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ACTIVE SITES ENVIRONMENTAL MONITORING PROGRAM FY 1996 ANNUAL REPORT

C. M. Morrissey
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Environmental Sciences Division

Publication No. 4611

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Environmental Sciences Division

G. R. Cunningham
Waste Management and Remedial Action Division

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ABBREVIATIONS AND ACRONYMS

AS0	Analytical Services Organization
ASEMP	Active Sites Environmental Monitoring Program
DOE	U.S. Department of 'Energy
EASC	Emergency Avoidance Solidification Campaign
ER	Environmental Restoration
ESD	Environmental Sciences Division
FRP	fiberglass-reinforced plastic
FY	fiscal year
HDTF	Hillcut Disposal Test Facility
IWMF	Interim Waste Management Facility
IRL	internal Reporting Level
LWOG	Liquid Waste Operations Group
LLW	low-level waste
LWSP	Liquid-Waste Solidification Project
MDA	Minimum Detectable Amount
NFS	Nuclear Fuel Services
NPDES	National Pollutant Discharge Elimination System
ORNL	Oak Ridge National Laboratory
PWTP	Process Waste Treatment Plant
QA	quality assurance
RCRA	Resource Conservation and Recovery Act
RSWOG.	radioactive solid waste operations group
SWSA	Solid Waste Storage Area
TRU	transuranic
UND	underpad
WOC	White Oak Creek
WMRAD	Waste Management and Remedial Action Division

EXECUTIVE SUMMARY

This report summarizes the activities of the Active Sites Environmental Monitoring Program (ASEMP) from October 1995 through September 1996. The Radioactive Solid Waste Operations Group (RSWOG) of the Waste Management and Remedial Action Division (WM'RAD) and the 'Environmental Sciences Division (ESD) at Oak Ridge National Laboratory (ORNL) established ASEMP in 1989. The purpose of the'program is to provide early detection and performance monitoring at active low-level waste (LLW) disposal sites in Solid Waste Storage Area (SWSA) 6 and transuranic (TRU) waste storage'sites in SWSA 5 North as required by Ctiapters II and III of U.S. Department of Energy (DOE) Order 5820.2A.

Monitoring results from the Interim Waste Management Facility (IWMF) disposal pads indicated that no LLW leached from the storage vaults. None of the 70 IWMF pad runoff samples collected in FY 1996 exceeded Internal Reporting Levels (IRLs) for gross alpha, gross beta, ^{137}Cs, or ^{60}Co activity. Tritium activity in the pad water runoff remained at background levels indicating no ^{3}H release from the vaults. The absence of water in'the IWMF underpad collection system indicated that the French drain was functioning as designed to suppress'the groundwater table and prevent 'contact of groundwater with the undersurface of the pads. Samples collected from the French drain showed gross radiological and ^{3}H activity consistent with uncontaminated shallow groundwater in the SWSA 6 area. Surface soil sampling around the IWMF pads indicated that vault loading operations have not resulted in radionuclide contamination of the surrounding area.

The CO, pH control system continues to be an effective, low-cost means of pH control and has eliminated the necessity and expense of transporting pad runoff water to the Process Waste Treatment Plant (PWTP). In response to pH levels above the National Pollutant Discharge Elimination System (NPDES) permit limit in the IWMF pad runoff water, the CO, bubbling system was installed in 1994 as a "best management practice" to control the elevated pH. The system is electronically controlled in response to a high pH in water flowing from the pads.

Hillcut Disposal Test Facility (HDTF) runoff water samples continue to be collected and analyzed for radiological constituents. A total of -2150 gal. of water drained from the HDTF pad and underpad collection system in FY 1996. Runoff from the pad occurs in significant volumes only during winter and spring. All samples of combined pad and underpad runoff water were well below the IRLs for all radiological parameters.

