef Flesh - Background (BFBCTRL) 6/87	---	---	< 1.5 E-08	2.37 ± 1.3 E-08
Beef Flesh - Near Site (BFBNEAR) 10/87	---	---	< 2.0 E-08	< 2.5 E-08
Beef Flesh - Background (BFCTRL) 9/87	---	---	< 1.3 E-08	1.31 ± 1.2 E-08

TABLE C-3.3

RADIOACTIVITY CONCENTRATIONS IN FOOD CROPS - 1987

(μCi/g DRY)

LOCATION	Tritium (μCi/mL)	Sr-90	K-40	Co-60	Cs-137
Corn - Near Site (BFVNEAR) 9/87	< 1.5 E-07	4.92 ± 1.4 E-10	3.18 ± 0.3 E-06	< 1.8 E-08	< 1.4 E-08
Corn - Background (BFVCTRL) 9/87	< 1.2 E-07	9.26 ± 1.6 E-10	3.09 ± 0.2 E-06	< 1.3 E-08	< 8.0 E-09
Apples - Near Site (BFVNEAR) 9/87	< 2.0 E-07	3.65 ± 0.4 E-08	7.42 ± 0.5 E-06	< 3.1 E-08	< 2.4 E-08
Apples - Background (BFVCTRL) 9/87	< 2.0 E-07	3.72 ± 0.4 E-08	7.16 ± 0.5 E-06	< 2.2 E-08	< 2.0 E-08
Hay - Near Site (BFVNEAR) 10/87	NA	2.33 ± 0.3 E-07	1.09 ± 0.1 E-05	< 2.3 E-08	1.83 ± 1.6 E-08
Hay - Background (BFVCTRL) 9/87	NA	2.48 ± 0.3 E-08	2.50 ± 0.1 E-05	< 1.6 E-08	1.12 ± 0.9 E-08

NA - Not Analyzed

TABLE C-3.4

RADIOACTIVITY CONCENTRATIONS IN FISH FROM CATTARAUGUS CREEK - 1987

(μCi/g - DRY)

CATTARAUGUS CREEK (BFFCATC) - 2ND QUARTER 1987

	FLESH		
	Sr-90	Cs-134	Cs-137
MEDIAN	3.33 E-08	<1.93 E-07	<2.16 E-07
AVERAGE GEOMETRIC DEVIATION	2.14	1.53	1.49
MAXIMUM	9.73 ± 2.1 E-08	<3.3 E-07	3.80 ± 1.1 E-07
MINIMUM	1.15 ± 0.6 E-08	<1.0 E-07	<1.4 E-07

CATTARAUGUS CREEK (BFFCATC) - 3RD QUARTER 1987

	FLESH			SKELETON
	Sr-90	Cs-134	Cs-137	Sr-90
MEDIAN	4.30 E-08	< 3.18 E-07	< 3.34 E-07	3.58 E-07
AVERAGE GEOMETRIC DEVIATION	1.64	1.39	1.51	1.47
MAXIMUM	7.12 ± 2.0 E-08	< 4.1 E-07	< 4.4 E-07	4.39 ± 2.5 E-07
MINIMUM	1.60 ± 1.2 E-08	< 2.0 E-07	< 1.7 E-07	1.18 ± 0.6 E-07

CATTARAUGUS CREEK (BFFCTRL) BACKGROUND 2ND QTR 1987

	FLESH		
	Sr-90	Cs-134	Cs-137
MEDIAN	9.30 E-09	<1.19 E-07	<1.20 E-07
AVERAGE GEOMETRIC DEVIATION	1.62	1.29	1.44
MAXIMUM	4.69 ± 0.6 E-08	<2.4 E-07	<2.8 E-07
MINIMUM	<7.0 E-09	<9.5 E-08	<8.7 E-08

CATTARAUGUS CREEK (BFFCTRL) BACKGROUND - 3RD QTR 1987

	FLESH		
	Sr-90	Cs-134	Cs-137
MEDIAN	2.13 E-08	< 2.06 E-07	< 2.15 E-07
AVERAGE GEOMETRIC DEVIATION	1.32	1.24	1.26
MAXIMUM	3.91 ± 0.7 E-08	< 3.0 E-07	< 3.4 E-07
MINIMUM	1.60 ± 0.9 E-08	< 1.6 E-07	< 1.5 E-07

CATTARAUGUS CREEK (BFFCATD) BELOW SPRINGVILLE DAM - 2ND QTR 1987

	FLESH		
	Sr-90	Cs-134	Cs-137
MEDIAN	6.55 E-08	<1.57 E-07	<1.91 E-07
AVERAGE GEOMETRIC DEVIATION	1.87	1.70	1.83
MAXIMUM	3.28 ± 0.5 E-07	<4.5 E-07	<4.8 E-07
MINIMUM	6.94 ± 4.1 E-09	<5.7 E-08	4.40 ± 4.2 E-08

CATTARAUGUS CREEK (BFFCATD) BELOW SPRINGVILLE DAM 3RD QTR 1987

	FLESH		
	Sr-90	Cs-134	Cs-137
MEDIAN	9.60 E-09	< 4.70 E-08	< 6.60 E-08
AVERAGE GEOMETRIC DEVIATION	1.92	1.53	1.87
MAXIMUM	7.15 ± 1.7 E-08	< 2.4 E-07	< 2.5 E-07
MINIMUM	4.28 ± 0.9 E-09	< 3.5 E-08	< 2.7 E-08

APPENDIX C-4
SUMMARY OF DIRECT RADIATION MONITORING

TABLE C-4.1
SUMMARY OF TLD MEASUREMENTS - 1987
(Roentgen ± 3SD)

Location*	1st Qtr	2nd Qtr	3rd Qtr	4th Qtr	Location Average
1	0.017 ± 0.002	0.024 ± 0.006	0.022 ± 0.004	0.022 ± 0.005	0.021 ± 0.004
2	0.016 ± 0.003	0.024 ± 0.004	0.021 ± 0.002	0.020 ± 0.004	0.020 ± 0.003
3	0.016 ± 0.003	0.023 ± 0.004	0.020 ± 0.003	0.020 ± 0.002	0.020 ± 0.003
4	0.016 ± 0.001	0.022 ± 0.003	0.021 ± 0.004	0.021 ± 0.005	0.020 ± 0.003
5	0.017 ± 0.003	0.024 ± 0.006	0.023 ± 0.003	0.023 ± 0.004	0.022 ± 0.004
6	0.016 ± 0.002	0.022 ± 0.003	0.020 ± 0.002	0.020 ± 0.002	0.020 ± 0.002
7	0.015 ± 0.002	0.026 ± 0.006	0.019 ± 0.003	0.021 ± 0.003	0.020 ± 0.004
8	0.016 ± 0.001	0.022 ± 0.004	0.021 ± 0.002	0.021 ± 0.002	0.020 ± 0.002
9	0.016 ± 0.002	0.022 ± 0.002	0.020 ± 0.006	0.019 ± 0.005	0.019 ± 0.004
10	0.016 ± 0.002	0.023 ± 0.005	0.021 ± 0.002	0.023 ± 0.005	0.021 ± 0.004
11	0.018 ± 0.003	0.026 ± 0.007	0.024 ± 0.005	0.024 ± 0.006	0.023 ± 0.005
12	0.014 ± 0.003	0.023 ± 0.004	0.020 ± 0.001	0.021 ± 0.003	0.020 ± 0.003
13	0.019 ± 0.003	0.024 ± 0.002	0.023 ± 0.003	0.024 ± 0.004	0.023 ± 0.003
14	0.018 ± 0.002	0.025 ± 0.004	0.023 ± 0.005	0.023 ± 0.003	0.023 ± 0.004
15	0.018 ± 0.002	0.023 ± 0.006	0.022 ± 0.002	0.022 ± 0.003	0.021 ± 0.003
16	0.018 ± 0.002	0.023 ± 0.004	0.022 ± 0.003	0.023 ± 0.003	0.022 ± 0.003
17	0.017 ± 0.004	0.023 ± 0.005	0.022 ± 0.002	0.025 ± 0.002	0.022 ± 0.003
18**	0.021 ± 0.004	0.031 ± 0.008	0.028 ± 0.004	0.031 ± 0.004	0.028 ± 0.005
19**	0.019 ± 0.004	0.025 ± 0.006	0.026 ± 0.005	0.026 ± 0.003	0.024 ± 0.005
20	0.016 ± 0.002	0.023 ± 0.005	0.022 ± 0.003	0.022 ± 0.003	0.021 ± 0.003
21	0.016 ± 0.002	0.021 ± 0.004	0.020 ± 0.004	0.020 ± 0.003	0.019 ± 0.003
22	0.016 ± 0.004	0.022 ± 0.003	0.021 ± 0.004	0.022 ± 0.004	0.020 ± 0.004
23	0.016 ± 0.003	0.021 ± 0.004	0.020 ± 0.003	0.021 ± 0.005	0.020 ± 0.004
24**	1.927 ± 0.270	1.863 ± 0.320	1.640 ± 0.195	1.716 ± 0.258	1.787 ± 0.261
25	0.037 ± 0.007	0.043 ± 0.007	0.041 ± 0.002	0.046 ± 0.006	0.042 ± 0.006
26	0.035 ± 0.004	0.041 ± 0.010	0.039 ± 0.005	0.049 ± 0.004	0.041 ± 0.006
27	0.018 ± 0.003	0.025 ± 0.003	0.024 ± 0.002	0.025 ± 0.003	0.023 ± 0.003
28	0.017 ± 0.003	0.023 ± 0.004	0.023 ± 0.003	0.025 ± 0.003	0.022 ± 0.003
29	0.021 ± 0.003	0.029 ± 0.004	0.028 ± 0.002	0.030 ± 0.004	0.027 ± 0.003
30	0.036 ± 0.005	0.040 ± 0.051	0.039 ± 0.003	0.039 ± 0.004	0.038 ± 0.004
31	***	0.021 ± 0.003	0.021 ± 0.003	0.023 ± 0.003	0.022 ± 0.003
32	***	0.021 ± 0.005	0.022 ± 0.003	0.024 ± 0.005	0.022 ± 0.004
33	***	0.024 ± 0.004	0.023 ± 0.003	0.025 ± 0.005	0.024 ± 0.004
34	***	0.025 ± 0.003	0.025 ± 0.002	0.026 ± 0.005	0.025 ± 0.003
35	***	0.025 ± 0.003	0.024 ± 0.002	0.027 ± 0.005	0.025 ± 0.003
36	***	0.032 ± 0.008	0.031 ± 0.002	0.032 ± 0.005	0.032 ± 0.005
37	***	***	***	0.013 ± 0.006	0.013 ± 0.006
Quarterly Average**	0.019 ± 0.003	0.025 ± 0.005	0.024 ± 0.003	0.025 ± 0.004	0.023 ± 0.004

* See Figures A-1 and A-2 for locations.

** TLDs 18, 19 and 24 are on-site at locations which are not accessible to the public. They are not part of the off-site monitoring program and are not included in the quarterly averages.

*** TLD packages not placed.

APPENDIX C-5
SUMMARY OF NONRADIOLOGICAL MONITORING

SUMMARY OF NONRADIOLOGICAL MONITORING

Nonradiological emissions and plant effluents are controlled and permitted under New York State and U.S. EPA regulations. Airborne emissions arise from seven sources, all of which are permitted by New York State Department of Environmental Conservation (NYSDEC). These release points include two natural gas-fired boilers, two nitric acid tank vents, an office paper waste incinerator, a glass-melter off-gas system and a cement storage silo vent. The melter off-gas system is currently being tested and operated under a permit to construct. These permits are identified and described in Table C-5.1. Although there are periodic New York State inspections of the air emission points, routine sampling and analysis of nonradiological emissions from these points are not required. Discharges from these points are well below the levels requiring monitoring under the state permit system.

Liquid discharges are regulated under the State Pollution Discharge Elimination System (SPDES). The outfalls and monitoring requirements for the permit are presented in Table C-5.2. The locations of the monitoring points are shown in Figure C-5.1.

The results of the SPDES nonradiological monitoring are presented in Figures C-5.2 through C-5.23. These data indicate Project effluents were generally within the permit limits during 1987. However, the WVDP reported a total of 19 noncompliance episodes. These noncompliances are summarized in Table C-5.3 and are described in the following paragraphs.

The majority of noncompliance episodes are for pH and solids at outfall 007, the mixing basin for sanitary and utility room wastewaters. Of the 11 excursions reported at this outfall, eight were for pH and three were for solids (one suspended solids and two settleable solids). The pH excursions are attributed to the influence of basic (i.e., high pH) boiler blowdown wastewaters and, on several occasions, to photosynthetically mediated carbon dioxide assimilation by the flourishing algae population in the wastewater mixing basin. The solids excursions arise from resuspension of settled materials during aeration of the mixing basin for pH control. The solids excursions during September 1987 also contributed to the two high BOD concentrations measured and averaged for outfalls 001, 007 and 008.

Outfall 001, the batch discharge from the low-level waste treatment facility, experienced or contributed to six other permit excursions. Three of these excursions were for pH, which slightly exceeded the upper limit of 9.0 in the "heel" of the lagoon. Two other excursions were data reporting errors; values for arsenic were reported as "less than" values when the value reported was actually higher than the permit limits.

The remaining two excursions are related in that the solids excursion for the July 1987 discharge, caused by rain induced flushing of the loose sediment from the lagoon near the end of a discharge episode, also caused a high BOD value for that discharge.

These noncompliance episodes are summarized in Table C5-3. The environmental impacts associated with these noncompliance episodes are negligible because of their generally small magnitude and short duration, the innocuous nature of the noncomplying parameters, and natural dilution by a factor of approximately 1000 between the point where Erdman Brook leaves the controlled area of the site (formerly outfall 006) and Cattaraugus Creek (the nearest point of public access).

TABLE C-5.1
WEST VALLEY DEMONSTRATION PROJECT ENVIRONMENTAL PERMITS

Permit #	Issued by	Expiration Date	Type of Permit
042200-0114-00002 WC	NYSDEC	6/89	Certificate to operate air contamination source - boiler
042200-0114-00003 WC	NYSDEC	6/89	Certificate to operate air contamination source - boiler
042200-0114-0004 WR	NYSDEC	6/89	Certificate to operate air contamination source - incinerator**
042200-0114-00010 WM	NYSDEC	6/89	Certificate to operate air contamination source - Low Level Waste Treatment Facility Nitric Acid Storage Tank
042200-0114-014D1 WI	NYSDEC	6/89	Certificate to operate air contamination source - Nitric Acid Bulk Storage Tank
042200-0114-CSS01	NYSDEC	6/89	Certificate to Operate Cement Storage Silo Ventilation System
042200-0114-015F-1	NYSDEC	6/86*	Permit to Construct Vitrification Off-Gas System
NY-0000973	NYSDEC	9/90	State Pollution Discharge Elimination System (SPDES permit)
WVDP-187-01	EPA		Certificate to Operate Radioactive Air Source - Building 01-14 Ventilation System***
WVDP-287-01	EPA		Certificate to Operate Radioactive Air Source - Contact Size Reduction & Decontamination Facility***
WVDP-387-01	EPA		Certificate to Operate Radioactive Air Source - Supernatant Treatment Ventilation System***
WVDP-487-01	EPA		Certificate to Operate Radioactive Air Source - Low Level Waste Supercompactor Ventilation System***
WVDP-587-01	EPA		Certificate to Operate Radioactive Air Source - Outdoor Ventilation Exhaust***
WVDP-687-01	EPA		Certificate to Operate Radioactive Air Source - Liquid Waste Treatment System (modification of Process Building Ventilation System)***

* Permit to construct is extended annually with submittal of status report.
** Currently nonradioactive waste is removed to a commercial landfill and not incinerated.
*** National Emission Standard for Hazardous Air Pollutants (NESHAP) tempory permits are valid until the final permits are issued.

TABLE C-5.2
WEST VALLEY DEMONSTRATION PROJECT
SPDES SAMPLING PROGRAM
Effective September 1, 1985

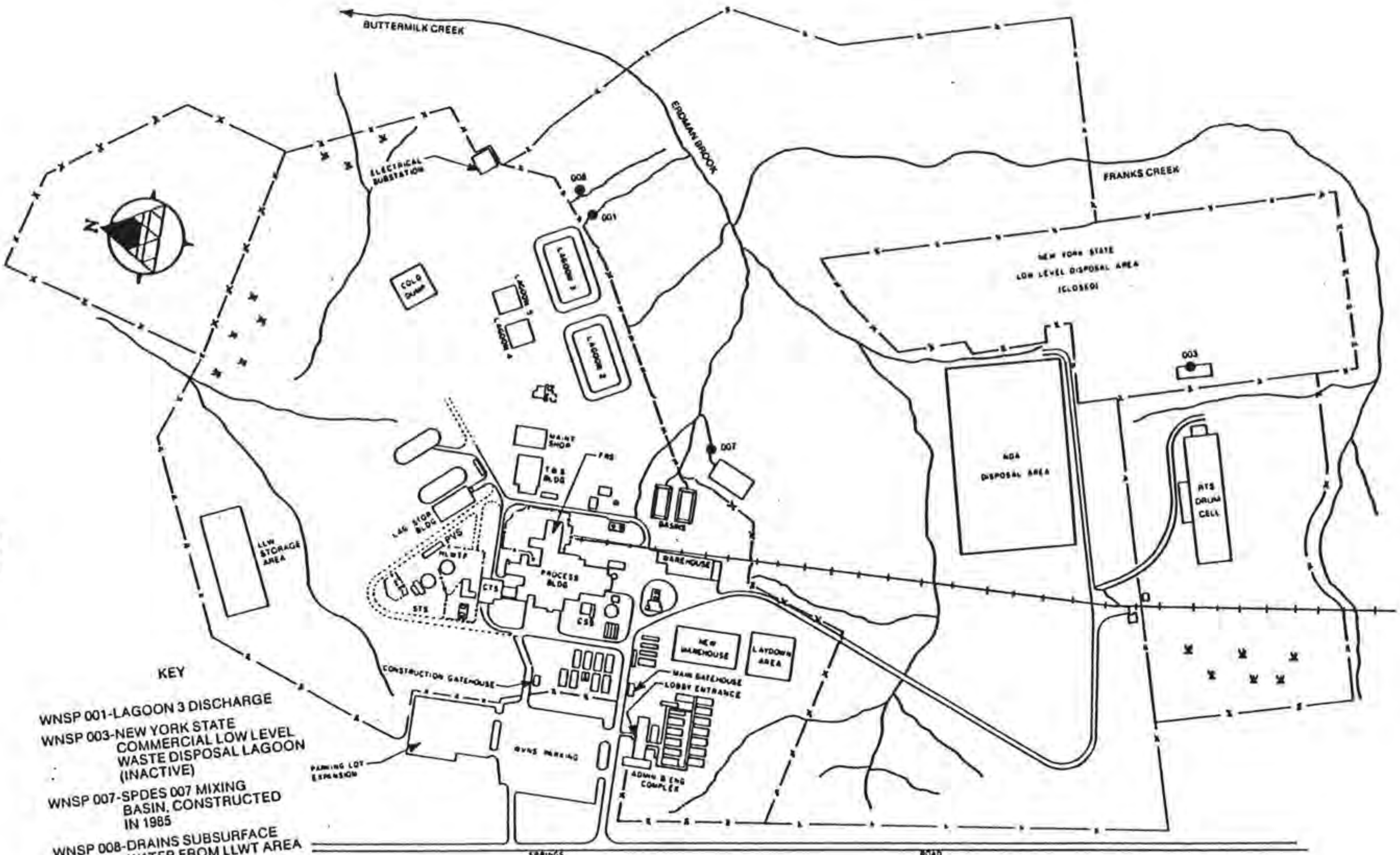
Outfall	Parameter	Limit	Sample Frequency
001 (Process and Storm waste waters)	Flow		2 per discharge event
	Aluminum	14.0 mg/L	2 per discharge event
	Ammonia	*	2 per discharge event
	Arsenic	0.01 mg/L	2 per discharge event
	BOD-5	**	2 per discharge event
	Iron	**	2 per discharge event
	Zinc	0.31 mg/L	2 per discharge event
	Suspended Solids	45.0 mg/L	2 per discharge event
	Cyanide	0.1 mg/L	2 per discharge event
	Settleable Solids	0.30 mL/L	2 per discharge event
	pH	6.0 - 9.0	2 per discharge event
	Oil and Grease	15.0 mg/L	2 per discharge event
	Cadmium	0.013 mg/L	annual
	Chromium	0.050 mg/L	annual
	Copper	0.050 mg/L	annual
	Lead	0.080 mg/L	annual
	Nickel	0.080 mg/L	annual
	Selenium	0.040 mg/L	annual
007 (Sanitary and Utility waste water)	Flow		3 per month
	Ammonia	*	3 per month
	BOD-5	**	3 per month
	Iron	**	3 per month
	Suspended Solids	45.0 mg/L	2 per month
	Settleable Solids	0.3 mL/L	Weekly
	pH	6.0 - 9.0	Weekly
	Chloroform	0.020 mg/L	annual
008 (French Drain waste water)	Flow		3 per month
	BOD-5	**	3 per month
	Iron	**	3 per month
	pH	6.0 - 9.0	3 per month
	Silver	0.008 mg/L	annual
	Zinc	0.100 mg/L	annual

* Reported as flow weighted average of Outfalls 001 and 007.

** Reported as flow weighted average of Outfalls 001, 007 and 008. Iron data are net limits reported after background concentrations are subtracted.

TABLE C-5.3
WEST VALLEY DEMONSTRATION PROJECT
1987 SPDES NONCOMPLIANCE EPISODES

Date	Outfall	Parameter	Limit	Value	Comments
Feb. 87	007	pH	6.0 - 9.0	9.1	
Apr. 87	001	pH	6.0 - 9.0	9.06	
May 87	007	pH	6.0 - 9-0	9.21	
June 87	007	pH	6.0 - 9.0	9.16	
July 87	001	Arsenic	0.01 Daily Max.	0.2	reporting error 2 occasions reported
July 87	001	Total Suspended Solids	30.0 Avg. 45.0 Max.	31.4	
July 87	007	pH	6.0 - 9.0	9.89	4 occasions reported
July 87	Sum 001, 007 & 008	BOD-5	5.0 Daily Avg.	5.64	
Aug. 87	007	pH	6.0 - 9.0	9.40	
Sep. 87	001	Total Suspended Solids	30.0 Avg. 45.0 Max.	46.0	
Sep. 87	007	Total Suspended Solids	30.0 Avg. 45.0 Max.	54.0	
Sep. 87	007	Settleable Solids	0.3 mL/L	4.0 2.3	2 occasions reported
Sep. 87	Sum 001, 007 & 008	BOD-5	5.0 Daily Avg.	9.04	2 occasions reported



KEY

WNSP 001-LAGOON 3 DISCHARGE
WNSP 003-NEW YORK STATE COMMERCIAL LOW LEVEL WASTE DISPOSAL LAGOON (INACTIVE)
WNSP 007-SPDES 007 MIXING BASIN, CONSTRUCTED IN 1985
WNSP 008-DRAINS SUBSURFACE WATER FROM LLWT AREA (FRENCH DRAIN)

Approx. Scale — Meters
0 50 100

Figure C-5.1. Locations of SPDES Monitoring Points On-site.