Sufficient water for sampling accumulated in only -5% of the Emergency Avoidance Solidification Campaign (EASC)/Liquid-Waste Solidification Project (LWSP)

storage casks. Most of the casks that had sufficient water to sample were from the EASC and provided -50 to 300 mL. However, 10 L of water was pumped from one of the casks. The liquid pumped from the casks is contaminated with constituents of the solidified waste. The reason for the presence of such contamination is most likely that residual contamination remained on the outside of the waste form after solidification. Relatively high concentrations of chloride, fluoride, nitrate, sulfate, as well as sodium and other cations, all of which are present in the waste at high concentrations, were found in the cask water samples. Gross alpha and gross beta results show no elevated alpha activity but do indicate relatively low levels of gross beta contamination. Cesium-137 activity was detected in most of the liquid samples at levels up to 2670 Bq/L.

Soil sampling in and around the EASC/LWSP cask storage site showed that loading and storage operations have not resulted in contaminant releases to the surrounding area. However, soils in the area show slightly elevated ^{137}Cs activity probably resulting from past trench disposal operations.

Sumps that drain TRU storage areas in SWSA 5 N continue to be free from any waste-related radiological contamination. One sump consistently shows elevated levels of gross beta activity. The presence of ^{40}K and the color of the water in this sump indicate that the activity is related to leaching from soil or vegetation.

Groundwater monitoring at SWSA 5 N continued to show elevated gross alpha activity in well 516 that has been shown to result from the presence of ^{244}Cm and ^{241}Am. This well is hydrologically downgradient from the disposal trenches. Traces of ^{244}Cm, ^{241}Am, and associated alpha activity were also detected in a seep downgradient from SWSA 5 N trenches at the bank of White Oak Creek.

Data from soil sampling around storage buildings in SWSA 7 show no radiological impacts from operations associated with these buildings.

1. INTRODUCTION

Chapter III of U.S. Department of Energy (DOE) Order 5820.2A (DOE 1988) specifies requirements for the management of facilities that were used for the disposal of radioactive solid low-level waste (LLW) on or after the date of the order (September 26, 1988). Activities in Solid Waste Storage Area (SWSA) 6 at Oak Ridge National Laboratory (ORNL) are governed by Chapter III. Chapter II of 5820.2A covers the transuranic (TRU) waste storage areas in SWSA 5 North at ORNL. Both chapters require environmental monitoring to provide early warning of leaks before such leaks pose a threat to human health or the environment. Chapter III also requires monitoring of LLW disposal facilities so that their performance can be evaluated. In order to comply with 5820.2A, the Environmental Sciences Division (ESD) at ORNL implements the Active Sites Environmental Monitoring Program (ASEMP) for the Radioactive Solid Waste-Operations Group (RSWOG) withinthe Waste Management and Remedial Action Division (WMRAD) at ORNL. The scope of ASEMP includes all ORNL waste disposal sites that were active on or after the date of the Order and that are under the operational control of RSWOG of WMRAD.

This report continues a series of annual and semiannual reports that present the results of ASEMP monitoring activities (Wickliff et al. 1991 a, 1991 b; Ashwood et al. 1991a,1991b; Morrissey et al. 1994a, 1994b, 1995, 1996; Yager et al. 1989). This report details monitoring data for fiscal year (FY) 1996 and is divided into three major areas: (1) SWSA 6, including the Interim Waste Management Facility (IWMF); the Hillcut Disposal Test Facility (HDTF), and the low-level Liquid-Waste Solidification Project (LWSP), (2) TRU-waste storage'areas in SWSA 5 N, and (3) storage building 7574 in SWSA 7. The detailed monitoring methodology is described in the second revision of the ASEMP program plan (Morrissey et al. 1994) and in updated ASEMP monitoring procedures on-file in the project manager's office. This report presents a summary of the methodology used to gather data for each major area along with the FY 1996 results. Figures referenced in the text are found in Appendix A and data tables are presented in Appendix B.

2. SWSA 6 LOW-LEVEL WASTE FACILITIES

SWSA 6 is a 68-acre LLW disposal area at ORNL that opened in 1969 and began full-scale operations in 1973. A wide variety of wastes have been disposed at SWSA 6 including LLW and chemical and biological wastes. Disposal units consist of unlined trenches, auger holes, silos, concrete casks, and tumulus-type facilities. Figure A.1, Appendix A, is an aerial view of SWSA 6 showing Resource Conservation and Recovery Act (RCRA) plastic caps covering old burial trenches, below-grade high- and low-activity silos, tumulus facilities under temporary cover (the tumulus pads are now covered with an earthen cap), LWSP casks, the IWMF area, the HDTF area: and various support

buildings. The capped areas, disposal silos, and tumulus pads area not monitored as part of ASEMP. These are no longer "active" disposal areas and are under the institutional control of the Environmental Restoration Program.

Monitoring activities associated with SWSA 6 facilities are divided into three major areas: IWMF, LWSP, and HDTF. Low-activity wastes are currently placed in concrete vaults on the aboveground IWMF concrete pads. Monitoring runoff from the IWMF is a major function of ASEMP. During the mid-1980s, high-activity wastes were stored in concrete vaults (similar to tumulus vaults) placed on a concrete pad cut into the side of a hill as a demonstration of this method of disposal. The HDTF is not an active site, but has historically been included in ASEMP. The LWSP casks and storage area are functionally similar to the earlier EASC/LWSP facility in Melton Valley, and are discussed in Section 3. Figure A.2, Appendix A, is a drawing of SWSA 6 showing the relative location of these facilities.

IWMF monitoring includes pad water runoff sampling and pH control, French drain outfall sampling, underpad drainage system sampling, and soil sampling around the facility. The LWSP casks are sampled for water that collects in the annular space of the casks. The soil around the LWSP site is sampled and analyzed for radiological activity. At HDTF, water that accumulates on the pad or in the underpad area is collected and sampled.

2.1 INTERIM WASTE MANAGEMENT FACILITY

IWMF became operational in December 1991 and is patterned after the earlier tumulus-type facilities. Concrete pads support concrete vaults containing LLW in a grout mixture. The concrete vaults are stacked three high on the pads so that 330 waste-containing vaults can be loaded onto each pad. IWMF pads eventually will be covered with an engineered cap designed to minimize infiltration of rain water. Ultimately, the IWMF may consist of 12 concrete pads fully loaded with vaults.

Because the IWMF facility is above ground, the primary method of contaminant transport is rain water falling on the vaults and pads. The pads and vaults are not covered during loading operations and are thus open to direct precipitation. Resulting runoff from the pads is directed through a monitoring shed where samples are collected by an electronically controlled automatic sampler that responds when flow from the pads is detected. Runoff then flows through a National Pollutant Discharge Elimination System (NPDES) sampling point and discharges to a nearby surface stream. Figure A.3, Appendix A, is an aerial view of the IWMF area showing two pads in use, two pads under construction, and the locations of the French drain outfall and the monitoring shed in relation to the pads. Of the six pads that have now been constructed, two are completely loaded with waste-containing vaults and one is in the process of being loaded. The location of the IWMF area in the southwest corner of SWSA 6 was shown

in Figure A.2.

The conceptual model for the IWMF differs from that of the earlier tumulus facilities only in that there is a French drain between the IWMF pads and the hill to the north. This drain is designed to prevent groundwater from entering the gravel base beneath the pads. Any 'water that does enter the gravel base drains to the underpad sump at the monitoring station.

Values of pH exceeding the NPDES permit limit of 9.0 have been reported for IWMF as they were for the original tumulus pads (Ashwood et al. 1991a,1991 b; Wickliff et al. 1991a,1991 b; Morrissey et al., 1994a, 1994b, 1995, 1996). In response to concerns over the release of water from the concrete pads with a pH above the NPDES permit limit, an automated CO, bubbling system was installed at IWMF in 1993. This system functions to maintain IWMF effluent pH below the NPDES permit limit. It is operated as a "best management practice" and is designed to lower pad runoff pH by supplying CO, to the pad runoff water. The CO, supply is electronically controlled to respond when there is flow from the pad and the pH approaches the NPDES limit of 9.0.