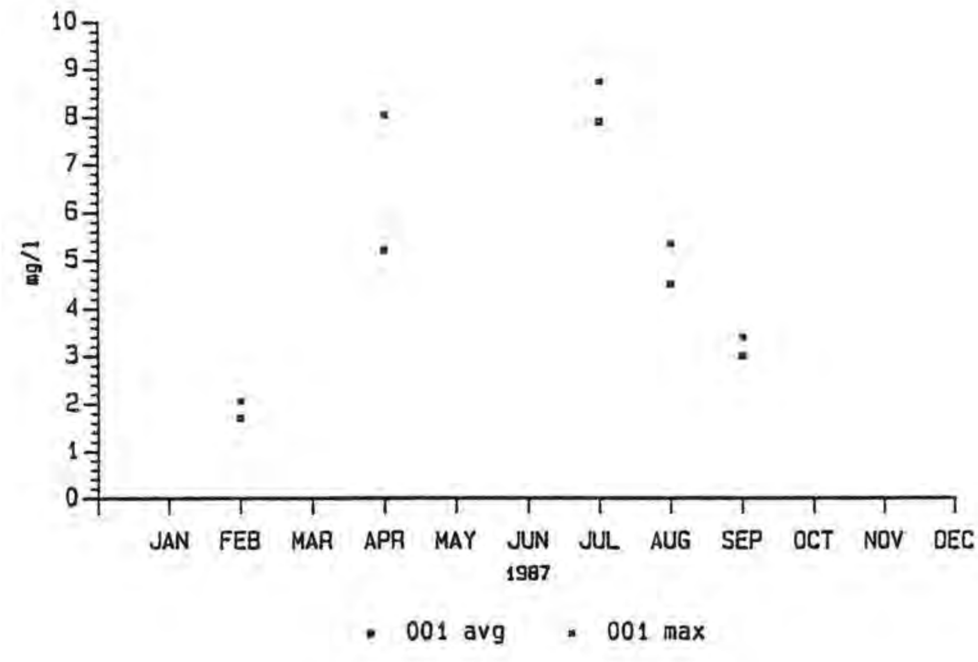


Figure C-5.2 BOD-5 Outfall 001.

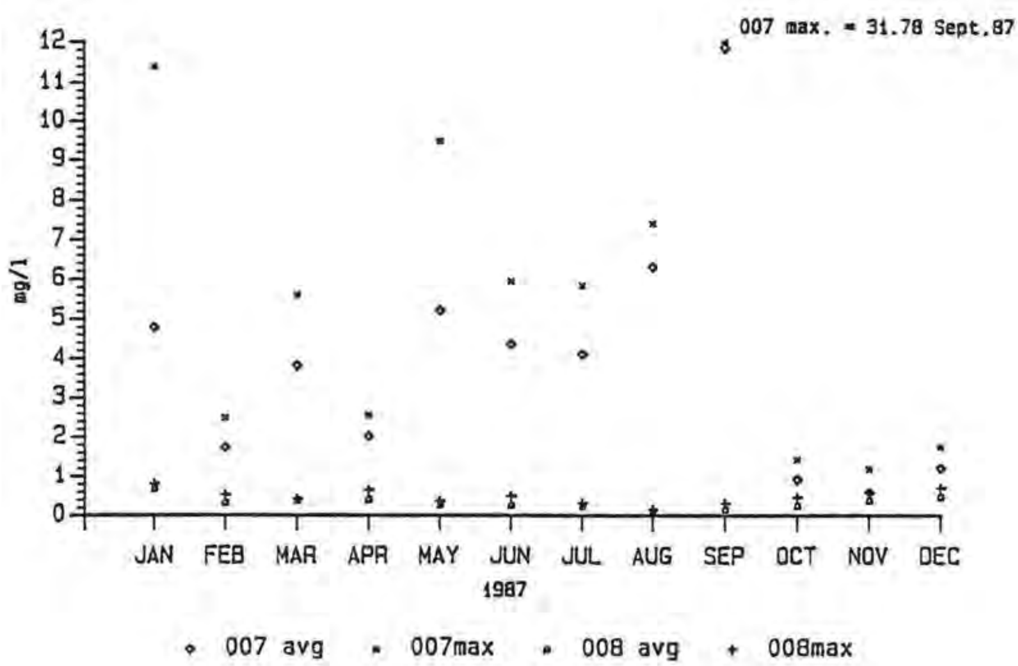


Figure C-5.3 BOD-5 Outfall 007, 008.