2.1.1 Pad and Underpad Runoff

2.1 .1 .1 Methodology

The IWMF monitoring area consists of three sumps for the collection of water from (1) the active pad (ie., the pad on which waste vaults are actively being loaded) and the empty pads, (2) the inactive (*i.e.*, fully loaded) pads, and (3) the underpads. The design of the IWMF pad drainage system allows runoff from the active and empty pads to flow through PVC piping into a sump, designated the stormwater sump, at the monitoring station. Runoff from the inactive pads drains to a separate sump, designated the infiltration sump, at the monitoring station. The volume of each sump is -7500 L (2000 gal.). Any water that accumulates in the underpad gravel base drain is routed to the monitoring station and collected in a -3800-L (1000 gal.) sump.

Samples of pad runoff are collected using electronically controlled automatic samplers, Each sample is analyzed for gross alpha, gross beta, and gamma activity. Samples are periodically analyzed for ^{3}H activity and cation and anion concentrations.

Pad runoff water pH is continuously monitored using pH probes in both the stormwater and infiltration sumps. 'These data are' recorded'electronically by a data acquisition system that was installed during FY 1'994. A-signal is sent to open solenoid valves in the CO, lines if the pH rises above 8.5. This allows flow of CO, into the runoff water, thus lowering the pH. This system has wbrked well and continued to maintain effiuent pH levels below the NPDES limit.

To date, little water has drained from the underpad even during periods of very heavy rainfall. Thus, the upgradient French drain is functioning effectively to route shallow groundwater around the facility. The valve controlling flow from the underpad discharge line into the underpad sump remains closed during normal operations. When a visit is made to the site to collect pad runoff samples, this valve is opened to check for underpad drainage. If sufficient water for analysis does drain from this line, samples will be collected and analyzed for gross radionuclide activity.

2.1 .1.2 Results

Radiological activity present in samples collected at IWMF and elsewhere in SWSA 6 are compared to 'internal reporting levels (IRLs)' outlined in the ASEMP program plan (Morrissey et al. 1994). The rationale for establishing these IRLs, originally set as 'action levels, is discussed by Ashwood and Ashwood (1991). The ASEMP-established IRLs are as follows:

Internal Reporting Levels (IRLs) for samples collected in SWSA 6.

Analyte	IRL (Bq/L)
gross a	1.0
gross β	5.0
^{60}Co	1.5
^{137}Cs	2.5
^{3}H	none

[a]Gross β activity does not include tritium.

Table B.l, Appendix B, tabulates the gross radionuclide results for all samples collected from the IWMF pad runoff collection sumps and the IWMF French drain during FY 1996. Thirty-six samples were collected from the stormwater sump, thirty-four from the infiltration sump, and three from the French drain outfall.

Figures A.4 through A.13, Appendix A, graphically summarize the FY 1996 radiological data for runoff to the stormwater and infiltration sumps. These data show that no samples exceeded the IRLs for gross alpha, gross beta, ^{60}Co, or ^{137}Cs activity. No IRL has been established for ^{3}H in pad runoff; however, ^{3}H activity observed in pad runoff water remains within normal background levels observed in uncontaminated areas of SWSA 6. Error bars displayed on the graphs depict counting errors only (± 1 standard deviation) as reported by the Analytical Services Organization (ASO). No error bars are shown on ^{60}Co or ^{137}Cs graphs for the latter portion of FY 1996. This reflects the change from AS0 performing the gamma counting to ASEMP personnel performing

the gamma analysis within ESD. Gamma results from ESD that are less than the minimum detectable amount (MDA) are reported without an associated error.