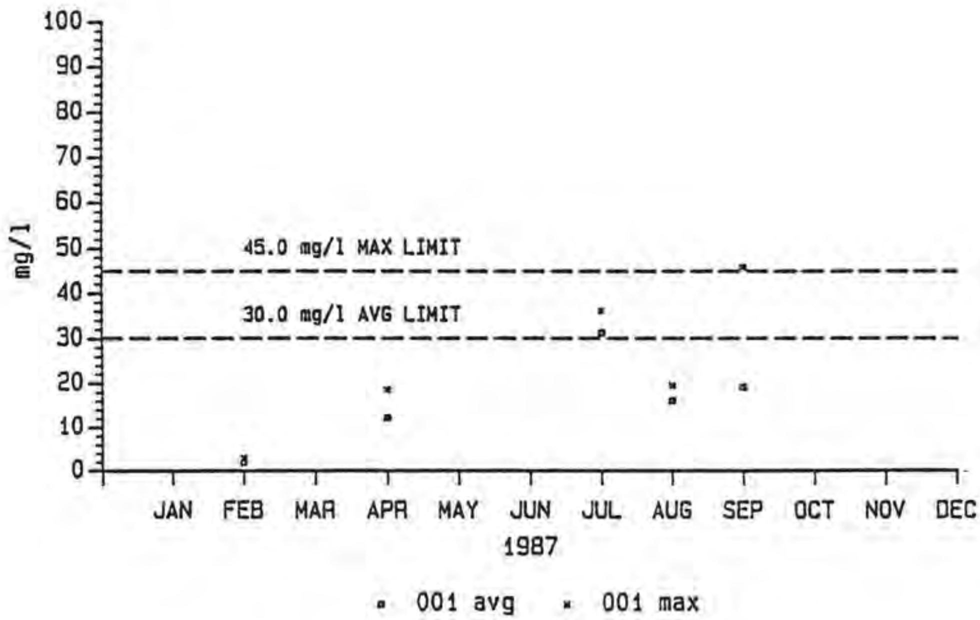


Figure C-5.4 Suspended Solids, Outfall 001

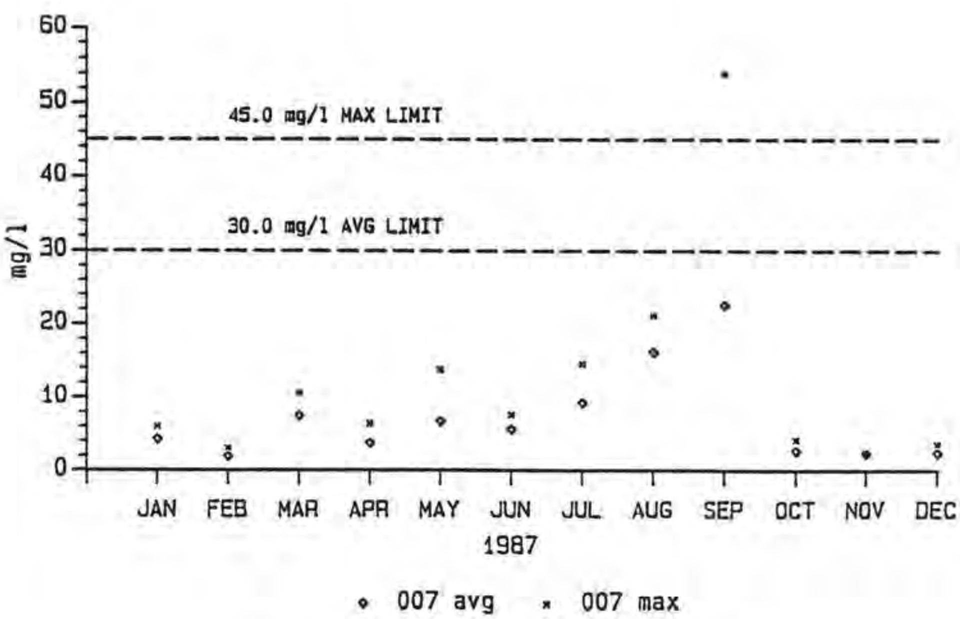


Figure C-5.5 Suspended Solids, Outfall 007

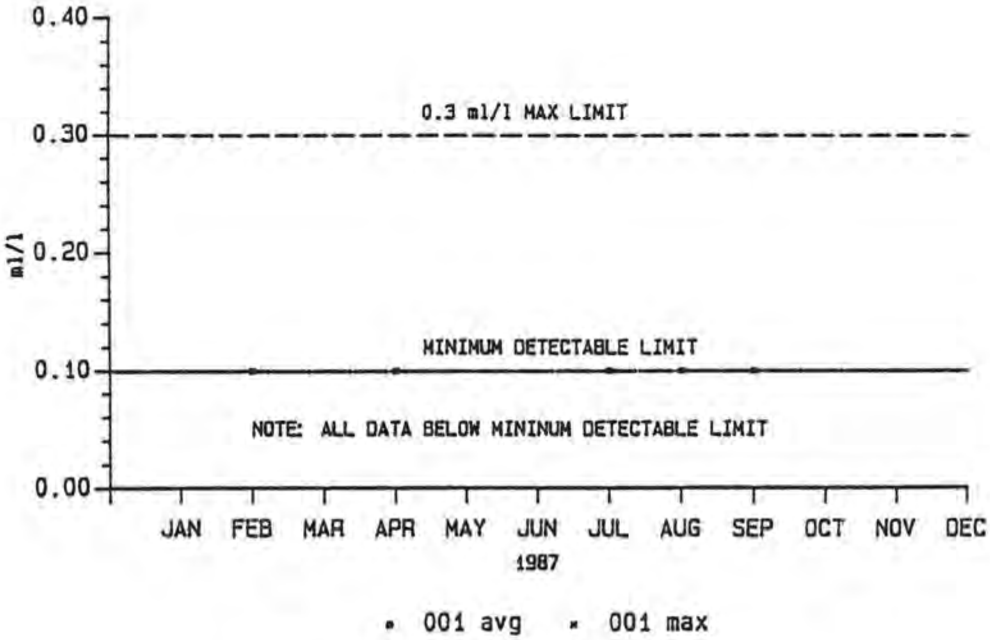


Figure C-5.6 Settleable Solids, Outfall 001

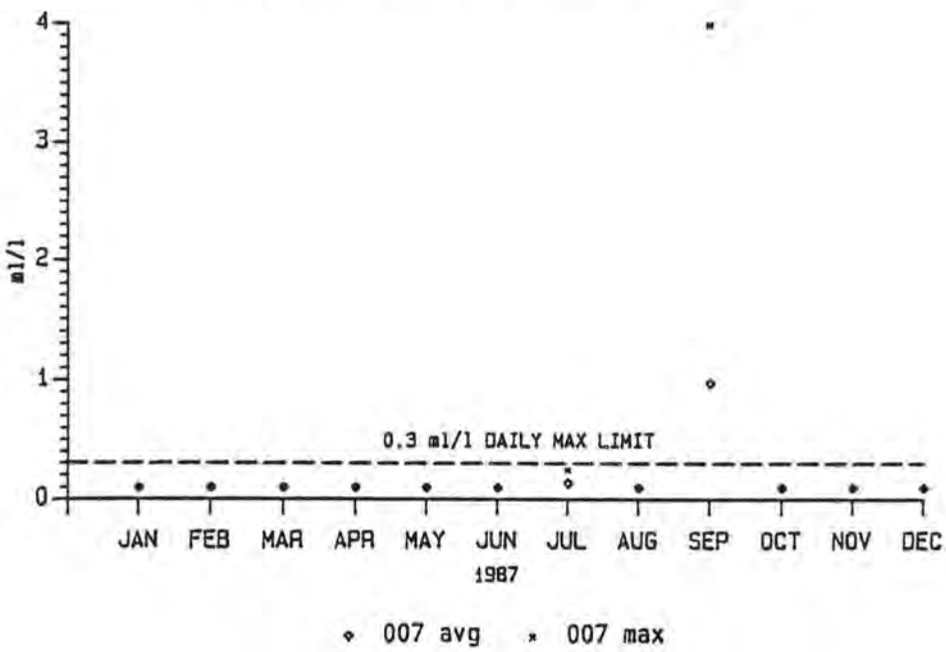


Figure C-5-7 Settleable Solids, Outfall 007

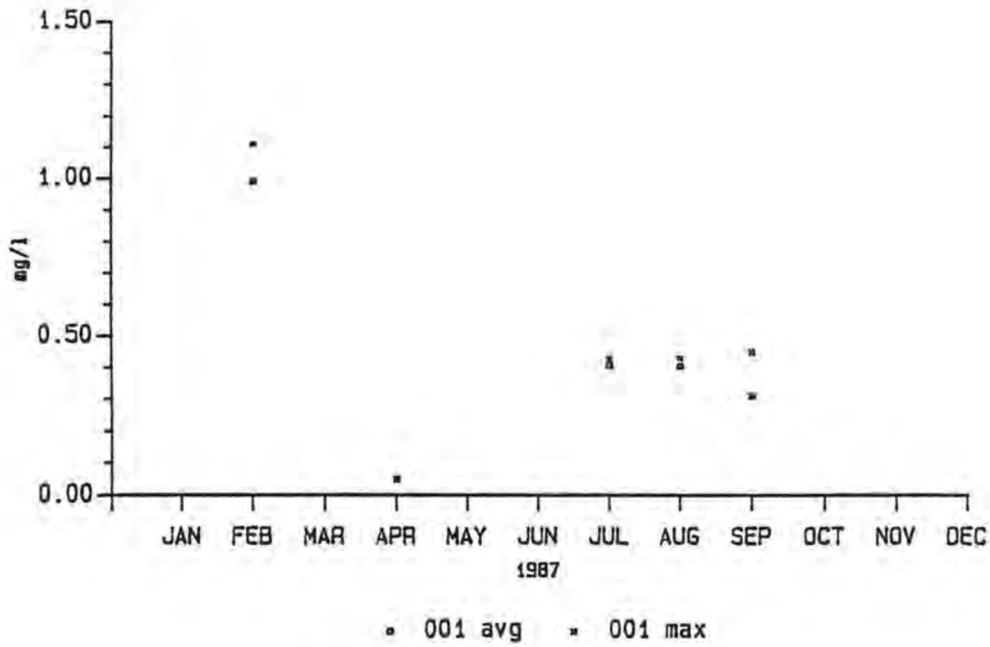


Figure C-5.8 Ammonia, Outfall 001

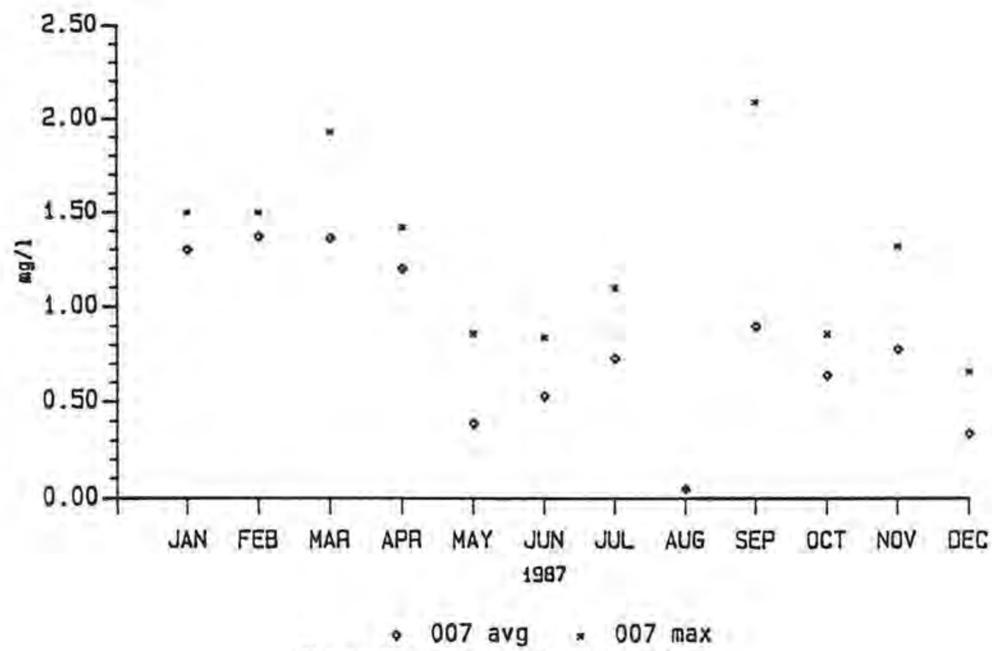


Figure C-5.9 Ammonia, Outfall 007

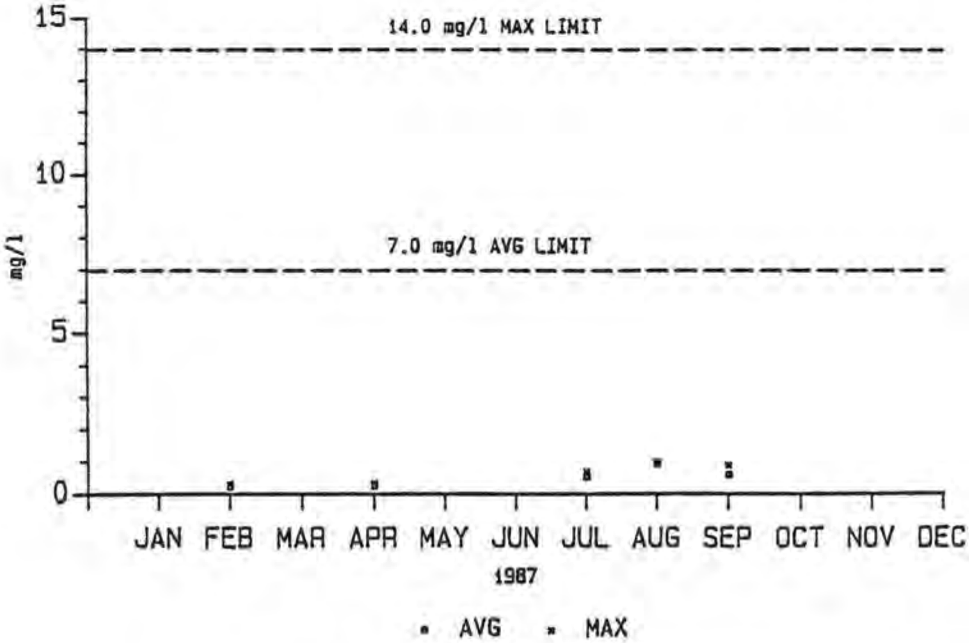


Figure C-5.10 Metals (Al), Outfall 001

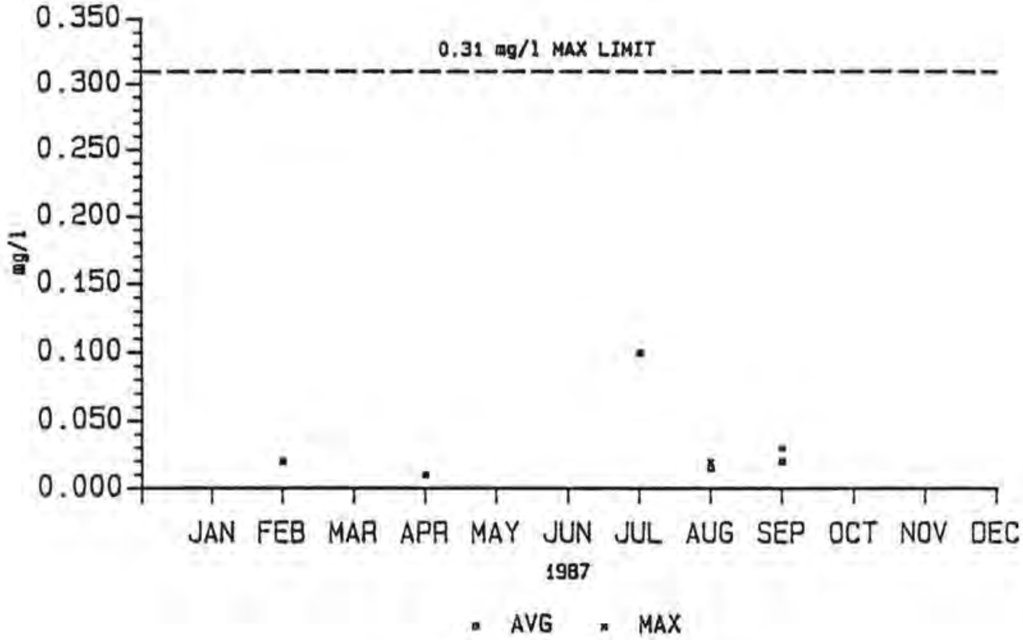


Figure C-5.11 Metals (Zn), Outfall 001

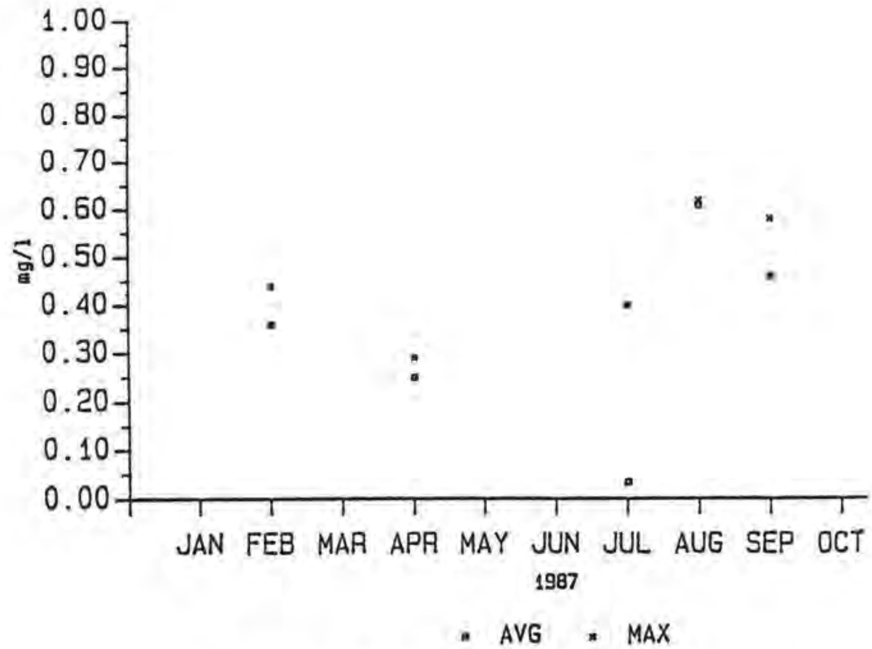


Figure C-5.12 Metals (Fe), Outfall 001

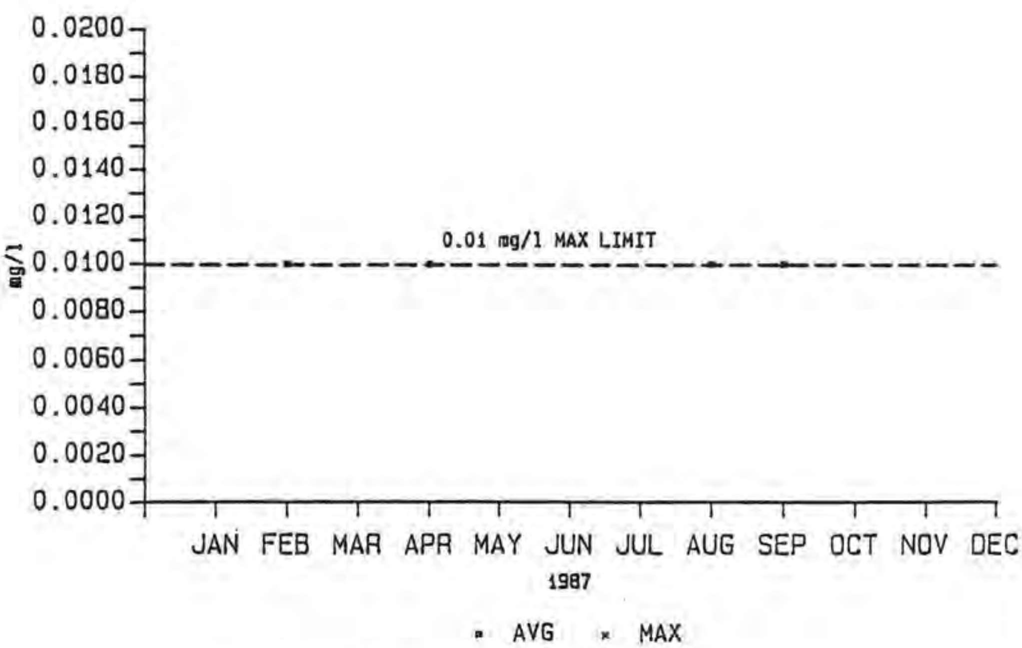


Figure C-5.13 Metals (As), Outfall 001

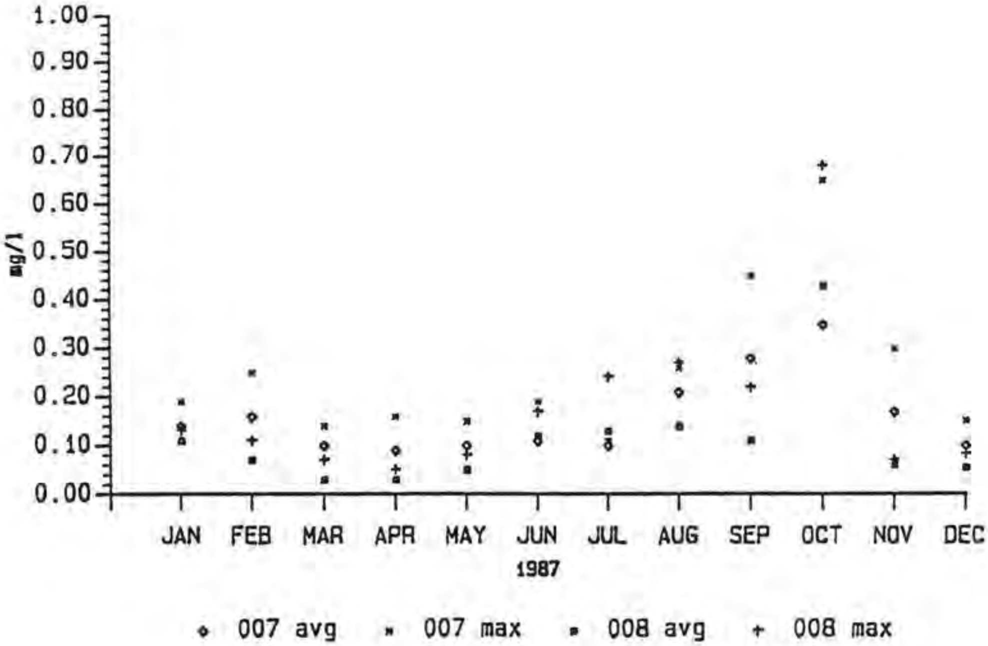


Figure C-5.14 Metals (Fe), Outfalls 007, 008

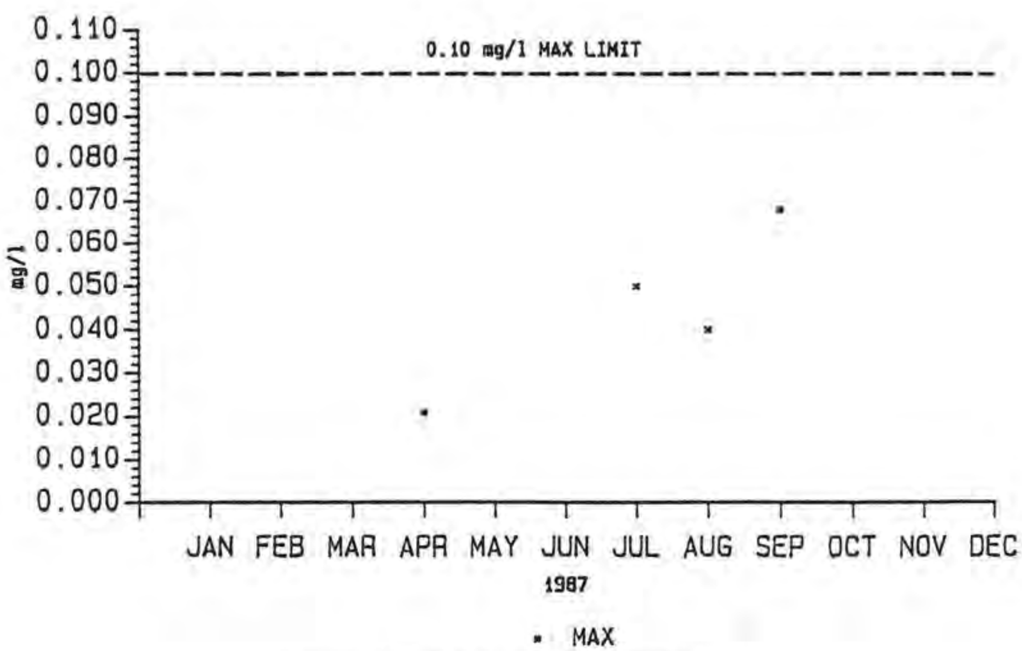


Figure C-5.15 Cyanide, Outfall 001

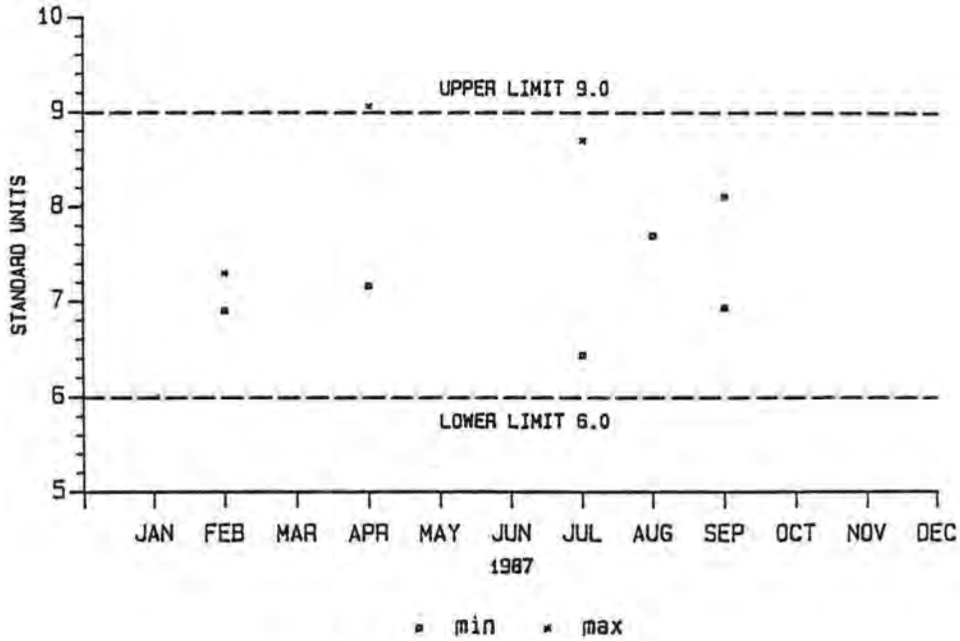


Figure C-5.16 pH, Outfall 001

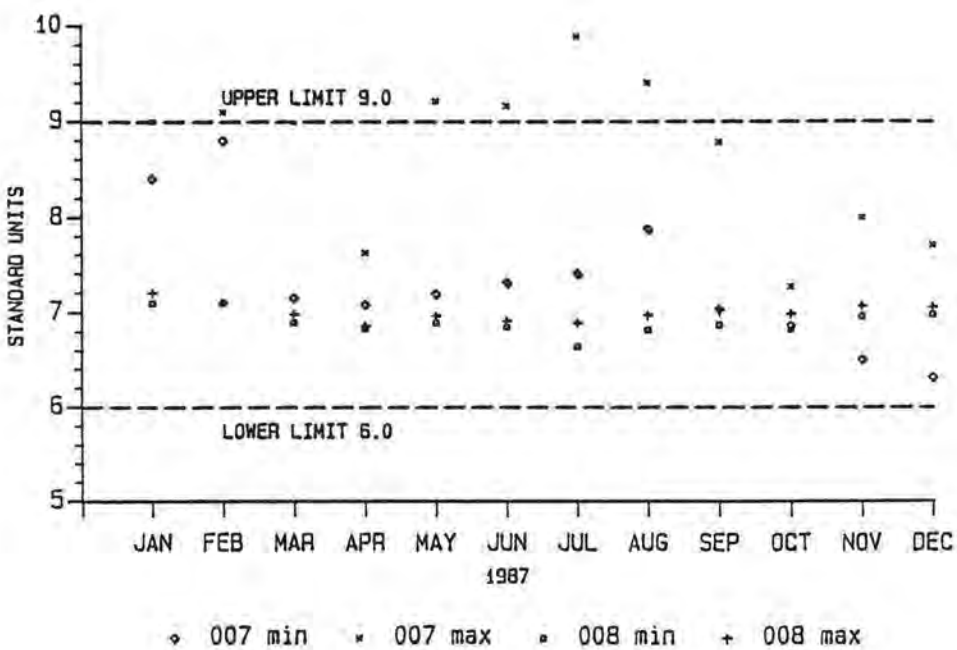


Figure C-5.17 pH, Outfalls 007, 008

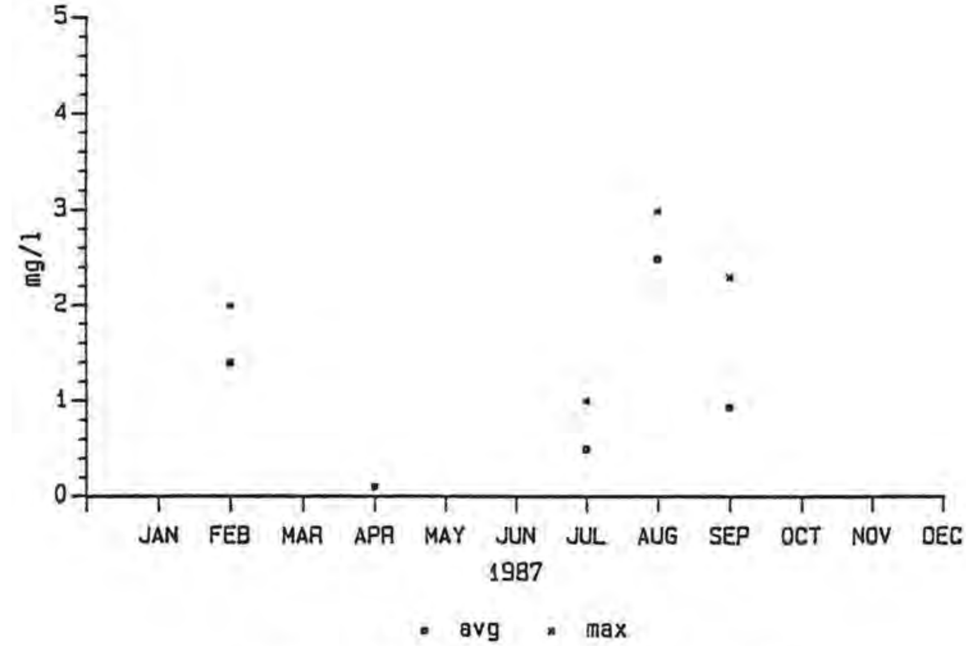


Figure C-5.18 Oil and Grease, Outfall 001

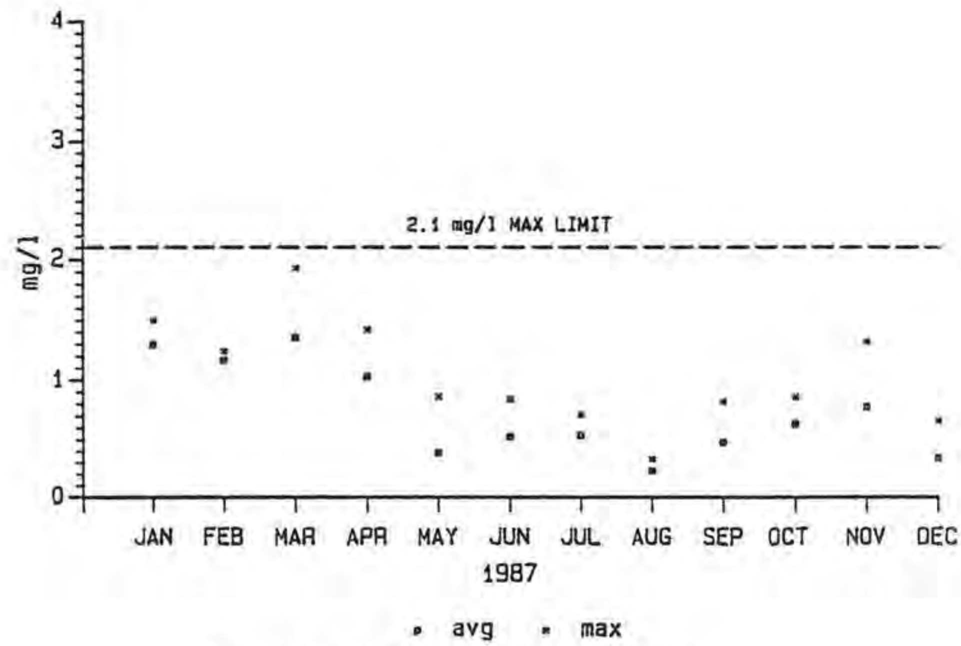


Figure C-5.19 Discharge Rate, Outfall 001

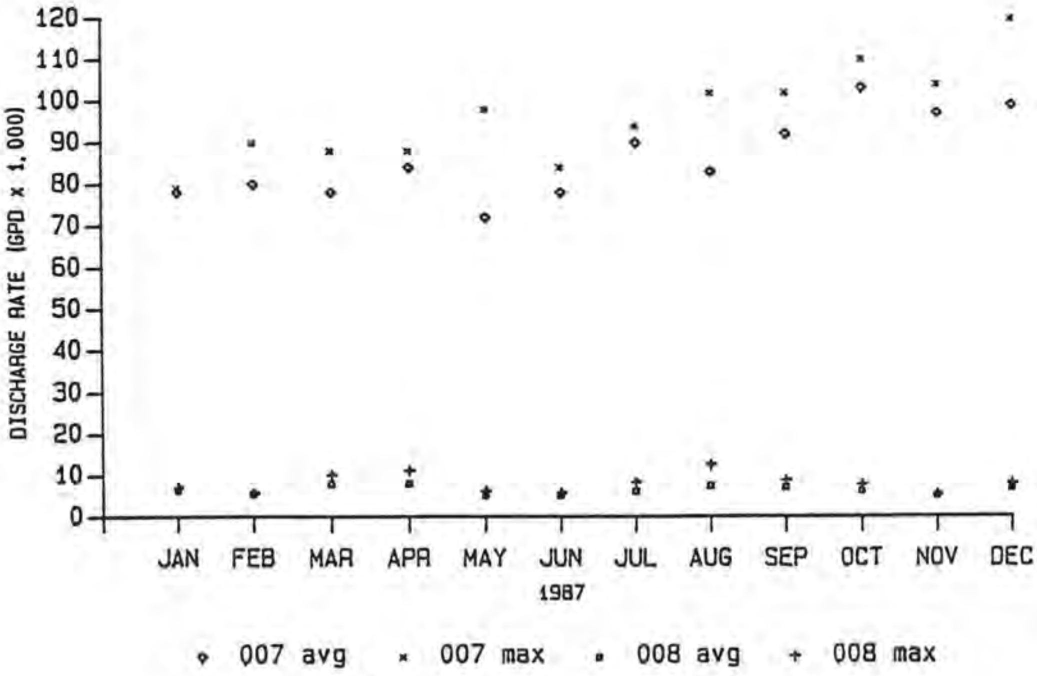


Figure C-5.20 Discharge Rate, Outfalls 007, 008

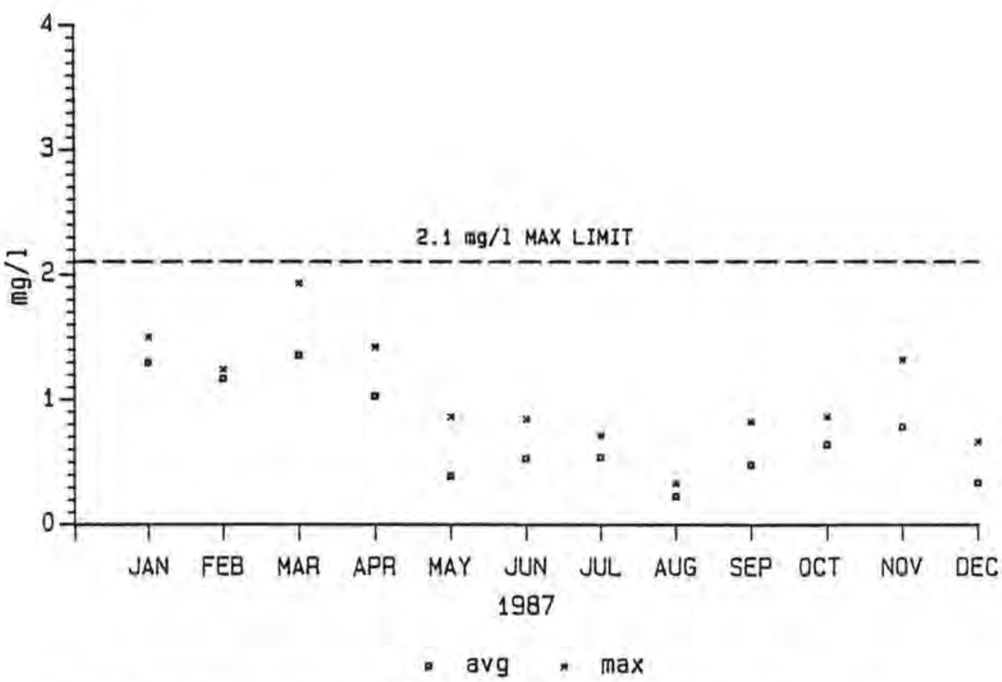


Figure C-5. 21 Flow Weighted Averages - Ammonia, Outfalls 001, 007

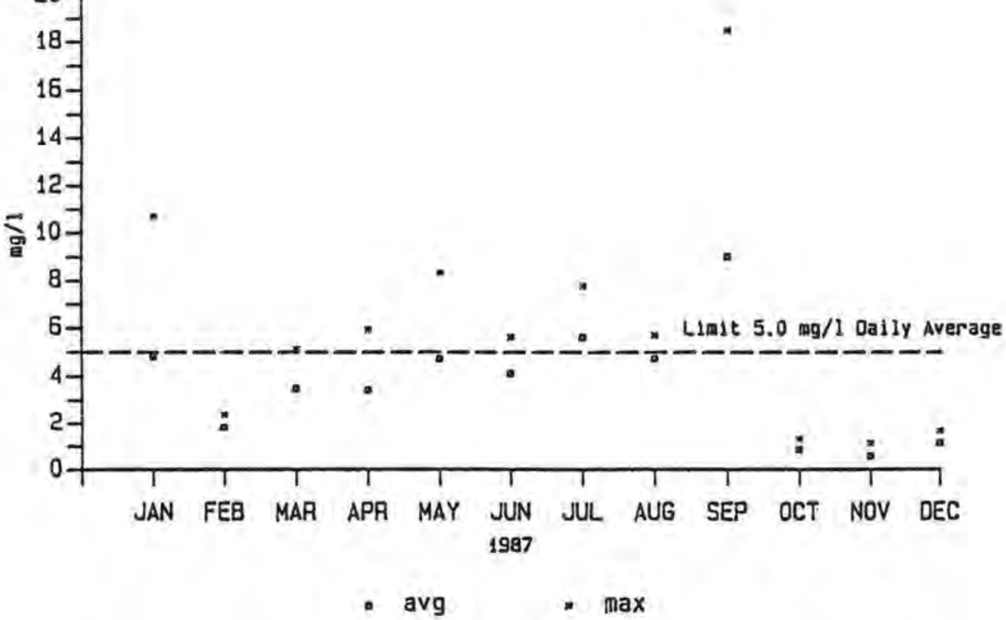


Figure C-5.22 Flow Weighted Averages - BOD-5, Outfalls 001, 007, 008

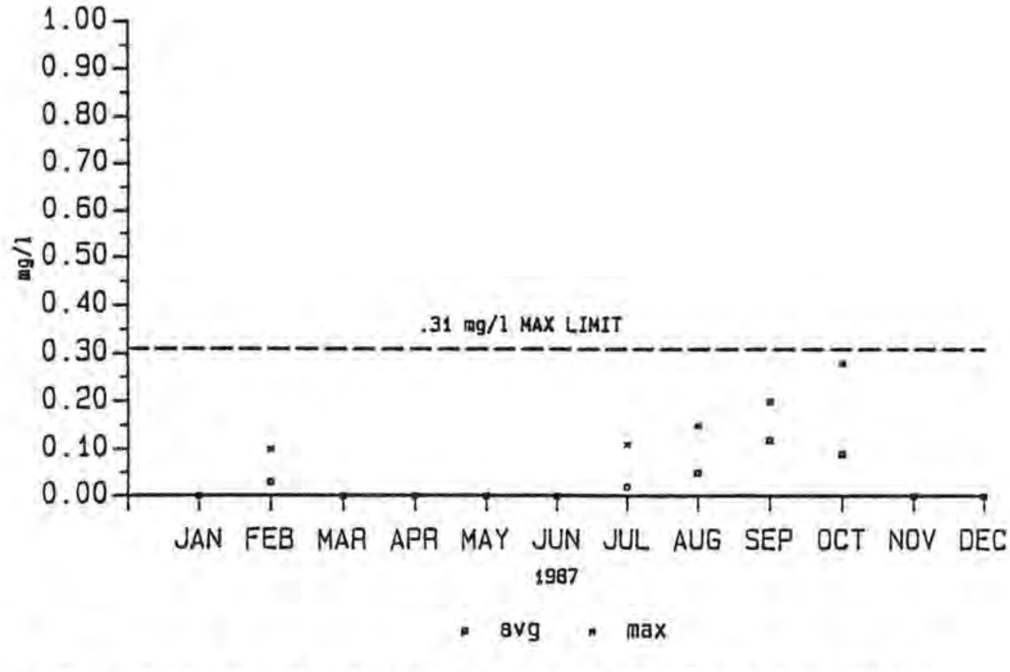


Figure C-5.23 Flow Weighted Averages - Metals (Fe) Outfalls 001, 007, 008

APPENDIX E
SUMMARY OF GROUNDWATER MONITORING

TABLE E-1
SUPPORTING GROUNDWATER MONITORING STATIONS
SAMPLED DURING 1987

LOCATION CODE	QUARTER SAMPLED	PH	CONDUCTIVITY @ 25 °C µmhos/cm	µCi/mL ALPHA	BETA	TRITIUM	Cs-137
				WELLS NEAR SITE FACILITIES			
WNW80-3	FIRST	7.12	648	<1.25E-09	3.26E-07 ± 0.11E-07	2.99E-07 ± 1.16E-07	<4.2E-08
WNW80-3	SECOND	6.95	571	<2.29E-09	2.51E-07 ± 0.07E-07	2.26E-07 ± 1.12E-07	<4.2E-08
WNW80-3	THIRD	7.00	495	<2.06E-09	2.84E-07 ± 0.10E-07	1.76E-06 ± 1.08E-07	<4.2E-08
WNW80-4	FIRST	7.44	553	<1.34E-09	7.39E-09 ± 2.38E-09	5.38E-07 ± 1.29E-07	<4.2E-08
WNW80-4	SECOND	7.08	580	<9.66E-10	5.14E-09 ± 1.31E-09	1.40E-06 ± 0.15E-07	<4.2E-08
WNW80-4	THIRD	7.27	736	<1.75E-09	1.83E-08 ± 0.31E-08	9.52E-07 ± 1.31E-07	<4.2E-08
				WELLS NEAR NRC DISPOSAL UNIT			
WNW82-1A	FIRST	7.24	1196	1.24E-08 ± 0.80E-08	3.14E-09 ± 2.19E-09	not available	<4.2E-08
WNW82-1A	SECOND	7.00	1237	5.14E-09 ± 4.76E-09	8.67E-09 ± 1.75E-09	7.70E-07 ± 1.23E-07	<4.2E-08
WNW82-1A	THIRD	7.16	1226	<3.69E-09	2.69E-09 ± 2.02E-09	4.91E-07 ± 1.13E-07	<4.2E-08
WNW82-1B	FIRST	7.10	1456	<5.11E-09	6.75E-09 ± 2.64E-09	not available	<4.2E-08
WNW82-1B	SECOND	7.00	1448	<5.71E-09	4.65E-09 ± 1.75E-09	4.14E-07 ± 1.09E-07	<4.2E-08
WNW82-1B	THIRD	7.00	1397	<3.96E-09	5.92E-09 ± 2.43E-09	6.88E-07 ± 1.17E-07	<4.2E-08
WNW82-1C	FIRST	7.65	504	1.18E-07 ± 0.47E-07	1.48E-07 ± 0.13E-07	not available	<4.2E-08
WNW82-1C	SECOND	7.48	483	2.32E-08 ± 1.26E-08	4.47E-08 ± 0.54E-08	<1.0E-07	<4.2E-08
WNW82-1C	THIRD	7.78	462	1.65E-08 ± 1.16E-08	4.30E-08 ± 0.52E-08	<1.0E-07	<4.2E-08
WNW82-2B	FIRST	7.34	795	1.14E-07 ± 0.49E-07	1.77E-07 ± 0.15E-07	not available	<4.2E-08
WNW82-2B	SECOND	7.17	793	6.28E-08 ± 2.34E-08	1.03E-07 ± 0.06E-07	<1.0E-07	<4.2E-08
WNW82-2B	THIRD	7.47	781	8.07E-08 ± 3.02E-08	2.18E-07 ± 0.15E-07	<1.0E-07	<4.2E-08
WNW82-2C	THIRD	9.25	692	2.24E-08 ± 1.81E-08	6.02E-08 ± 0.95E-08	<1.0E-07	<4.2E-08
WNW82-3A	FIRST	7.47	768	<5.33E-09	2.55E-08 ± 0.37E-08	not available	<4.2E-08
WNW82-3A	SECOND	7.25	523	1.02E-08 ± 0.58E-08	2.88E-08 ± 0.27E-08	<1.0E-07	<4.2E-08
WNW82-3A	THIRD	7.69	692	1.50E-07 ± 0.60E-07	2.58E-07 ± 0.16E-07	4.01E-07 ± 1.30E-07	<4.2E-08
WNW82-4A1	FIRST	6.81	1301	<3.8 E-09	6.51E-09 ± 2.71E-09	not available	<4.2E-08
WNW82-4A1	SECOND	6.69	1346	<3.81E-09	5.08E-09 ± 1.54E-09	2.48E-05 ± 0.08E-05	<4.2E-08
WNW82-4A1	THIRD	6.89	1319	<6.04E-09	1.11E-08 ± 0.30E-08	2.29E-05 ± 0.07E-05	<4.2E-08
WNW82-4A2	FIRST	6.82	1484	<7.12E-09	8.55E-09 ± 2.99E-09	not available	<4.2E-08
WNW82-4A2	SECOND	6.72	1544	<3.61E-09	7.11E-09 ± 1.70E-09	3.83E-07 ± 1.10E-07	<4.2E-08
WNW82-4A2	THIRD	6.77	1465	<3.31E-09	7.96E-09 ± 2.89E-09	<1.0E-07	<4.2E-08
WNW82-4A3	FIRST	6.85	1460	<9.10E-09	1.08E-08 ± 0.36E-08	not available	<4.2E-08
WNW82-4A3	SECOND	6.70	1450	<2.10E-09	6.52E-09 ± 1.68E-09	3.55E-07 ± 1.10E-07	<4.2E-08
WNW82-4A3	THIRD	6.74	1440	<3.33E-09	6.59E-09 ± 2.79E-09	1.45E-07 ± 1.15E-07	<4.2E-08

TABLE E-2
1987 FUEL TANK GROUNDWATER MONITORING

PARAMETER	WNW86-13 FIRST QTR	WNW68-13 SECOND QTR	WNW86-13 THIRD QTR	WNW86-13 FOURTH QTR
pH	7.15	6.85	7.15	7.19
CONDUCTIVITY (µmhos/cm)	702	667	673	675
TOC (mg/L)	8.7	8.7	<1.0	4.7
PHENOLS (mg/L)	<0.01	<0.01	<0.01	<0.01
BENZENE (µg/L)			<0.2	<0.2
TOLUENE (µg/L)			<0.2	<0.2
o-XYLENE (µg/L)			<0.2	<0.2
m-XYLENE (µg/L)			<0.2	<0.2
p-XYLENE (µg/L)			<0.2	<0.2
ALPHA (µCi/mL)	<2.23E-09	<1.49E-09	<9.55E-10	<3.22E-09
BETA (µCi/mL)	3.01E-09 ± 2.01E-0	3.99E-09 ± 1.21E-09	4.36E-09 ± 2.06E-09	5.14E-09 ± 2.27E-09
TRITIUM (µCi/mL)	<1.0E-07	2.20E-07 ± 1.10E-07	1.21E-07 ± 1.05E-07	<1.0E-07

TABLE E-3
1987 WATER QUALITY PARAMETERS FOR
HIGH-LEVEL RADIOACTIVE WASTE TANK COMPLEX
GROUNDWATER MONITORING UNIT

LOCATION CODE	QUARTER SAMPLED	pH	CONDUCTIVITY (@25 °C) (µmhos/cm)	TOC	PHENOL	CHLORIDE	NITRATE	SULFATE	FLUORIDE
				mg/L					
WNW80-02	FIRST	7.97	306	13.0	0.02	20.0	2.75	9.6	<0.20
WNW80-02	SECOND	8.14	309	1.0	<0.010	24.7	1.71	10.0	0.26
WNW80-02	THIRD	7.80	340	0.9	<0.010	30.9	1.88	10.8	<1.75
WNW80-02	FOURTH	7.77	347	1.0	<0.010	23.6	2.09	10.6	0.10
WNW86-07	FIRST	7.01	944	6.0	0.013	26.8	4.76	156.8	0.46
WNW86-07	SECOND	6.61	869	4.2	<0.010	33.0	5.97	176.8	0.41
WNW86-07	THIRD	6.70	961	1.2	<0.010	20.3	1.12	171.8	0.14
WNW86-07	FOURTH	6.71	957	1.1	<0.010	15.8	1.23	191.1	<0.20
WNW86-08	FIRST	6.78	1213	11.2	0.018	161.3	<0.10	180.3	<0.20
WNW86-08	SECOND	6.95	935	5.4	<0.010	65.2	<0.10	177.1	0.27
WNW86-08	THIRD	6.65	792	21.8	<0.010	24.9	<0.10	193.9	<0.10