Gross alpha activity in water from both sumps is generally at or only slightly above nondetectable levels. The highest observed level of gross alpha activity was in one sample from the stormwater sump that reached -0.5 Bq/L, still only 50% of the IRL. Gross beta activity in pad runoff water entering the stormwater sump averaged 0.48 Bq/L for the year. Average beta activity for the infiltration sump samples was 0.86 Bq/L, almost twice that of stormwater sump samples. Maximum observed values of gross beat activity were 1.8 Bq/L and 1.6 Bq/L for stormwater sump samples and infiltration sump samples, respectively. All beta activity measurements were well below the IRL of 5.0 Bq/L. No samples exceeded the ^{60}Co or ^{137}Cs IRLs (1.5 Bq/L and 2.5 Bq/L, respectively) during FY 1996. Most ^{60}Co or ^{137}Cs data were near minimum detectable amounts. Potassium-40 activity (Table B. 1, Appendix **B),** previously observed in tumulus runoff water in association with elevated levels of gross beta activity (Morrissey et al. 1994; Morrissey and Cunningham 1996; etc.), was infrequently detected above the MDA in stormwater sump samples. Potassium-40 activity, at statistically significant amounts, was detected somewhat more frequently in infiltration sump samples but only at very low levels. The observed ^{40}K activity is suspected to be the result of potassium leaching from the concrete'vaults and pads and is assumed to account for the observed gross beta activity; however, no direct correlation is observed between gross beta activity and ^{40}K activity. Tritium activity in runoff water in both sumps remained low and well within what are considered normal background levels for uncontaminated areas of SWSA 6.

Only traces of water drained from the IWMF underpad system even after periods of heavy rainfall. Therefore, no samples were collected. The absence of water in the underpad indicated that the French drain was performing as designed to route shallow groundwater away from the IWMF underpad system.

2.1.i pH control of pad water runoff.

2.1 .2.1 Methodology

In response to elevated pH, first observed at the tumulus facilities, an automatic pH control system was installed at IWMF. The system consists of a pH probe in both the 'infiltration and the stormwater sumps, a pressure transducer calibrated to measure water level in the stormwater sump, a supply of CO,, solenoid valves; and an electronic data acquisition device with input and output connections. Carbon dioxide can be released into either sump in response to elevated pH as long as the pressure transducer' records a water level indicating flow from the pads. Flow from the pads is restricted by 'adjusting the opening of the sump outflow valves and by a 3-in. high stainless steel plate at the outlet of each sump. The plate causes -3 in. of water to remain in the sumps at

all times. Set points are such that if the level in the stormwater sump is >3.2 in. and the pH in either sump is >8.5 the appropriate solenoid valve in the CO, line is opened by an electronic signal from the data logger and gas flows into the sump. If either the water level or the pH fall below set points, the data logger signal closes the solenoid valve and gas flow ceases. The data logger reads pH and water level once a minute and records data every 15 min. as an average of the I-min. values.

2.1.2.2 Results

Figures A.14 through A.25, Appendix A, display pH variations recorded at the IWMF outfall, in the stormwater sump, and in the infiltration sump. The figures display pH data for each quarter of FY 1996 at each location. IWMF outfall pH (Figs. A.14, A.17, A.20, and A.23) indicate that the NPDES permit limit was exceeded for only one fifteen-minute-average period during the entire year (Fig. A.17). These figures show that the CO, bubbler system was able to maintain the outfall pH below the NPDES permit level of 9.0 despite several periods during which water flowing into the infiltration sump exceeds pH 9.0. Average, maximum, and minimum pH values observed were:

Location	Quarter	Average pH	Maximum pH	Minimum pH
outfall	first	8.21	8.87	7.07
	second	8.14	'9.11	7.42
	third	7.34	8.65	6.61
	fourth	7.77	8.52	6.97
stormwater sump	first	7.56	8.71	6.60
	second	7.53	8.71	6.77
	third	7.42	8.64	6.67
	fourth	7.78	9.05	7.30
infiltration sump	first	7.22	8.91	5.88
	second	7.24	9.61	5.81
	third	7.83	9.11	7.21
	fourth	7.96	8.95	7.45

2.1.3 Soil sampling

2.1.3.1 Methodology

Surface soil was collected at ten locations around the IWMF facility by the method described in procedure ASEMP-04. The purpose of collecting such samples is to monitor for radiological contamination in the IWMF area that may be caused by IWMF loading operations.