WNW86-08	FOURTH	6.79	776	1.8	<0.010	24.6	<0.10	179.5	<0.20
WNW86-09	FIRST	7.29	681	12.2	0.015	33.1	7.98	34.4	0.29
WNW86-09	SECOND	7.21	686	4.9	<0.010	34.0	5.63	35.3	0.12
WNW86-09	THIRD	7.25	661	1.4	<0.010	35.2	6.56	36.1	<0.10
WNW86-09	FOURTH	6.83	677	1.0	<0.010	41.4	7.29	34.0	<0.20
WNDMPNE*	FIRST	6.61	333	11.5	0.028	13.1	3.17	26.6	<0.20
WNDMPNE	SECOND	6.86	651	2.0	<0.015	64.3	3.80	52.9	<0.20
WNDMPNE	THIRD	6.93	647	3.8	0.010	69.6	2.71	52.2	<0.10
WNDMPNE	FOURTH	6.61	572	5.1	<0.010	42.4	4.38	55.0	<0.20
WNW86-12*	FIRST	7.37	526	2.7	<0.010	23.3	<0.20	48.4	0.51
WNW86-12	SECOND	7.67	538	1.1	<0.010	29.6	<1.00	46.1	<0.20
WNW86-12	THIRD	7.64	394	1.7	<0.013	33.8	0.23	51.7	<0.10
WNW86-12	FOURTH	7.37	567	1.3	<0.010	39.6	<0.10	53.9	<0.20

Notes: Each entry represents the average of four replicate measurements per quarter. Cohen's method from the "RCRA Ground-water Monitoring Technical Enforcement Guidance Document" was used to average the mixture of positive and less-than-detection-limit values.

* Monitoring wells near former cold dump.

TABLE E-4
1987 TOTAL METALS FOR
HIGH-LEVEL RADIOACTIVE WASTE TANK COMPLEX
GROUNDWATER MONITORING UNIT
(mg/L)

LOCATION CODE	QUARTER SAMPLED	ARSENIC	BARIUM	CADMIUM	CHROMIUM	IRON	LEAD	MANGANESE	MERCURY	SELENIUM	SILVER	SODIUM
WNW80-02	FIRST	<0.001	0.05	<0.001	0.005	0.51	0.047	0.03	<0.0100	<0.001	0.001	2.8
WNW80-02	SECOND	0.008	0.12	0.005	0.034	6.20	0.017	0.20	<0.0005	<0.005	<0.005	5.0
WNW80-02	THIRD	<0.005	0.08	<0.008	0.013	4.30	0.004	0.26	<0.0005	<0.005	<0.005	4.8
WNW80-02	FOURTH	<0.005	0.07	<0.005	<0.005	0.18	0.058	0.05	<0.0005	<0.005	<0.005	< 5.0
WNW86-07	FIRST	<0.010	0.04	<0.010	<0.10	2.62	0.010	0.31	<0.0100	0.009	<0.010	9.1
WNW86-07	SECOND	<0.005	0.07	0.005	0.008	0.37	0.006	0.15	<0.0005	<0.005	<0.005	7.5
WNW86-07	THIRD	<0.005	<0.08	<0.006	0.005	0.13	<0.005	0.26	<0.0005	<0.005	<0.005	9.0
WNW86-07	FOURTH	<0.005	0.10	0.006	0.005	0.49	<0.040	0.21	<0.0005	<0.005	<0.005	12.5
WNW86-08	FIRST	<0.010	0.62	<0.010	0.020	7.21	0.153	24.22	<0.0100	0.010	<0.010	10.5
WNW86-08	SECOND	<0.005	0.13	<0.005	0.020	1.65	0.005	8.25	<0.0005	<0.005	<0.005	10.0
WNW86-08	THIRD	<0.005	0.10	<0.006	0.005	1.40	<0.005	10.08	<0.0005	<0.005	<0.005	8.3
WNW86-08	FOURTH	<0.005	0.09	<0.005	<0.005	0.72	<0.040	5.48	<0.0005	<0.005	<0.005	7.0
WNW86-09	FIRST				***DATA NOT AVAILABLE***							
WNW86-09	SECOND	0.005	0.21	0.015	0.027	4.18	0.011	0.14	<0.0005	<0.005	<0.005	8.0
WNW86-09	THIRD	<0.005	0.21	<0.006	0.005	2.83	0.005	0.25	<0.0005	<0.005	0.005	6.3
WNW86-09	FOURTH	<0.005	0.21	0.005	0.004	1.90	0.043	0.19	<0.0005	<0.005	<0.005	7.0
WNDMPNE*	FIRST	0.008	0.09	<0.001	0.010	2.77	0.031	0.11	<0.0100	<0.001	0.001	2.9
WNDMPNE	SECOND	0.008	0.11	<0.005	0.012	0.39	<0.005	0.03	<0.0005	<0.005	<0.005	20.0
WNDMPNE	THIRD	<0.005	0.09	<0.008	0.004	0.05	0.003	0.01	<0.0005	<0.005	<0.005	14.8
WNDMPNE	FOURTH	<0.005	0.08	0.006	<0.005	0.16	<0.040	0.02	<0.0005	<0.005	<0.005	12.3
WNW86-12*	FIRST	0.000	0.21	<0.001	0.004	0.31	0.028	0.06	<0.0020	0.003	0.008	9.0
WNW86-12	SECOND	<0.005	0.26	<0.005	0.006	0.24	<0.005	0.07	<0.0005	<0.005	<0.005	10.0
WNW86-12	THIRD	<0.005	0.30	<0.008	0.005	0.26	0.009	0.08	0.0003	<0.005	0.007	11.0
WNW86-12	FOURTH	<0.005	0.26	<0.007	<0.005	0.25	0.013	0.07	<0.0005	<0.005	<0.005	10.8

Notes: Each entry represents the average of four replicate measurements per quarter. Cohen's method from the "RCRA Ground-water Monitoring Technical Enforcement Guidance Document" was used to average the mixture of positive and less-than-detection-limit values.

* Monitoring wells near former cold dump.

TABLE E-5
1987 DISSOLVED METALS FOR
HIGH-LEVEL RADIOACTIVE WASTE TANK COMPLEX
GROUNDWATER MONITORING UNIT
(mg/L)

LOCATION CODE	QUARTER SAMPLED	ARSENIC	BARIUM	CADMIUM	CHROMIUM	IRON	LEAD	MANGANESE	MERCURY	SELENIUM	SILVER	SODIUM
WNW80-02	FIRST	<0.001	0.06	<0.001	0.004	0.07	0.037	0.01	<0.0100	0.003	<0.001	3.2
WNW80-02	SECOND	<0.005	0.06	<0.005	<0.006	0.03	<0.005	0.09	<0.0007	<0.005	<0.005	5.0
WNW80-02	THIRD	<0.005	0.07	<0.005	<0.005	0.27	<0.005	0.42	<0.0005	<0.005	<0.005	4.8
WNW80-02	FOURTH	<0.005	0.08	<0.005	0.004	0.04	<0.020	0.05	<0.0005	<0.005	<0.005	<5.0
WNW86-07	FIRST	<0.001	0.07	<0.001	0.001	0.02	0.002	0.22	<0.0010	0.009	<0.001	8.5
WNW86-07	SECOND	<0.005	0.06	<0.005	<0.006	<0.02	<0.005	0.06	<0.0005	<0.005	<0.005	7.8
WNW86-07	THIRD	<0.005	<0.08	<0.005	<0.005	<0.03	<0.005	0.21	<0.0005	<0.005	<0.005	14.8
WNW86-07	FOURTH	<0.005	0.07	<0.005	<0.005	0.02	0.021	0.19	<0.0005	<0.005	<0.005	11.5
WNW86-08	FIRST	<0.001	0.14	<0.001	0.014	2.88	0.023	25.24	0.0033	<0.001	0.002	8.8
WNW86-08	SECOND	<0.005	0.11	<0.005	<0.006	0.34	<0.005	5.60	<0.0005	<0.005	<0.005	10.0
WNW86-08	THIRD	0.005	0.08	<0.005	<0.005	1.40	<0.005	13.25	<0.0005	<0.005	<0.005	8.3
WNW86-08	FOURTH	<0.005	0.10	<0.005	<0.005	0.28	<0.030	7.88	<0.0005	<0.005	<0.005	7.0
WNW86-09	FIRST	<0.001	0.13	<0.001	0.000	0.02	0.002	0.04	0.0010	0.006	<0.001	4.9
WNW86-09	SECOND	<0.005	0.17	<0.005	<0.006	0.02	<0.005	0.07	<0.0005	<0.005	<0.005	8.5
WNW86-09	THIRD	<0.005	0.18	<0.005	<0.005	<0.03	<0.005	<0.01	<0.0005	<0.005	<0.005	6.8
WNW86-09	FOURTH	<0.005	0.21	<0.005	<0.005	0.03	<0.030	0.01	<0.0005	<0.005	<0.005	7.0
WNDMPNE*	FIRST	<0.010	0.05	<0.010	<0.010	0.05	0.010	0.01	<0.0100	<0.010	<0.010	2.8
WNDMPNE	SECOND	<0.005	0.10	<0.005	<0.005	<0.02	<0.005	0.02	<0.0005	<0.005	<0.005	20.0
WNDMPNE	THIRD	<0.005	0.09	<0.005	<0.005	<0.05	<0.005	0.01	<0.0005	<0.005	<0.005	15.0
WNDMPNE	FOURTH	<0.005	0.07	<0.005	<0.005	0.02	<0.030	0.01	<0.0005	<0.005	<0.005	12.5
WNW86-12*	FIRST	<0.001	0.22	<0.001	0.003	0.21	0.033	0.06	0.0010	0.006	0.007	9.7
WNW86-12	SECOND	<0.005	0.25	<0.005	<0.005	0.18	<0.005	0.07	<0.0005	<0.005	<0.005	10.0
WNW86-12	THIRD	<0.005	0.30	<0.005	<0.005	0.26	<0.005	0.07	<0.0005	<0.005	<0.005	11.0
WNW86-12	FOURTH	<0.005	0.25	<0.005	<0.005	0.25	<0.030	0.08	<0.0005	<0.005	<0.005	11.5

Notes: Each entry represents the average of four replicate measurements per quarter. Cohen's method from the "RCRA Ground-water Monitoring Technical Enforcement Guidance Document" was used to average the mixture of positive and less-than-detection-limit values.

* Monitoring wells near former cold dump.

TABLE E-6
1987 RADIOACTIVITY CONCENTRATIONS FOR GROUNDWATER
IN HIGH-LEVEL RADIOACTIVE WASTE TANK COMPLEX MONITORING UNIT
(µCi/mL)

LOCATION CODE	QUARTER SAMPLED	ALPHA	BETA	Tritium (H-3)	Cs-137	Co-60
WNW80-02	FIRST	<1.13E-09	<1.64E-09	<1.00E-07	<1.08E-07	<1.09E-07
WNW80-02	SECOND	1.29E-09 ± 7.07E-10	5.58E-09 ± 6.77E-10	<1.00E-07	<1.08E-07	<1.09E-07
WNW80-02	THIRD	<1.58E-09	2.01E-09 ± 6.75E-10	1.23E-07 ± 5.42E-08	<1.08E-07	<1.09E-07
WNW80-02	FOURTH	<1.05E-09	7.63E-10 ± 6.96E-10	<1.00E-07	<1.08E-07	<1.09E-07
WNW86-07	FIRST	<6.00E-09	5.56E-09 ± 1.22E-09	4.61E-07 ± 6.84E-08	<1.08E-07	<1.09E-07
WNW86-07	SECOND	2.17E-09 ± 1.27E-09	7.37E-09 ± 8.08E-10	2.30E-07 ± 5.66E-08	<1.08E-07	<1.09E-07
WNW86-07	THIRD	<2.11E-09	5.17E-09 ± 7.92E-10	1.57E-07 ± 5.37E-08	<1.08E-07	<1.09E-07
WNW86-07	FOURTH	<2.95E-09	3.77E-09 ± 1.01E-09	<1.00E-07	<1.08E-07	<1.09E-07
WNW86-08	FIRST	<5.15E-09	3.85E-09 ± 1.17E-09	4.13E-06 ± 1.34E-07	<1.08E-07	<1.09E-07
WNW86-08	SECOND	4.77E-09 ± 1.80E-09	2.82E-08 ± 1.40E-09	3.66E-06 ± 9.17E-08	<1.08E-07	<1.09E-07
WNW86-08	THIRD	<1.85E-09	1.03E-08 ± 9.17E-10	1.15E-06 ± 9.71E-07	<1.08E-07	<1.09E-07
WNW86-08	FOURTH	<2.33E-09	7.33E-09 ± 1.13E-09	5.80E-06 ± 2.60E-07	<1.08E-07	<1.09E-07
WNW86-09	FIRST	1.39E-08 ± 5.47E-09	1.19E-07 ± 3.03E-09	3.34E-06 ± 9.63E-08	<1.08E-07	<1.09E-07
WNW86-09	SECOND	8.89E-09 ± 2.13E-09	1.03E-07 ± 2.49E-09	3.45E-06 ± 9.15E-08	<1.08E-07	<1.09E-07
WNW86-09	THIRD	2.04E-09 ± 1.57E-09	1.45E-07 ± 3.13E-09	2.26E-06 ± 9.43E-08	<1.08E-07	<1.09E-07
WNW86-09	FOURTH	<2.74E-09	1.45E-07 ± 3.20E-09	3.90E-06 ± 2.20E-07	<1.08E-07	<1.09E-07
WNDMPNE*	FIRST	2.49E-09 ± 1.99E-09	6.82E-08 ± 2.51E-09	1.75E-07 ± 5.43E-08	<1.08E-07	<1.09E-07
WNDMPNE	SECOND	3.25E-09 ± 1.23E-09	9.89E-08 ± 2.30E-09	9.94E-07 ± 6.53E-08	<1.08E-07	<1.09E-07
WNDMPNE	THIRD	<1.44E-09	9.61E-08 ± 2.36E-09	8.07E-07 ± 6.25E-08	<1.08E-07	<1.09E-07
WNDMPNE	FOURTH	<1.69E-09	1.32E-07 ± 3.28E-09	5.67E-07 ± 1.20E-08	<1.08E-07	<1.09E-07
WNW86-12*	FIRST	<1.58E-09	1.70E-09 ± 9.27E-10	5.46E-06 ± 1.24E-07	<1.08E-07	<1.09E-07
WNW86-12	SECOND	<9.86E-10	1.20E-09 ± 5.05E-10	4.82E-06 ± 1.15E-07	<1.08E-07	<1.09E-07
WNW86-12	THIRD	<1.31E-09	1.46E-09 ± 6.51E-10	5.03E-06 ± 1.18E-07	<1.08E-07	<1.09E-07
WNW86-12	FOURTH	<1.92E-09	1.45E-09 ± 8.27E-10	4.51E-06 ± 2.20E-07	<1.08E-07	<1.09E-07

Note: Each entry represents the average of four replicate measurements per quarter.

* Monitoring wells near former cold dump.

TABLE E-7
1987 WATER QUALITY PARAMETERS FOR
LOW-LEVEL RADIOACTIVE WASTE LAGOON SYSTEM
GROUNDWATER MONITORING UNIT

LOCATION CODE	QUARTER SAMPLED	pH	CONDUCTIVITY (@25 °C) (µmhos/cm)	mg/L TOC	PHENOL	CHLORIDE	NITRATE	SULFATE	FLUORIDE
WNW86-06	FIRST	6.74	1982	10	0.01	639.1	0.34	49.65	<0.20
WNW86-06	SECOND	6.85	1611	2	<0.01	419.7	<0.10	49.79	<0.20
WNW86-06	THIRD	6.72	1600	1	<0.01	212.4	<0.10	38.00	<0.10
WNW86-06	FOURTH	6.52	1292	1	<0.01	350.3	<0.10	29.25	<0.20
WNGSEEP	FIRST	6.61	402	6	0.01	25.0	4.74	43.58	0.29
WNGSEEP	SECOND	6.49	496	< 1	<0.01	40.5	2.52	55.40	0.10
WNGSEEP	THIRD	6.53	479	< 1	<0.01	36.0	3.73	46.67	<0.10
WNGSEEP	FOURTH	6.04	446	1	<0.01	27.7	6.04	43.00	<0.20
WNSP008	FIRST	7.09	680	11	<0.01	39.6	5.74	60.87	0.04
WNSP008	SECOND	6.70	877	7	<0.02	72.9	6.08	62.33	0.32
WNSP008	THIRD	6.91	895	1	<0.01	81.0	5.44	75.05	0.20
WNSP008	FOURTH	6.65	875	3	<0.01	62.5	6.73	94.60	<0.20
WNW80-05	FIRST	6.92	423	14	0.03	30.6	1.96	28.34	0.37
WNW80-05	SECOND	6.73	650	1	<0.01	58.5	2.67	51.61	<0.20
WNW80-05	THIRD	7.14	546	< 1	<0.01	41.5	0.27	45.79	0.16
WNW80-05	FOURTH	6.98	477	4	<0.01	25.8	0.90	37.31	0.38
WNW80-06	FIRST	6.45	633	16	<0.01	165.7	<0.10	44.51	<0.20
WNW80-06	SECOND	5.96	721	1	<0.01	31.7	1.41	126.66	0.37
WNW80-06	THIRD	6.39	894	1	<0.01	52.0	1.04	164.98	0.17
WNW80-06	FOURTH	6.27	813	1	<0.01	33.4	0.43	153.83	<0.20
WNW86-03	FIRST	7.35	724	16	0.03	74.1	5.95	36.09	0.26
WNW86-03	SECOND	7.42	717	2	<0.01	68.1	4.93	34.00	0.16
WNW86-03	THIRD	7.36	779	< 1	<0.01	90.3	9.60	32.15	0.10
WNW86-03	FOURTH	7.22	823	1	<0.01	129.3	5.35	33.34	<0.20
WNW86-04	FIRST	7.23	706	11	0.01	75.4	5.48	39.97	0.10
WNW86-04	SECOND	7.31	726	3	<0.01	76.9	3.12	35.78	0.26
WNW86-04	THIRD	7.37	774	1	<0.01	82.7	7.28	33.81	0.14
WNW86-04	FOURTH	7.08	807	1	<0.01	97.6	3.90	30.18	<0.20
WNW86-05	FIRST	6.83	436	17	<0.01	2.5	<0.10	41.13	<0.20
WNW86-05	SECOND	6.66	949	34	<0.01	36.2	<1.00	59.59	0.64
WNW86-05	THIRD	6.63	793	12	<0.01	12.5	<0.10	45.70	0.09
WNW86-05	FOURTH	6.93	464	9	<0.01	2.8	<0.10	24.72	0.19

Note: Each entry represents the average of four replicate measurements per quarter. Cohen's method from the "RCRA Ground-water Monitoring Technical Enforcement Guidance Document" was used to average the mixture of positive and less-than-detection-limit values.

TABLE E-8
1987 TOTAL METALS FOR
LOW-LEVEL RADIOACTIVE WASTE LAGOON SYSTEM
GROUNDWATER MONITORING UNIT
(mg/L)

LOCATION CODE	QUARTER SAMPLED	ARSENIC	BARIUM	CADMIUM	CHROMIUM	IRON	LEAD	MANGANESE	MERCURY	SELENIUM	SILVER	SODIUM
WNW86-06	FIRST	<0.010	0.096	0.007	0.009	2.57	0.055	2.34	0.0092	<0.003	0.004	215
WNW86-06	SECOND	<0.005	0.085	0.005	0.009	0.44	<0.005	2.00	<0.0005	<0.005	<0.005	198
WNW86-06	THIRD	0.007	0.085	0.006	0.061	1.50	0.005	3.00	<0.0005	<0.005	<0.005	181
WNW86-06	FOURTH	<0.005	0.060	<0.005	0.005	0.27	0.018	2.90	<0.0005	<0.005	<0.005	118
WNGSEEP	FIRST	0.008	0.132	0.002	0.014	1.85	0.110	0.04	0.0048	<0.001	<0.001	9
WNGSEEP	SECOND	<0.005	0.138	<0.005	<0.007	2.13	<0.005	0.05	<0.0005	<0.005	<0.005	10
WNGSEEP	THIRD	<0.005	0.113	<0.155	0.009	0.13	<0.005	<0.01	<0.0005	<0.005	<0.005	13
WNGSEEP	FOURTH	<0.005	0.075	<0.007	<0.005	0.12	<0.040	0.01	<0.0005	<0.005	<0.005	11
WNSP008	FIRST	<0.010	0.060	0.002	0.010	0.09	0.078	1.21	<0.0100	<0.010	0.002	32
WNSP008	SECOND	<0.005	0.070	<0.005	<0.007	0.08	0.007	1.98	<0.0005	<0.005	<0.005	60
WNSP008	THIRD	<0.005	0.080	<0.006	0.001	0.04	<0.005	1.45	<0.0005	<0.005	<0.005	51
WNSP008	FOURTH	<0.005	0.085	0.005	<0.005	0.05	<0.020	1.93	<0.0005	<0.005	<0.005	42
WNW80-05	FIRST	0.010	0.119	0.000	0.020	15.96	0.085	0.22	0.0115	<0.001	<0.001	3
WNW80-05	SECOND	<0.005	0.130	<0.005	<0.005	15.50	0.021	0.31	<0.0005	<0.005	<0.005	9
WNW80-05	THIRD	<0.005	0.095	<0.008	<0.005	0.95	0.006	0.17	<0.0005	<0.005	<0.005	7
WNW80-05	FOURTH	<0.005	0.058	<0.005	<0.005	1.07	0.002	0.07	0.0004	<0.005	<0.005	6
WNW80-06	FIRST	<0.010	0.098	<0.010	0.043	8.75	0.063	0.15	<0.0100	<0.010	<0.010	6
WNW80-06	SECOND	<0.005	0.055	<0.005	<0.005	0.18	0.005	5.53	<0.0005	<0.005	<0.005	10
WNW80-06	THIRD	<0.005	0.039	<0.008	0.005	0.63	<0.005	7.90	<0.0005	<0.005	<0.005	16
WNW80-06	FOURTH	<0.005	0.063	<0.005	<0.005	0.86	<0.020	9.93	<0.0005	<0.005	<0.005	16
WNW86-03	FIRST	0.010	0.109	<0.010	<0.010	0.50	0.020	0.01	<0.0125	0.015	<0.010	17
WNW86-03	SECOND	<0.005	0.208	<0.005	0.005	0.11	0.005	<0.02	<0.0005	<0.005	<0.005	20
WNW86-03	THIRD	<0.005	0.213	<0.008	<0.005	0.05	0.022	0.01	<0.0005	<0.005	<0.005	22
WNW86-03	FOURTH	<0.005	0.190	<0.005	<0.005	0.04	<0.020	0.01	<0.0005	<0.005	<0.005	21
WNW86-04	FIRST	<0.010	0.195	<0.010	<0.010	5.47	0.022	0.09	0.0226	<0.010	<0.010	20
WNW86-04	SECOND	<0.005	0.285	<0.005	0.005	1.75	0.005	0.05	<0.0005	<0.005	<0.005	20
WNW86-04	THIRD	<0.005	0.215	<0.008	<0.005	0.13	0.005	0.04	<0.0005	<0.005	<0.005	22
WNW86-04	FOURTH	<0.005	0.290	<0.005	<0.005	3.08	<0.040	0.09	<0.0005	<0.005	<0.005	22
WNW86-05	FIRST	<0.010	0.113	<0.010	<0.010	0.81	0.020	2.63	<0.0100	<0.010	<0.010	18
WNW86-05	SECOND	<0.200	0.135	<0.005	<0.010	3.78	<0.100	12.50	<0.0005	<0.200	<0.020	64
WNW86-05	THIRD	<0.010	0.108	<0.002	<0.020	3.78	<0.050	10.85	0.0003	<0.005	<0.010	38
WNW86-05	FOURTH	<0.010	0.063	<0.002	0.067	2.16	<0.050	6.29	<0.0002	<0.050	0.053	16

Note: Each entry represents the average of four replicate measurements per quarter. Cohen's method from the "RCRA Groundwater Monitoring Technical Enforcement Guidance Document" was used to average the mixture of positive and less-than-detection-limit values.

TABLE E-9
1987 DISSOLVED METALS FOR
LOW-LEVEL RADIOACTIVE WASTE LAGOON SYSTEM
GROUNDWATER MONITORING UNIT
(mg/L)

LOCATION CODE	QUARTER SAMPLED	ARSENIC	BARIUM	CADMIUM	CHROMIUM	IRON	LEAD	MANGANESE	MERCURY	SELENIUM	SILVER	SODIUM
WNW86-06	FIRST	<0.001	0.08	<0.001	0.002	0.05	0.000	2.19	<0.0010	0.007	<0.001	188
WNW86-06	SECOND	<0.005	0.09	<0.005	<0.006	0.01	<0.005	2.00	<0.0005	<0.005	<0.005	195
WNW86-06	THIRD	<0.005	0.08	<0.005	<0.005	<0.05	<0.005	3.00	<0.0005	<0.005	<0.005	164
WNW86-06	FOURTH	<0.005	0.06	<0.005	<0.005	0.02	<0.020	2.68	<0.0005	<0.005	<0.005	100
WNGSEEP	FIRST	<0.010	0.08	<0.010	<0.010	0.04	0.010	<0.01	<0.0100	0.010	<0.010	9
WNGSEEP	SECOND	<0.005	0.11	<0.005	<0.005	<0.02	<0.05	<0.01	<0.0005	<0.005	<0.005	10
WNGSEEP	THIRD	<0.005	0.12	<0.005	<0.005	<0.03	<0.005	<0.01	<0.0005	<0.005	<0.005	12
WNGSEEP	FOURTH	<0.005	0.08	<0.005	<0.005	<0.02	<0.030	0.01	<0.0005	<0.005	<0.005	12
WNSP008	FIRST	<0.010	0.05	<0.010	<0.010	0.04	0.010	1.02	<0.0100	0.010	0.018	28
WNSP008	SECOND	<0.005	0.07	<0.005	<0.005	<0.02	<0.005	1.85	<0.0005	<0.005	<0.005	60
WNSP008	THIRD	<0.005	0.07	<0.005	<0.005	<0.03	<0.005	1.80	<0.0005	<0.009	<0.005	52
WNSP008	FOURTH	<0.005	0.08	<0.005	<0.005	0.03	0.023	1.85	<0.0005	<0.005	<0.005	42
WNW80-05	FIRST	<0.001	0.05	0.001	0.005	0.31	0.008	2.12	0.0010	0.005	0.001	12
WNW80-05	SECOND	<0.005	0.07	<0.005	<0.005	<0.02	<0.005	0.08	<0.0005	<0.005	<0.005	9
WNW80-05	THIRD	<0.005	0.09	<0.005	0.004	0.19	<0.005	0.18	<0.0005	<0.005	<0.005	7
WNW80-05	FOURTH	<0.005	0.06	<0.005	<0.005	0.43	<0.020	0.07	<0.0005	<0.005	<0.005	6
WNW80-06	FIRST	<0.003	0.05	<0.003	0.006	0.30	0.006	6.44	0.0049	0.010	<0.003	12
WNW80-06	SECOND	<0.005	0.02	<0.005	<0.005	0.03	<0.005	5.43	<0.0005	<0.005	<0.005	10
WNW80-06	THIRD	<0.005	0.06	<0.005	<0.005	0.18	<0.005	4.15	<0.0005	<0.005	<0.005	32
WNW80-06	FOURTH	<0.005	0.07	<0.005	<0.005	0.75	0.020	11.00	<0.0005	<0.005	<0.005	14
WNW86-03	FIRST	<0.001	0.13	<0.001	0.002	0.03	0.010	0.01	0.0010	<0.005	0.001	17
WNW86-03	SECOND	<0.005	0.19	<0.005	<0.006	<0 02	<0.005	<0.02	<0.0008	<0.005	<0.005	20
WNW86-03	THIRD	<0.005	0.23	<0.005	0.005	<0.05	<0.005	<0.01	<0.0005	<0.005	<0.005	21
WNW86-03	FOURTH	<0.005	0.21	<0.005	<0.005	<0.02	0.018	<0.01	<0.0005	<0.005	<0.005	22
WNW86-04	FIRST	0.001	0.21	<0.001	<0.001	0.08	0.001	0.05	0.0010	0.013	0.001	17
WNW86-04	SECOND	<0.005	0.24	<0.005	<0.006	0.03	<0.005	0.04	<0.0008	<0.005	<0.005	20
WNW86-04	THIRD	<0.005	0.19	<0.005	<0.005	<0.05	<0.005	0.04	<0.0005	<0.005	<0.005	21
WNW86-04	FOURTH	<0.005	0.23	<0.005	<0.005	0.05	0.030	0.04	<0.0005	<0.005	<0.005	22
WNW86-05	FIRST	0.003	0.05	<0.001	0.006	0.29	0.012	2.13	0.0010	0.003	0.001	12
WNW86-05	SECOND	<0.200	0.12	<0.005	<0.010	1.18	<0.100	11.50	<0.0005	<0.200	<0.020	59
WNW86-05	THIRD	<0.010	0.12	<0.002	<0.020	3.43	<0.050	10.48	0.0003	<0.005	<0.010	36
WNW86-05	FOURTH	<0.010	0.07	<0.002	0.046	1.77	0.050	5.88	0.0002	<0.050	0.089	15

Note: Each entry represents the average of four replicate measurements per quarter. Cohen's method from the "RCRA Ground-water Monitoring Technical Enforcement Guidance Document" was used to average the mixture of positive and less-than-detection-limit values.

TABLE E-10
1987 RADIOACTIVITY CONCENTRATIONS FOR GROUNDWATER IN THE
LOW-LEVEL RADIOACTIVE WASTE LAGOON SYSTEM
(μCi/mL)

LOCATION CODE	QUARTER SAMPLED	ALPHA	BETA	Tritium (H-3)	Cs-137	Co-60
WNW86-06	FIRST	<5.30E-09	7.02E-09 ± 1.39E-09	6.30E-08 ± 5.41E-08	7.77E-08 +/-5.27E-08	<1.09E-07
WNW86-06	SECOND	<1.76E-09	9.53E-09 ± 9.68E-10	5.68E-08 ± 5.27E-08	<1.08E-07	<1.09E-07
WNW86-06	THIRD	<3.57E-09	4.81E-09 ± 9.64E-10	<1.00E-07	<1.08E-07	<1.09E-07
WNW86-06	FOURTH	<2.48E-09	4.17E-09 ± 1.08E-09	<1.00E-07	<1.08E-07	<1.09E-07
WNGSEEP	FIRST	<2.44E-09	2.70E-09 ± 9.43E-10	1.18E-06 ± 7.72E-08	<5.72E-08	<1.09E-07
WNGSEEP	SECOND	<1.08E-09	2.95E-09 ± 5.86E-10	1.48E-06 ± 7.13E-08	<1.08E-07	<1.09E-07
WNGSEEP	THIRD	<1.17E-09	3.31E-09 ± 6.23E-10	1.28E-06 ± 7.38E-08	<1.08E-07	<1.09E-07
WNGSEEP	FOURTH	<1.29E-09	3.24E-09 ± 9.01E-10	5.80 E-06 ± 2.60E-07	<1.08E-07	<1.09E-07
WNSP008	FIRST	<2.50E-09	3.22E-08 ± 1.89E-09	5.63E-06 ± 1.48E-07	<1.08E-07	<1.09E-07
WNSP008	SECOND	1.26E-09 ± 8.68E-10	2.35E-08 ± 1.19E-09	8.50E-06 ± 1.66E-07	<1.08E-07	<1.09E-07
WNSP008	THIRD	<2.08E-09 ± 0.00E+00	2.99E-08 ± 1.43E-09	7.47E-06 ± 1.58E-07	5.49E-08 ± 4.96E-08	<1.09E-07
WNSP008	FOURTH	<1.82E-09	3.72E-08 ± 1.94E-09	9.31E-06 ±3.60E-07	<1.08E-07	<1.09E-07
WNW80-05	FIRST	<1.12E-09	<1.77E-09	<5.77E-08	<1.08E-07	<1.09E-07
WNW80-05	SECOND	4.67E-09 ± 1.82E-09	9.14E-09 ± 8.90E-10	7.42E-07 ± 6.56E-08	<1.08E-07	<1.09E-07
WNW80-05	THIRD	<1.29E-09	1.16E-08 ± 1.20E-09	5.09E-07 ± 5.91E-08	<1.08E-07	<1.09E-07
WNW80-05	FOURTH	<1.28E-09	1.56E-09 ± 7.70E-10	4.92E-07 ± 8.74E-08	<1.08E-07	<1.09E-07
WNW80-06	FIRST	7.77E-09 ± 3.37E-09	1.79E-08 ± 1.65E-09	1.55E-06 ± 8.13E-08	<1.08E-07	<1.09E-07
WNW80-06	SECOND	<1.79E-09	7.06E-09 ± 7.95E-10	2.05E-06 ± 7.88E-08	<1.08E-07	<1.09E-07
WNW80-06	THIRD	<1.91E-09	4.49E-09 ± 8.81E-10	1.66E-06 ± 8.51E-08	<1.08E-07	<1.09E-07
WNW80-06	FOURTH	<1.90E-09	2.14E-09 ± 8.12E-10	1.30E-07 ± 1.11E-07	<1.08E-07	<1.09E-07
WNW86-03	FIRST	<2.78E-09	8.42E-09 ± 1.23E-09	1.28E-06 ± 7.00E-08	<1.08E-07	<1.09E-07
WNW86-03	SECOND	1.24E-09 ± 9.37E-10	1.00E-08 ± 8.68E-10	1.61E-06 ± 7.13E-08	<1.08E-07	<1.09E-07
WNW86-03	THIRD	<1.47E-09	5.05E-09 ± 8.24E-10	1.88E-06 ± 7.51E-08	5.90E-08 ± 5.45E-08	<1.09E-07
WNW86-03	FOURTH	<2.06E-09	8.31E-09 ± 1.08E-09	1.39E-06 ± 7.01E-08	<1.08E-07	<1.09E-07
WNW86-04	FIRST	<2.15E-09	1.14E-08 ± 1.36E-09	1.68E-06 ± 7.63E-08	<1.08E-07	<1.09E-07
WNW86-04	SECOND	2.32E-09 ± 1.14E-09	8.46E-09 ± 8.24E-10	1.66E-06 ± 7.50E-08	<1.08E-07	<1.09E-07
WNW86-04	THIRD	<1.79E-09	3.85E-08 ± 1.50E-09	2.06E-06 ± 7.63E-08	<1.08E-07	<1.09E-07
WNW86-04	FOURTH	<2.09E-09	1.90E-08 ± 1.47E-09	1.60E-06 ± 1.50E-07	<1.08E-07	<1.09E-07
WNW86-05	FIRST	8.60E-09 ± 2.98E-09	1.06E-05 ± 5.00E-08	8.94E-06 ± 1.81E-07	<1.08E-07	<1.09E-07
WNW86-05	SECOND	1.82E-08 ± 2.86E-09	3.14E-05 ± 5.00E-08	3.31E-05 ± 5.26E-07	<1.08E-07	<1.09E-07
WNW86-05	THIRD	4.84E-09 ± 2.01E-09	2.67E-05 ± 5.00E-08	1.82E-05 ± 3.26E-07	<1.08E-07	<1.09E-07
WNW86-05	FOURTH	<2.69E-09	1.61E-05 ± 5.00E-08	8.67E-06 ± 3.60E-07	<1.08E-07	<1.09E-07

Notes: Data represent average of four replicate measurements per quarter.
*In one replicate measurement from well WNW86-05, Fourth Quarter, Sr-90 = 7.75 E-06 ± 0.1E-06.

TABLE E-11
1987 WATER QUALITY PARAMETERS FOR
NRC-LICENSED DISPOSAL AREA
GROUNDWATER MONITORING UNIT

LOCATION CODE	QUARTER SAMPLED	pH	CONDUCTIVITY (@25 °C) (µmhos/cm)	TOC	PHENOL	CHLORIDE	NITRATE	SULFATE	FLUORIDE
				mg/L					
WNW83-2D*	FIRST	11.69	631	180	0.12	19.40	<0.10	10.00	0.57
WNW83-1D	SECOND	7.73	304	29	<0.01	6.47	0.28	3.07	0.40
WNW83-1D	THIRD	7.70	296	11	<0.01	6.69	<0.10	1.11	0.78
WNW83-1D	FOURTH	7.61	296	3	<0.01	7.73	0.28	0.10	0.64
WNW86-10	FIRST	8.46	521	16	<0.01	1.14	<0.10	56.60	0.01
WNW86-10	SECOND	8.81	528	5	<0.01	0.49	0.94	30.96	0.13
WNW86-10	THIRD	8.29	352	2	<0.01	0.83	0.31	42.65	0.13
WNW86-10	FOURTH	7.84	585	< 1	<0.01	0.52	0.53	56.81	<0.20
WNW86-11	FIRST	9.32	478	14	0.01	0.47	<0.10	15.34	0.39
WNW86-11	SECOND	7.35	643	14	0.01	1.21	1.38	67.44	0.04
WNW86-11	THIRD	7.55	681	8	<0.01	1.21	0.37	84.78	0.10
WNW86-11	FOURTH	7.51	646	1	<0.01	1.32	0.33	147.84	<0.20

Notes: Each entry represents the average of four replicate measurements per quarter. Cohen's method from the "RCRA Ground-water Monitoring Technical Enforcement Guidance Document" was used to average the mixture of positive and less-than-detection-limit values.

* Well WNW83-2D removed from service due to very low yield.

TABLE E-12
1987 TOTAL METALS FOR
NRC-LICENSED DISPOSAL AREA
GROUNDWATER MONITORING UNIT
(mg/L)

LOCATION CODE	QUARTER SAMPLED	ARSENIC	BARIUM	CADMIUM	CHROMIUM	IRON	LEAD	MANGANESE	MERCURY	SELENIUM	SILVER	SODIUM
WNW83-2D*	FIRST	0.270	1.50	0.030	0.640	317.70	2.890	3.96	< 0.0100	< 0.010	< 0.010	40
WNW83-1D	SECOND	< 0.005	0.49	< 0.005	0.009	14.65	0.016	0.21	< 0.0005	< 0.005	< 0.005	40
WNW83-1D	THIRD	0.005	0.50	< 0.008	0.007	17.00	0.030	0.28	< 0.0006	< 0.005	< 0.005	33
WNW83-1D	FOURTH	< 0.005	0.52	< 0.007	< 0.005	4.40	< 0.040	0.15	< 0.0005	< 0.010	< 0.005	25
WNW86-10	FIRST	< 0.010	0.07	< 0.010	0.010	5.03	0.100	0.43	< 0.0100	< 0.010	< 0.010	3
WNW86-10	SECOND	0.005	0.12	< 0.005	0.088	10.03	0.013	0.20	< 0.0006	< 0.005	< 0.005	80
WNW86-10	THIRD	0.006	0.14	< 0.006	0.005	0.80	< 0.005	0.05	< 0.0005	< 0.005	< 0.005	68
WNW86-10	FOURTH	0.010	0.16	< 0.007	0.006	0.55	0.040	0.05	< 0.0005	< 0.005	< 0.005	67
WNW86-11	FIRST	< 0.010	0.90	< 0.010	0.313	91.07	1.048	1.74	< 0.0100	< 0.010	< 0.010	77
WNW86-11	SECOND	0.007	0.19	< 0.005	0.070	26.50	0.037	0.54	< 0.0005	< 0.005	< 0.005	60
WNW86-11	THIRD	0.131	0.53	< 0.008	0.317	118.25	0.211	4.74	< 0.0005	< 0.005	0.005	60
WNW86-11	FOURTH	0.006	0.10	< 0.007	0.029	4.83	0.013	0.26	< 0.0005	< 0.005	< 0.005	56

Note: Each entry represents the average of four replicate measurements. Averages were obtained using Cohen's method from "RCRA Ground-water Monitoring Technical Enforcement Document."

* Well WNW83-2D removed from service due to very low yield.

TABLE E-13
1987 DISSOLVED METALS FOR
NRC-LICENSED DISPOSAL AREA
GROUNDWATER MONITORING UNIT
(mg/L)

LOCATION CODE	QUARTER SAMPLED	ARSENIC	BARIUM	CADMIUM	CHROMIUM	IRON	LEAD	MANGANESE	MERCURY	SELENIUM	SILVER	SODIUM
WNW83-2D*	FIRST	< 0.010	0.06	< 0.010	< 0.010	0.04	0.010	0.02	< 0.0100	< 0.010	< 0.010	25
WNW83-1D	SECOND	< 0.005	0.43	< 0.005	< 0.005	< 0.04	< 0.005	0.10	< 0.0005	< 0.005	< 0.005	40
WNW83-1D	THIRD	< 0.005	0.47	< 0.005	< 0.005	0.18	< 0.005	0.18	< 0.0006	< 0.005	< 0.005	31
WNW83-1D	FOURTH	< 0.005	0.50	< 0.005	< 0.005	0.09	< 0.030	0.10	< 0.0005	< 0.005	< 0.005	28
WNW86-10	FIRST	< 0.010	0.10	< 0.010	0.010	0.62	0.018	0.07	< 0.0100	0.010	0.025	50
WNW86-10	SECOND	< 0.005	0.07	< 0.005	0.005	< 0.04	< 0.005	0.01	< 0.0005	< 0.005	< 0.005	80
WNW86-10	THIRD	0.007	0.14	< 0.005	< 0.005	0.14	< 0.005	0.04	< 0.0005	< 0.005	< 0.005	66
WNW86-10	FOURTH	0.009	0.17	< 0.005	< 0.005	0.41	< 0.030	0.06	< 0.0005	< 0.005	< 0.005	66
WNW86-11	FIRST	< 0.010	0.07	< 0.010	< 0.010	0.01	0.010	0.01	< 0.0100	0.010	< 0.010	74
WNW86-11	SECOND	< 0.005	0.11	< 0.005	< 0.005	0.02	< 0.005	0.11	< 0.0005	< 0.005	< 0.005	60
WNW86-11	THIRD	< 0.005	0.12	< 0.005	< 0.005	< 0.05	< 0.005	0.30	< 0.0005	< 0.005	< 0.005	59
WNW86-11	FOURTH	< 0.005	0.09	< 0.005	< 0.005	0.01	< 0.030	0.13	< 0.0005	< 0.005	< 0.005	57

Notes: Each entry represents the average of four replicate measurements per quarter. Cohen's method from the "RCRA Ground-water Monitoring Technical Enforcement Guidance Document" was used to average the mixture of positive and less-than-detection-limit values.

* Well WNW83-2D removed from Service due to very low yield.

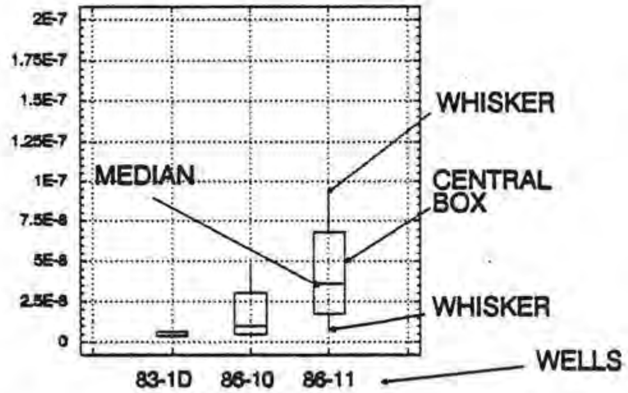
TABLE E-14
1987 RADIOACTIVITY CONCENTRATIONS FOR GROUNDWATER IN THE
NRC-LICENSED DISPOSAL AREA
(µCi/mL)

LOCATION CODE	QUARTER SAMPLED	ALPHA	BETA	Tritium (H-3)	Cs-137	Co-60
WNW83-2D*	FIRST	< 1.00E-07	2.84E-07 ± 5.89E-08	3.15E-07 ± 1.55E-08	< 4.20E-08	< 4.80E-08
WNW83-1D	SECOND	< 1.00E-07	2.12E-09 ± 1.09E-09	5.87E-09 ± 7.09E-10	< 8.60E-08	< 8.90E-08
WNW83-1D	THIRD	< 1.00E-07	2.69E-09 ± 1.15E-09	4.00E-09 ± 1.03E-09	< 1.08E-07	< 1.09E-07
WNW83-1D	FOURTH	< 1.00E-07	< 1.56E-09	3.51E-09 ± 8.94E-10	< 8.60E-08	< 8.90E-08
WNW86-10	FIRST	< 1.00E-07	2.10E-08 ± 7.66E-09	4.31E-08 ± 2.66E-09	< 1.08E-07	< 1.09E-07
WNW86-10	SECOND	< 1.00E-07	8.22E-09 ± 2.40E-09	1.37E-08 ± 1.14E-09	< 1.08E-07	< 1.09E-07
WNW86-10	THIRD	< 1.00E-07	< 1.61E-09	6.76E-09 ± 8.60E-10	< 1.08E-07	< 1.09E-07
WNW86-10	FOURTH	< 1.00E-07	< 2.01E-09	4.51E-09 ± 9.95E-10	< 1.08E-07	< 1.09E-07
WNW86-11	FIRST	< 1.00E-07	4.44E-08 ± 1.09E-08	8.80E-08 ± 4.14E-09	< 1.08E-07	< 1.09E-07
WNW86-11	SECOND	< 5.23E-08	1.11E-08 ± 3.97E-09	3.08E-08 ± 1.69E-09	< 1.08E-07	< 1.09E-07
WNW86-11	THIRD	1.31E-07 ± 5.17E-08	1.77E-08 ± 6.59E-09	4.25E-08 ± 2.69E-09	< 1.08E-07	< 1.09E-07
WNW86-11	FOURTH	< 1.00E-07	3.71E-09 ± 2.55E-09	1.21E-08 ± 1.36E-09	< 1.08E-07	< 1.09E-07

Notes: Data represent average of four replicate measurements per quarter.

* Well WNW83-2D removed from service due to very low yield.

Note: Example Box-and-Whisker plot and table are shown for gross beta levels (μCi/L) in samples from NRC-Licensed Disposal Area.



Quarter Sampled	83-1D	86-10	86-11
First	***NOT SAMPLED***	4.32E-08 ± 0.53E-08	8.34E-08 ± 0.80E-08
		4.02E-08 ± 0.52E-08	8.47E-08 ± 0.81E-08
		4.71E-08 ± 0.55E-08	9.32E-08 ± 0.86E-08
		4.20E-08 ± 0.53E-08	9.05E-08 ± 0.84E-08
Second	6.60E-09 ± 1.41E-09	1.38E-08 ± 0.20E-08	3.17E-08 ± 0.33E-08
	6.82E-09 ± 1.36E-09	1.14E-08 ± 0.18E-08	1.91E-08 ± 0..23E-08
	3.64E-09 ± 1.22E-09	8.64E-09 ± 1.58E-09	3.95E-08 ± 0.37E-08
	6.43E-09 ± 1.65E-09	2.11E-08 ± 0.33E-08	3.28E-08 ± 0.40E-08
Third	4.10E-09 ± 1.98E-09	6.41E-09 ± 1.53E-09	5.24E-08 ± 0.57E-08
	5.93E-09 ± 2.27E-09	3.89E-09 ± 1.35E-09	5.20E-08 ± 0.59E-08
	2.33E-09 ± 1.93E-09	4.06E-09 ± 1.38E-09	2.05E-08 ± 0.37E-08
	3.65E-09 ± 2.04E-09	1.27E-08 ± 0.24E-08	4.51E-08 ± 0.59E-08
Fourth	3.45E-09 ± 1.19E-09	4.12E-09 ± 1.36E-09	1.34E-08 ± 0.22E-08
	3.81E-09 ± 1.94E-09	4.82E-09 ± 2.14E-09	1.28E-08 ± 0.29E-08
	3.94E-09 ± 1.99E-09	4.30E-09 ± 2.14E-09	1.54E-08 ± 0.32E-08
	2.86E-09 ± 1.91E-09	4.79E-09 ± 2.20E-09	6.76E-09 ± 2.47E-09
Median	0.39E-08	1.00E-08	3.62E-08

The multiple box-and-whisker plot is used to display data for selected indicator parameters for wells grouped within the same waste management unit. The individual results of four replicate samples collected per quarter per parameter were included as individual values for all periods for which a particular well was sampled during 1987.

The multiple box-and-whisker plot:

- Indicates the median of the data as a horizontal line within the box;
- Indicates the middle 50 percent of the data (between the upper and lower quartiles) by the outline of the central box;
- Indicates the range of data by the extension of the whiskers (extreme values beyond 1.5 times the box length are plotted as individual points);
- May indicate skewed data characteristics by the relative positions of the median line, box outline, and whisker extensions; and
- Allows for immediate visual comparison of all wells within a waste management unit for a given parameter.

In all box-and-whisker plots shown in this appendix, the upgradient well is positioned on the left side of the plot.

Figure E-1. Explanation of Box-and-Whisker Plot used to display well water parameters for groundwater monitoring units.

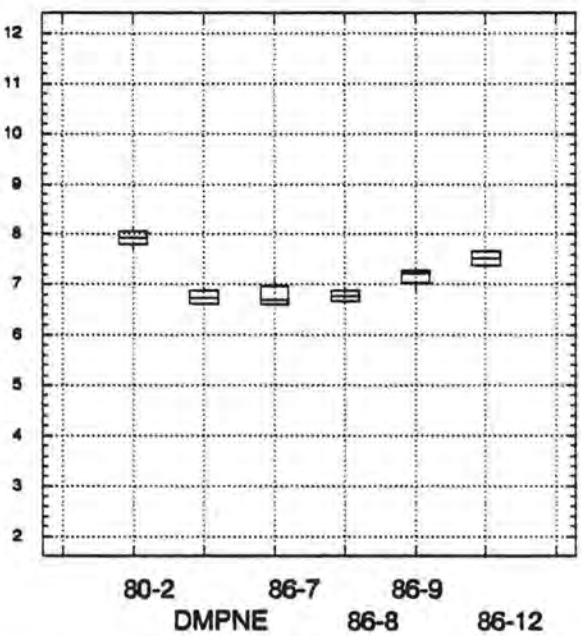


Figure E-2. pH values in well samples from the High-Level Radioactive Waste Tank Com-lex Groundwater Monitoring Unit.

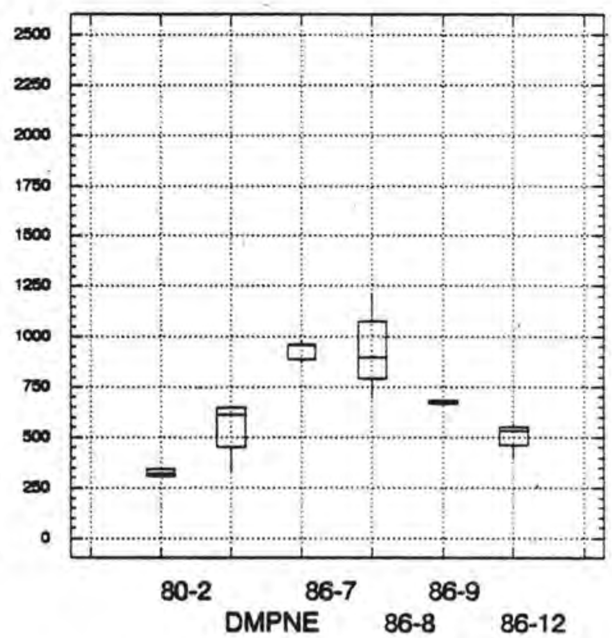


Figure E-3. Conductivity (μmhos/cm at 25 °C) in well samples from the High-Level Radioactive Waste Tank Complex Groundwater Monitoring Unit.

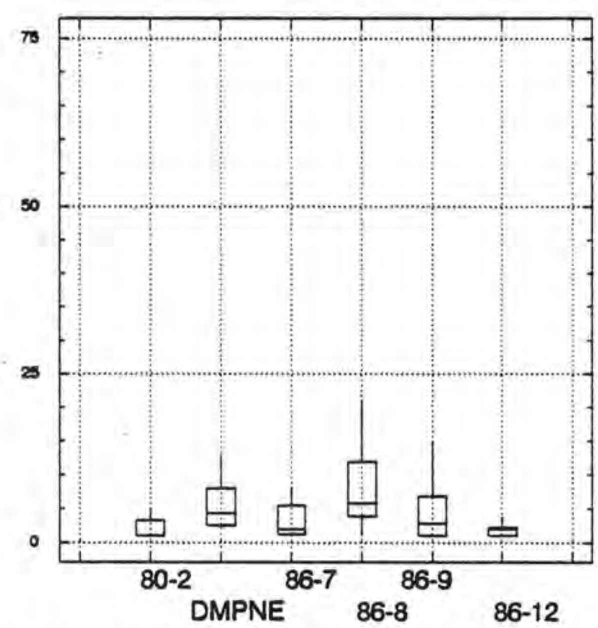


Figure E-4. Total Organic Carbon (mg/L) in well samples from the High-Level Radioactive Waste Tank Complex Groundwater Monitor-ing Unit.

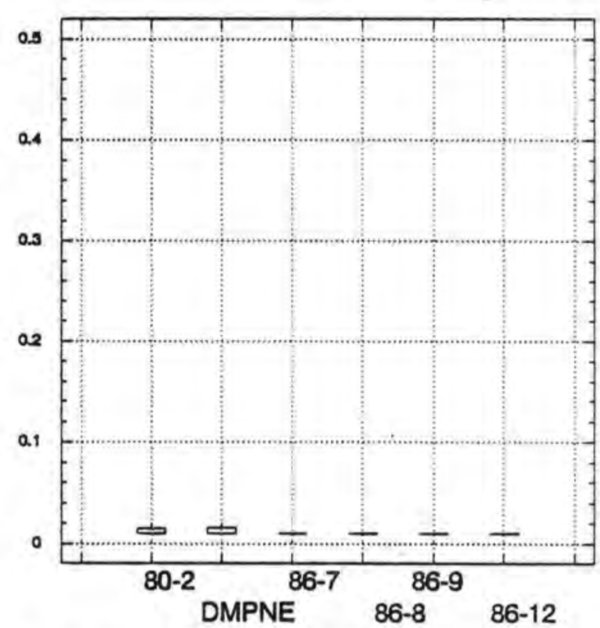


Figure E-5. Phenols (mg/L) in well samples from the High-Level Radioactive Waste Tank Complex Groundwater Monitoring Unit.

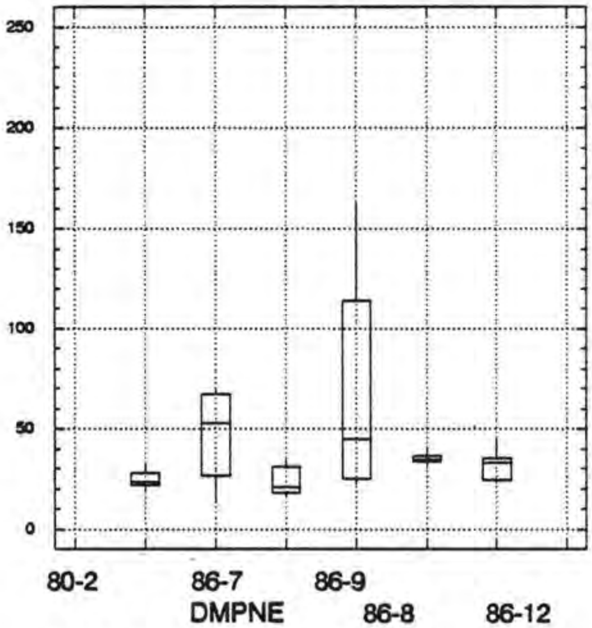


Figure E-6. Chloride (mg/L) in well samples from the High-Level Radioactive Waste Tank Complex Groundwater Monitoring Unit.

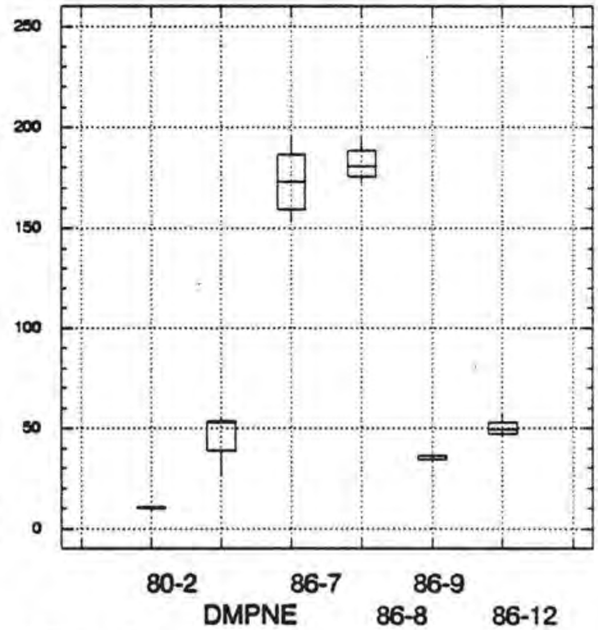


Figure E-7. Sulfate (mg/L) in well samples from the High-Level Radioactive Waste Tank Complex Groundwater Monitoring Unit.

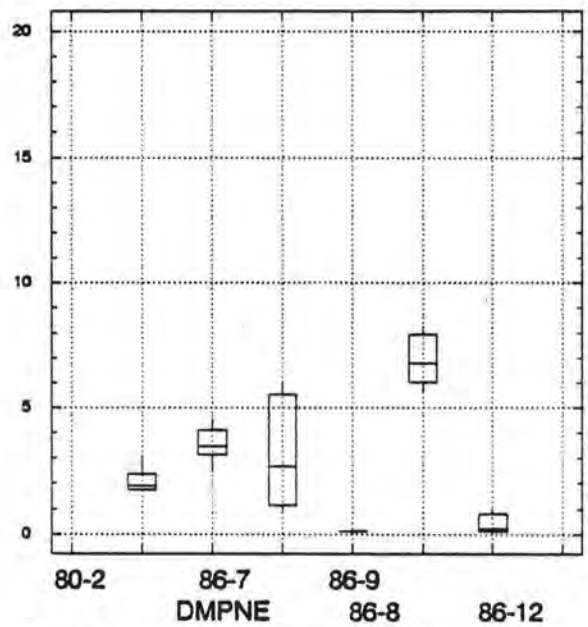


Figure E-8. Nitrate (mg/L) in well samples from the High-Level Radioactive Waste Tank Complex Groundwater Monitoring Unit.

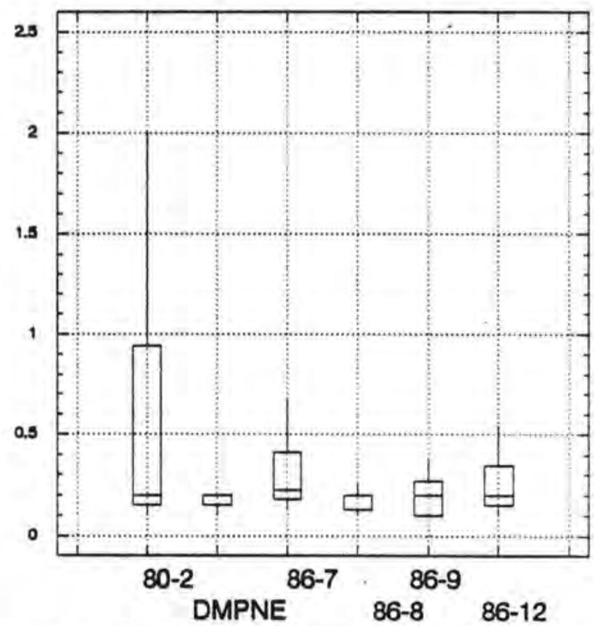


Figure E-9. Fluoride (mg/L) in well samples from the High-Level Radioactive Waste Tank Complex Groundwater Monitoring Unit.

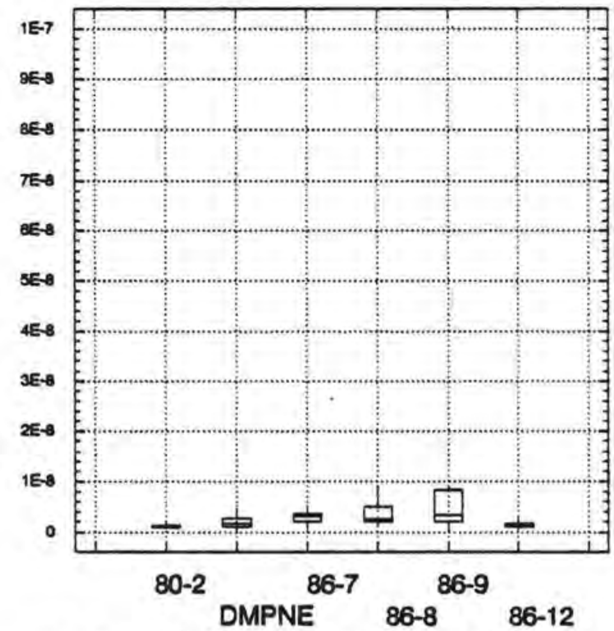


Figure E-10. Gross alpha levels (μCi/mL) for well samples from the High-Level Radioactive Waste Tank Complex Groundwater Monitoring Unit. (1st Quarter Data for 86-9 is missing.)

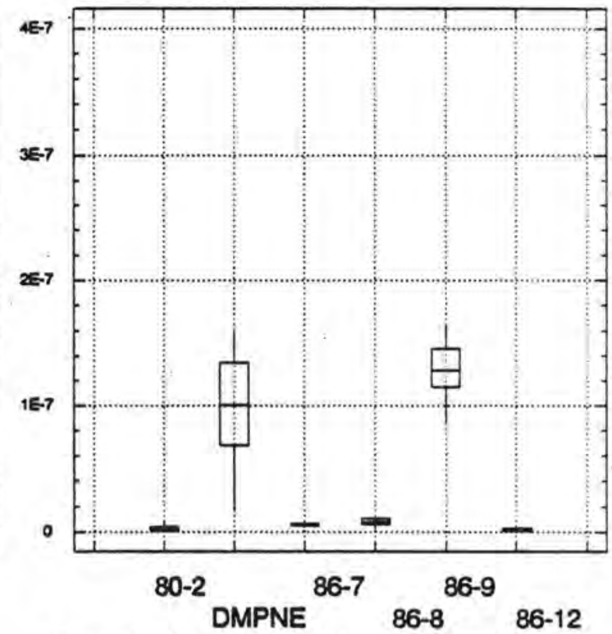


Figure E-11. Gross beta levels (μCi/mL) for well samples from the High-Level Radioactive Waste Tank Complex Groundwater Monitoring Unit.

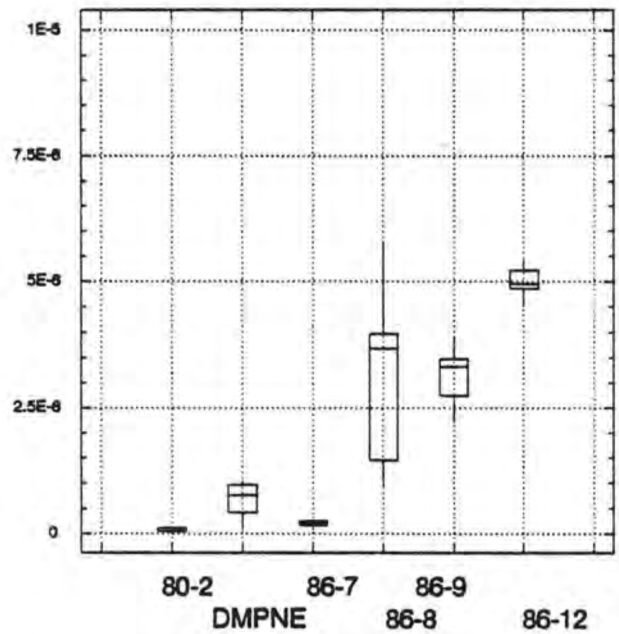


Figure E-12. Tritium (H-3) levels (μCi/mL) for well samples from the High-Level Radioactive Waste Tank Complex Groundwater Monitoring Unit.

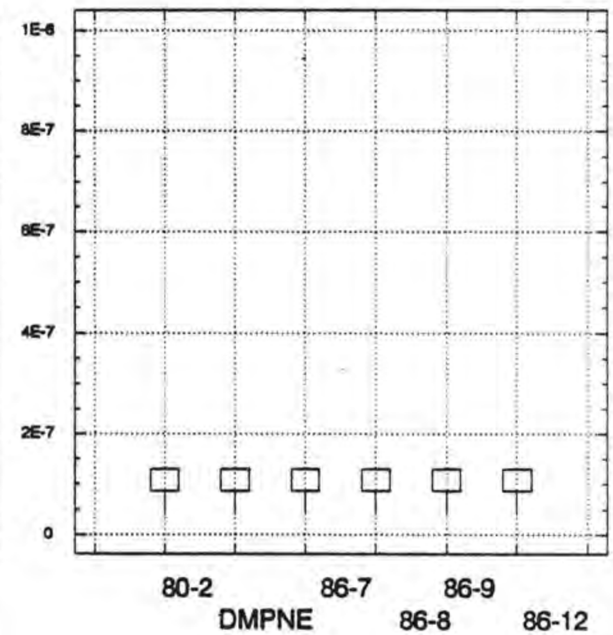


Figure E-13. Cesium-137 levels (μCi/mL) for well samples from the High-Level Radioactive Waste Tank Complex Groundwater Monitoring Unit.

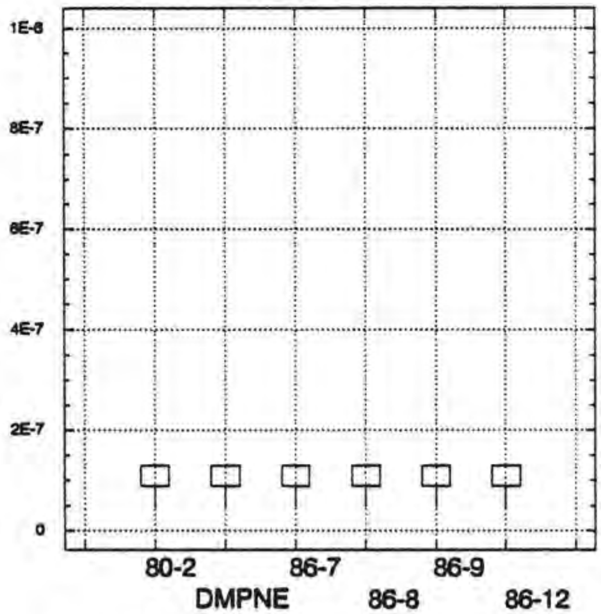


Figure E-14. Cobalt-60 levels (μCi/mL)in well samples from the High-Level Radioactive Waste Tank Complex Groundwater Monitoring Unit.

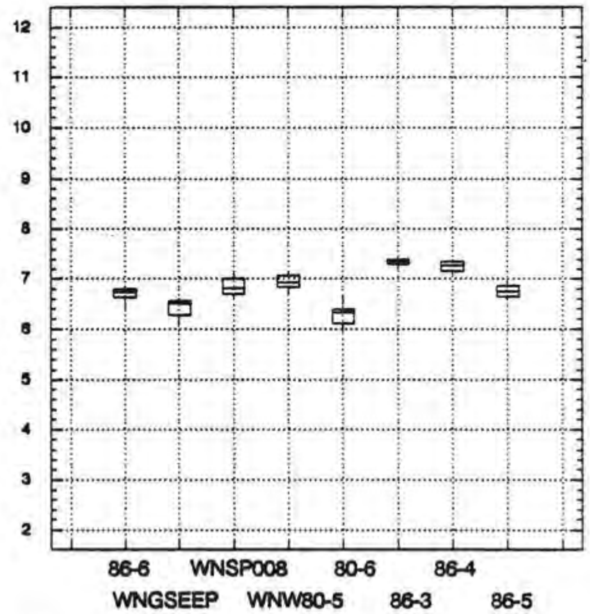


Figure E-15. pH in well samples from the Low-Level Radioactive Waste Lagoon System Groundwater Monitoring Unit.

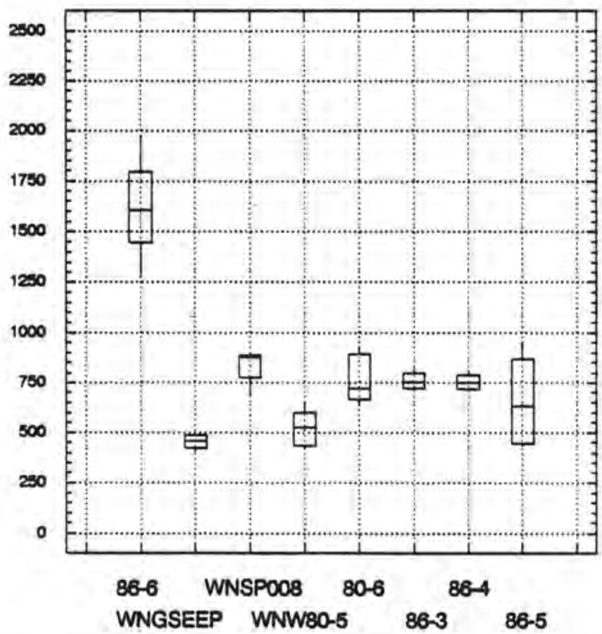


Figure E-16. Conductivity (μmhos at 25 °C) in well samples from the Low-Level Radioactive Waste Lagoon System Groundwater Monitoring Unit.

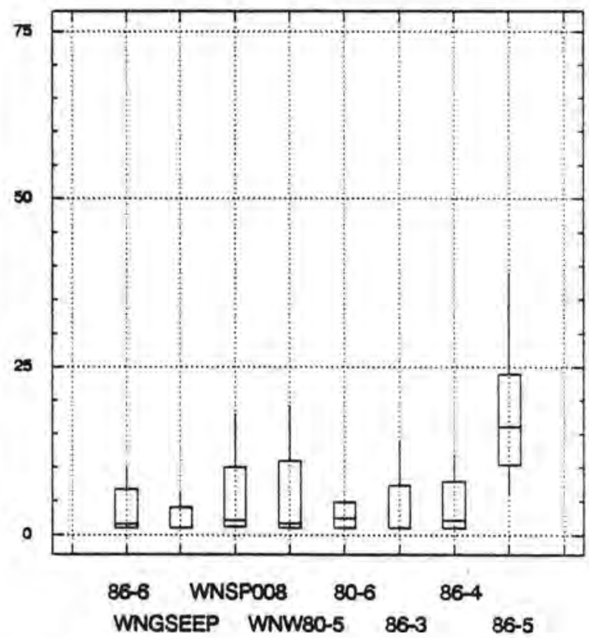


Figure E-17. Total Organic Carbon (mg/L) in well samples from the Low-Level Radioactive Waste Lagoon System Groundwater Monitoring Unit.

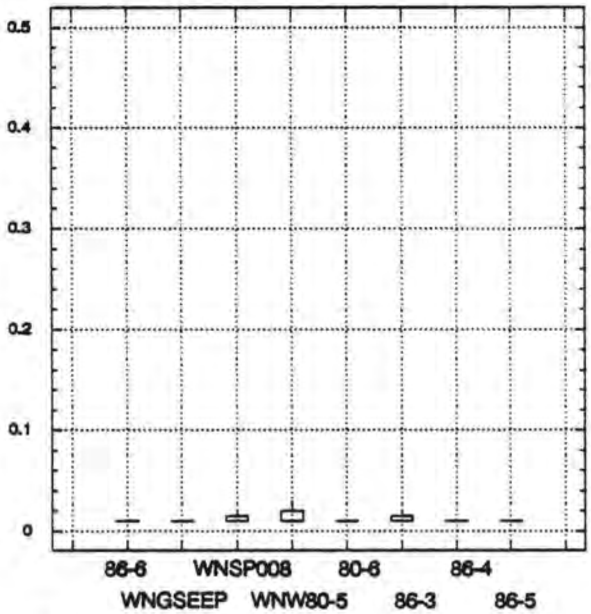


Figure E-18. Phenol levels (mg/L) in well samples from the Low-Level Radioactive Waste Lagoon System Groundwater Monitoring Unit.

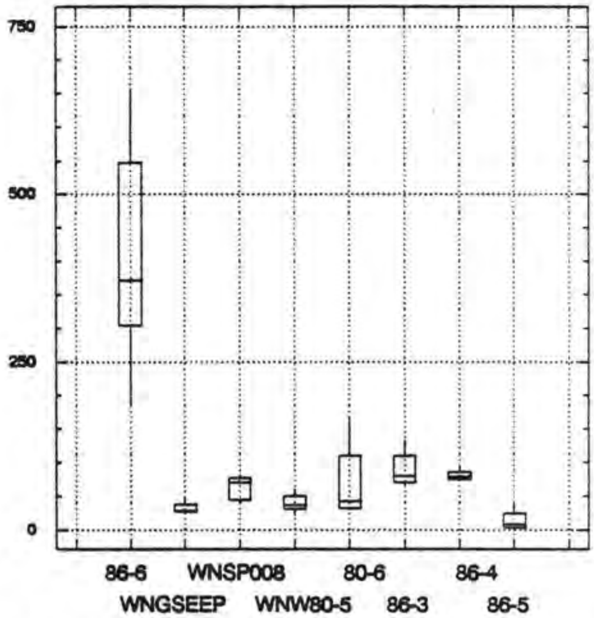


Figure E-19. Chloride (mg/L) in well samples from the Low-Level Radioactive Waste Lagoon System Groundwater Monitoring Unit.

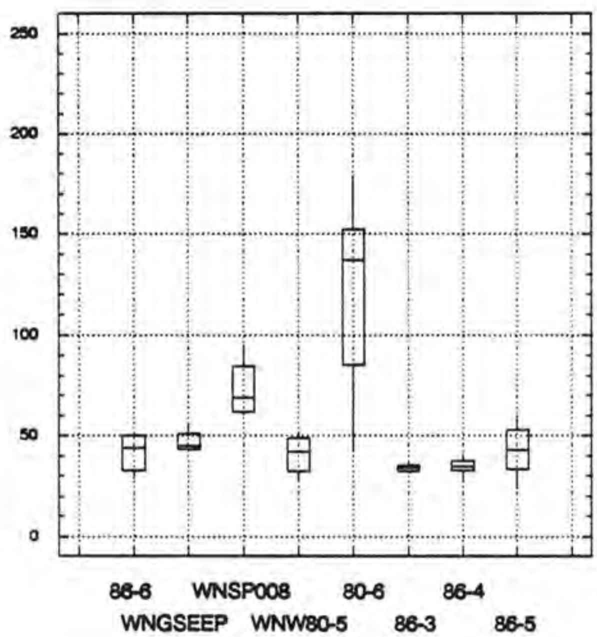


Figure E-20. Sulfate (mg/L) in well samples from the Low-Level Radioactive Waste Lagoon System Groundwater Monitoring Unit.

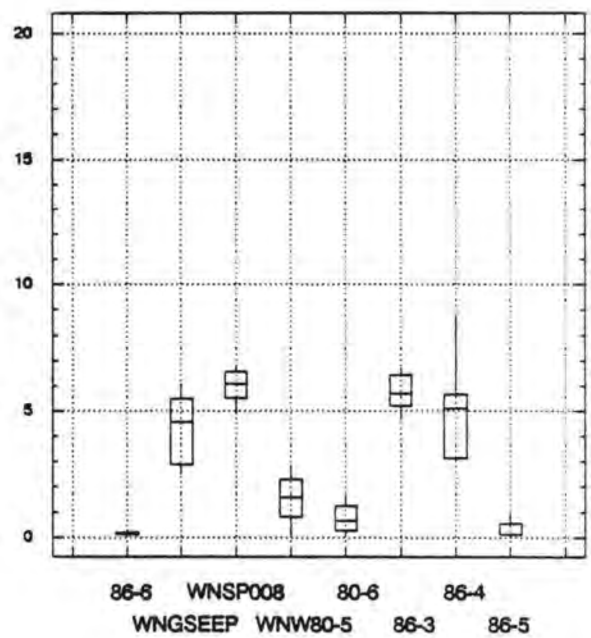


Figure E-21. Nitrate (mg/L) in well samples from the Low-Level Radioactive Waste Lagoon System Groundwater Monitoring Unit.

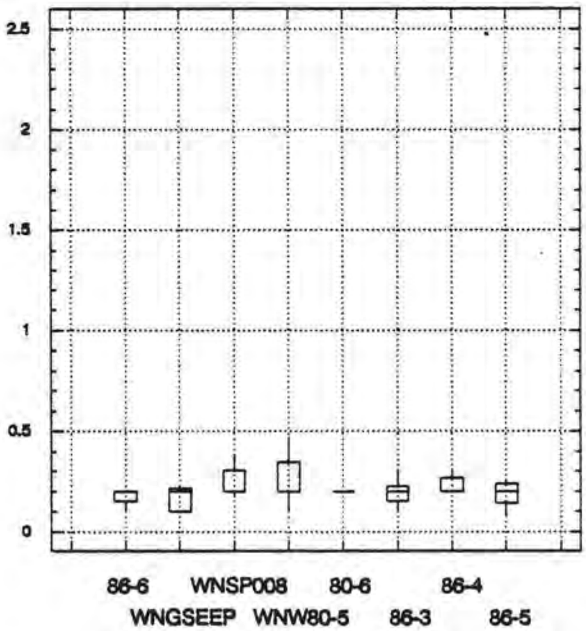


Figure E-22. Fluoride (mg/L) in well samples from Low-Level Radioactive Waste Lagoon System Groundwater Monitoring Unit.

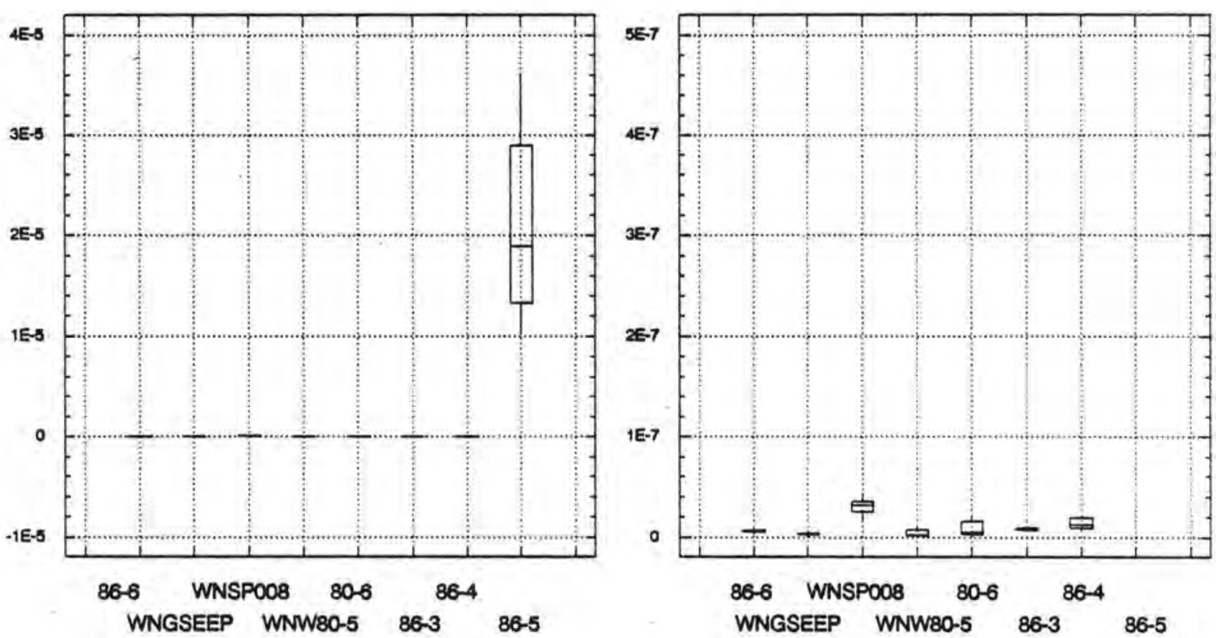


Figure E-23. Gross beta levels (μCi/mL) in well samples from the Low-Level Radioactive Waste Lagoon System Groundwater Monitoring Unit. Two charts are included to account for the off-scale reading at well 86-5.

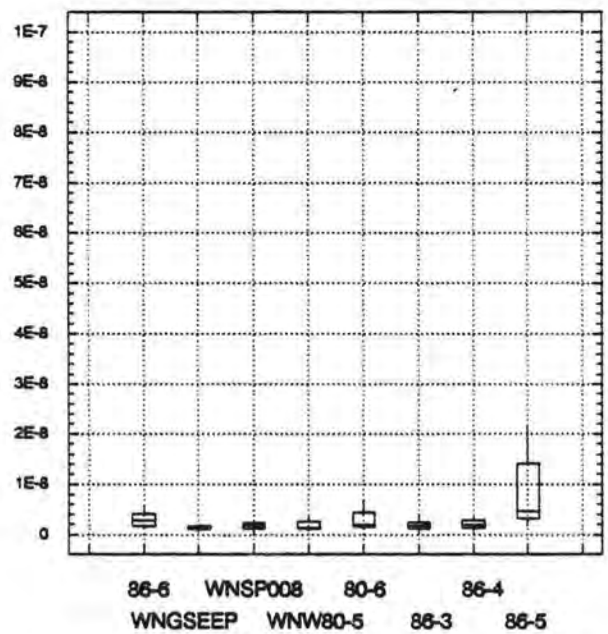


Figure E-24. Gross alpha levels (μCi/mL) in well samples from the Low-Level Radioactive Waste Lagoon System Groundwater Monitoring Unit.

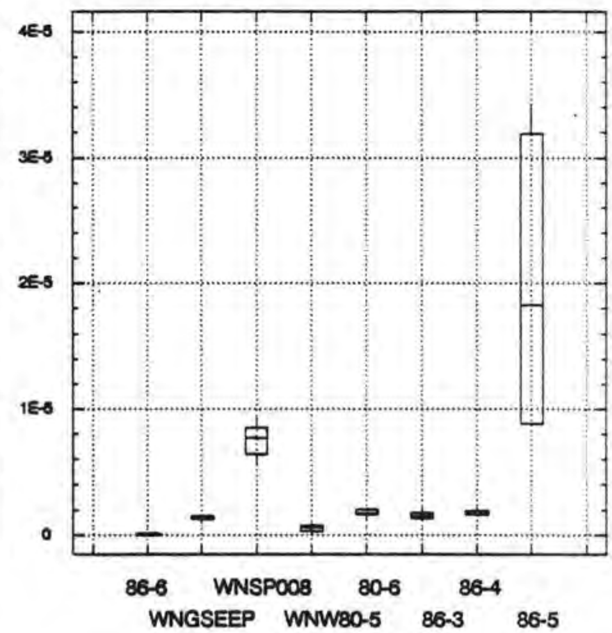


Figure E-25. Tritium (H-3) levels (μCi/mL) in well samples from the Low-Level Radioactive Waste Lagoon System Groundwater Monitoring Unit.

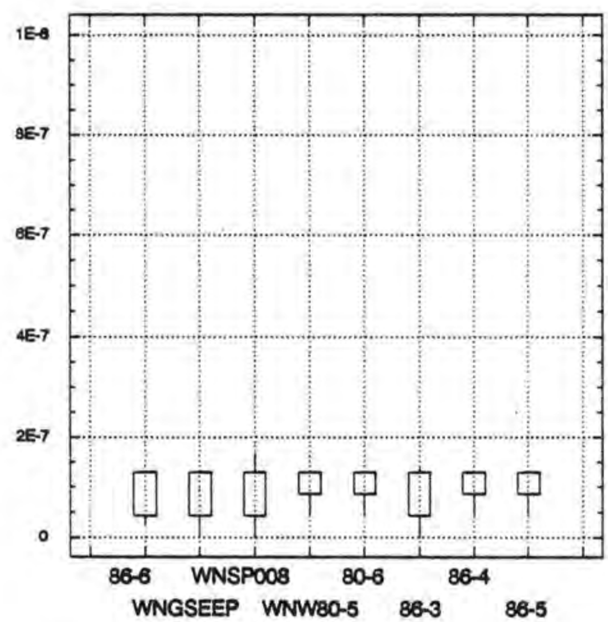


Figure E-26. Cesium-137 levels (μCi/mL) in well samples from the Low-Level Radioactive Waste Lagoon System Groundwater Monitoring Unit.

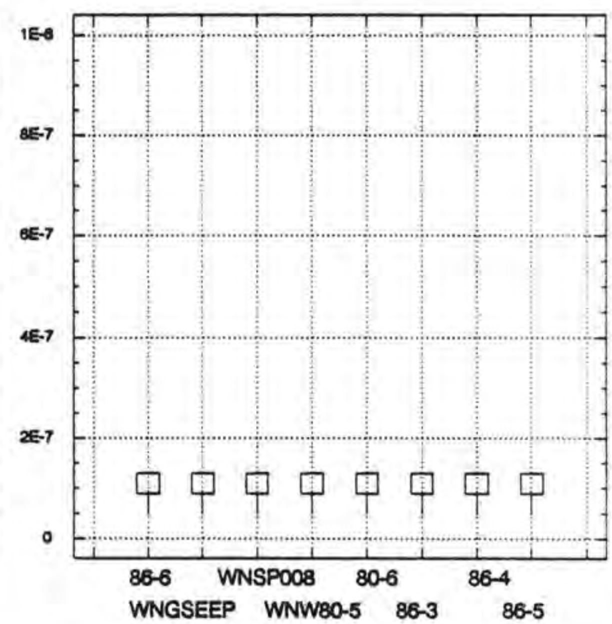


Figure E-27. Cobalt-60 levels (μCi/mL) in well samples from the Low-Level Radioactive Waste Lagoon System Groundwater Monitoring Unit.

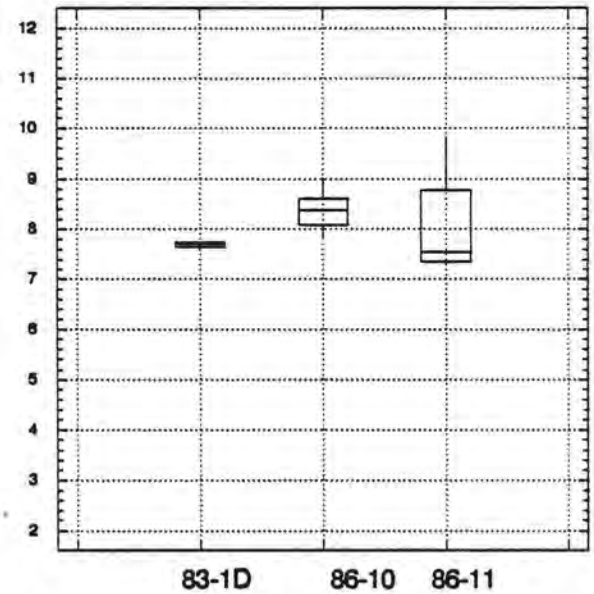


Figure E-28. pH values in well samples from the NRC-Licensed Disposal Area Groundwater Monitoring Unit.

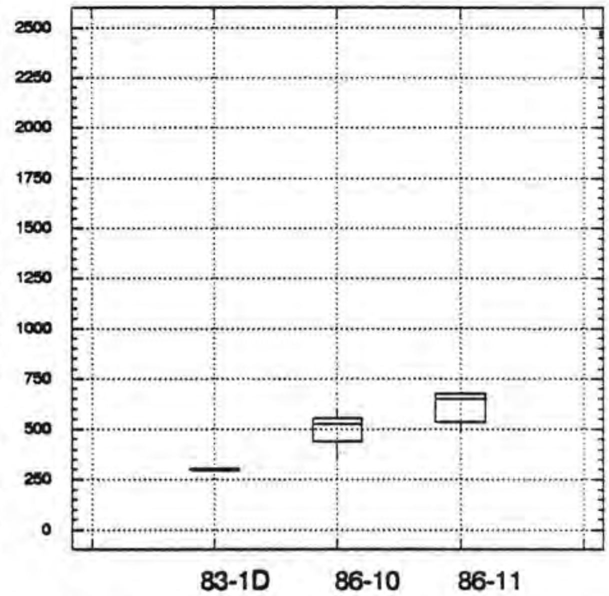


Figure E-29. Conductivity (μmhos/cm at 25 °C) in well samples from the NRC-Licensed Disposal Area Groundwater Monitoring Unit.

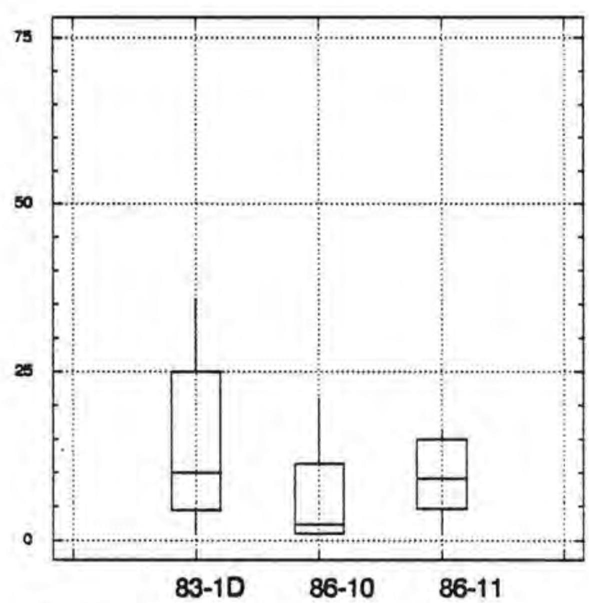


Figure E-30. Total organic carbon (mg/L) in well samples from the NRC-Licensed Disposal Area Groundwater Monitoring Unit.

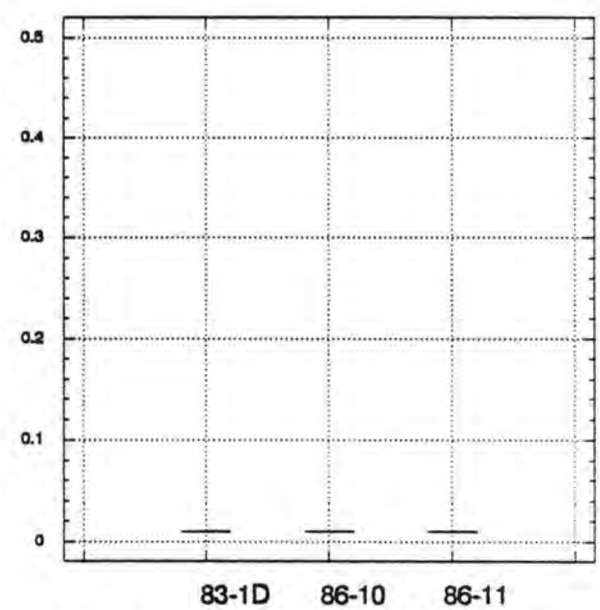


Figure E-31. Phenols (mg/L) in well samples from the NRC-Licensed Disposal Area Groundwater Monitoring Unit.

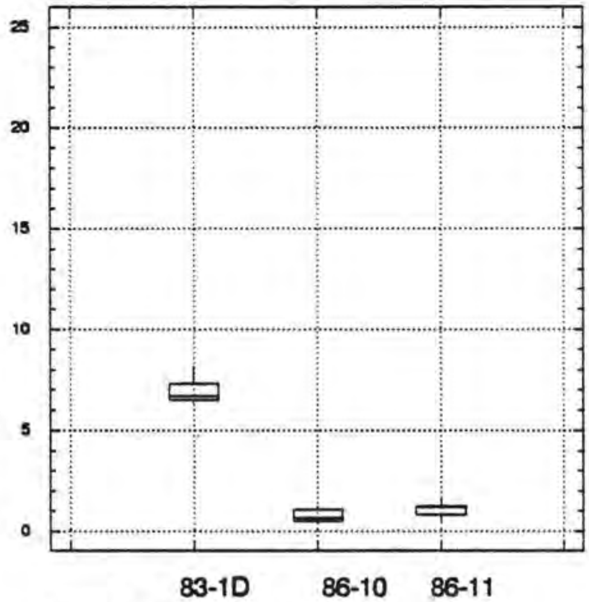


Figure E-32. Chloride (mg/L) in well samples from the NRC-Licensed Disposal Area Groundwater Monitoring Unit.

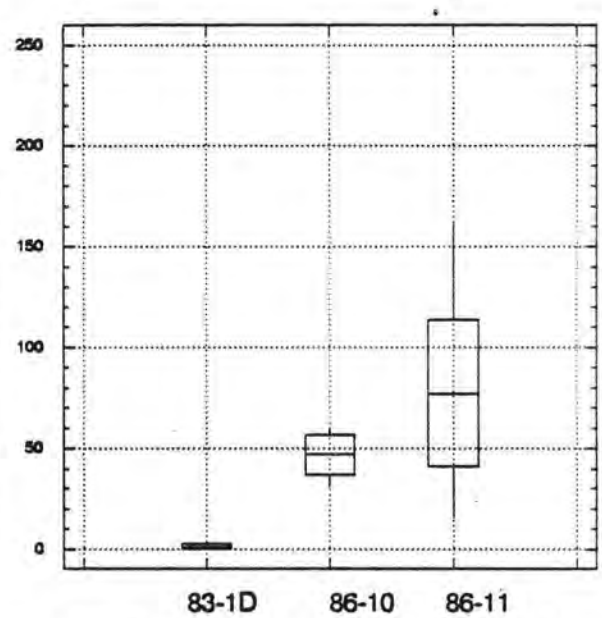


Figure E-33. Sulfate (mg/L) in well samples from the NRC-Licensed Disposal Area Groundwater Mon itoring Unit.

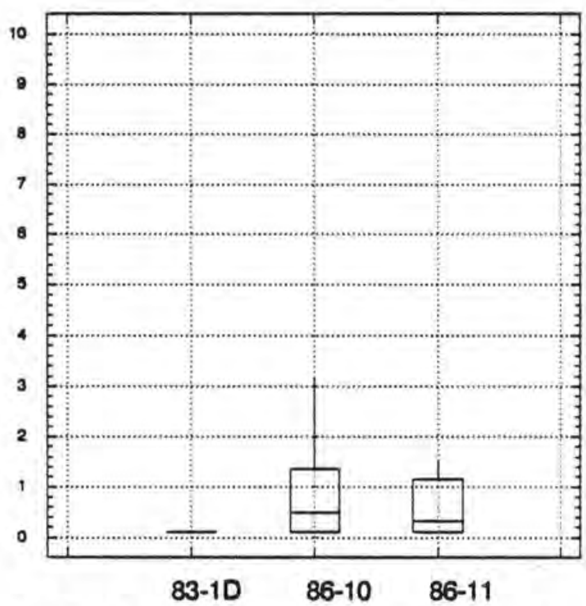


Figure E-34. Nitrate (mg/L) in well samples from the NRC-Licensed Disposal Area Groundwater Monitoring Unit.

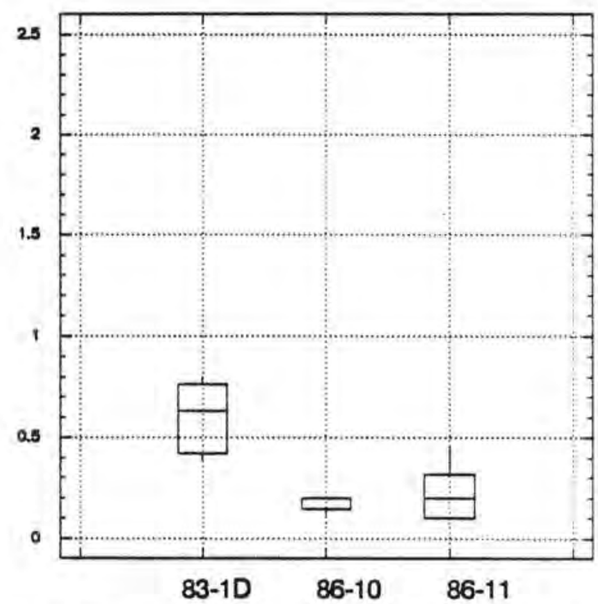


Figure E-35. Fluoride (mg/L) in well samples from the NRC-Licensed Disposal Area Groundwater Monitoring Unit.

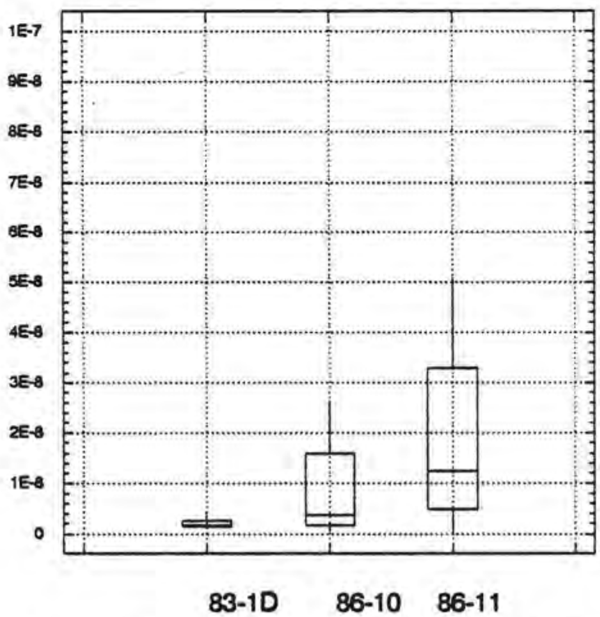


Figure E-36. Gross alpha levels (μCi/mL) for well samples from the NRC-Licensed Disposal Area Groundwater Monitoring Unit.

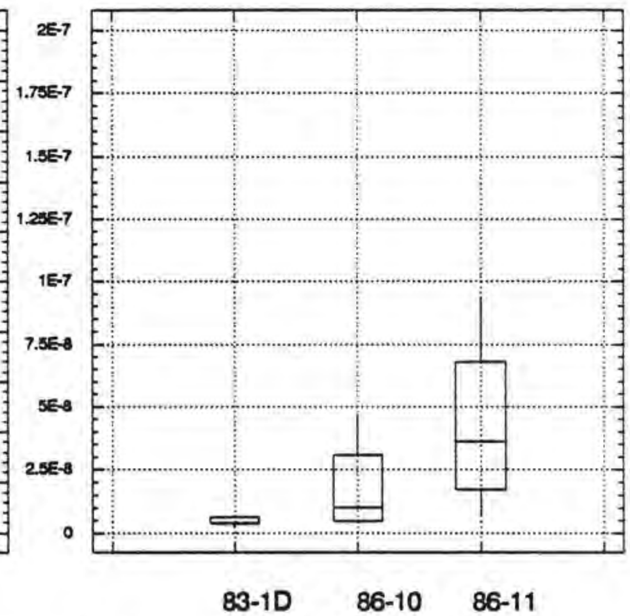


Figure E-37. Gross beta levels (μCi/mL) for well samples from the NRC-Licensed Disposal Area Groundwater Monitoring Unit.

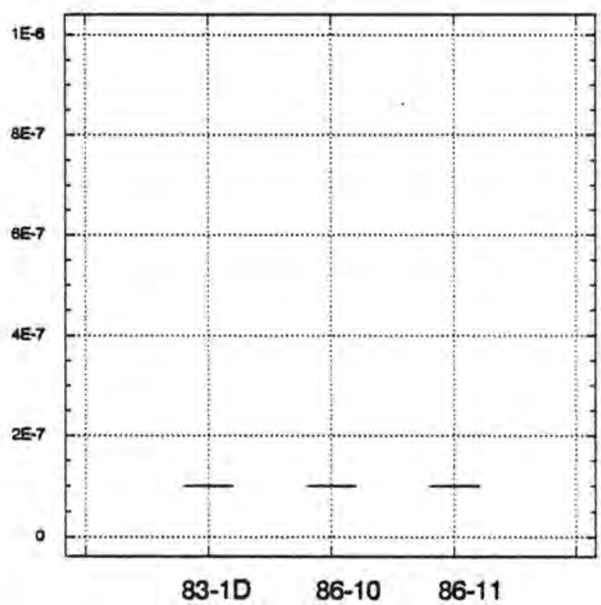


Figure E-38. Tritium (H-3) levels (μCi/mL) in well samples from the NRC-Licensed Disposal Area Goundwater Monitoring Unit.

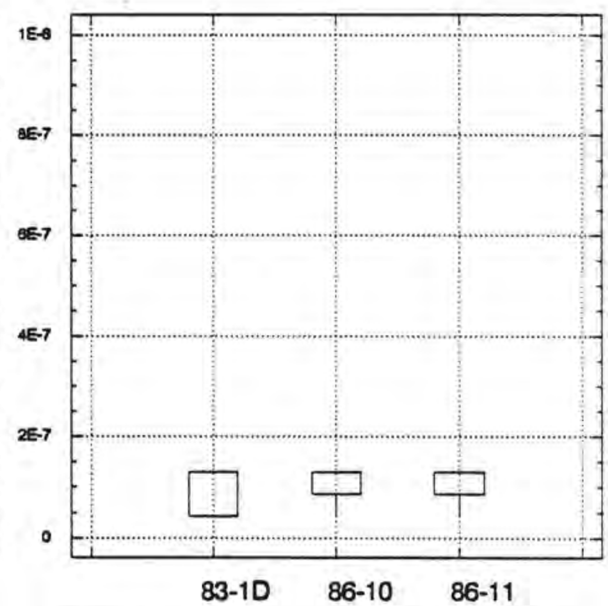


Figure E-39. Cesium-137 levels (μCi/mL) in well samples from the NRC-Licensed Disposal Area Groundwater Monitoring Unit.

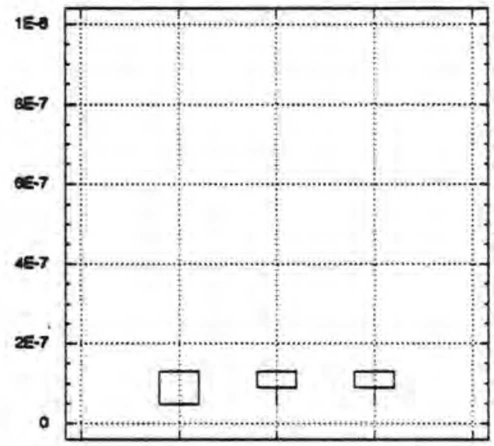


Figure E-40. Cobalt-60 levels (μCi/mL) in well samples from the NRC-Licensed Disposal Area Groundwater Monitoring Unit.