2.1.3.2 Results

Results of the FY 1996 soil sampling at the IWMF area are presented in Table B.2, Appendix B. All radiological data are within normal background levels typically observed in uncontaminated areas of SWSA 6. These results confirm that IWMF loading operations are not causing soil contamination in the immediate vicinity of the IWMF storage pads.

2.2 HILLCUT DISPOSAL TEST FACILITY

The HDTF is a demonstration project that was started in 1981 but was discontinued the following year before any wastes were emplaced (see Figs. A.1 and A.2, Appendix A, for location in SWSA 6). In 1985, the project was reactivated as part of the Low-Level Waste Disposal Development and Demonstration project. The HDTF provided a method for disposing of high-activity LLW since no suitable greater-confinement burial method was available at the time. The HDTF demonstration also provided a means by which to evaluate the use of hillslope cuts as possible sites for future engineered disposal facilities. The objective of the demonstration was to assess the degree of hydrologic isolation afforded by this type of design.

Figure A.26, Appendix A, shows the design of the HDTF with its monitoring wells and gravity drain. The HDTF is similar to the tumulus-type facilities and consists of a concrete pad (4.6 m × 4.6 m) constructed in a cut from the side slope of a hill. The pad was installed above the expected high water table in the area. Twenty- seven concrete boxes (1.1 m × 1.1 m × 1.4 m) of high-activity LLW were placed on the pad and covered with soil. The lids of the boxes were sealed with a bitumen mastic, and the boxes were banded. A runoff collection system was installed to drain both the pad and the gravel area underneath the pad. The HDTF allows for runoff from the pad and the gravel drain to be collected separately in two above-grade 500-gal tanks downslope from the facility. Two monitoring wells were installed, one on the pad and one in the gravel drain.

Water can reach the buried waste vaults through infiltrating precipitation or shallow stormflow. If the water table rises following heavy rains, the gravel base below the pad should intercept water from the shallow aquifer, serving to drain water away from the pad.

Records of the contents of three of the vaults placed on the HDTF pad indicate that these vaults cannot be certified to be free of RCRA material. The water that drains from the pad and underpad is, therefore, collected for treatment at the Process Waste Treatment Plant (PWTP).

2.2.1 Pad and underpad runoff collection and analysis

2.2.1.1 Methodology

The HDTF design allows water that drains from the pad surface and the underpad to be collected in separate tanks at the outfall. When water in these tanks reaches -70% of tank capacity, each is sampled and analyzed for gross radionuclide parameters. Tank contents are then transferred to holding tanks further downhill from the facility. Problems with drain line connections at the bottom of the underpad collection tank have made it necessary to combine the runoff into one tank for significant periods.

Samples are analyzed for gross alpha, gross beta, and gamma activity. When the analytical results are received, the SWSA 6 foremah is notified. The foreman is responsible for transporting the collected water to the PWTP. If radioactivity levels are above the IRLs, the ASEMP program manager is notified.

2.2.1.2 Results

Water level measurements in on-pad and underpad wells indicate that the underpad well remains dry while the on-pad well consistently retains a couple of inches of standing water. Water levels in both wells probably respond rapidly to significant rain events. However, measurements are made manually, generally after rainfall has stopped, and are not likely to catch a rapid response.

The underpad collection tank that had been off-line since 1994 was repaired and put back in service in February 1996. However, analytical data reported is still from samples collected from the downhill storage tank and represents combined pad and underpad flow. The on-pad tank collected most of the -2150 gal. of total runoff (both pad and underpad) that was measured during FY 1996. Freezing of the drain lines and tank contents continues to be a problem for sample collection in the winter months. A new cover was installed over the facility to replace the decaying old one. The drain valves in the downhill storage tanks were replaced with solid plugs to prevent leakage.

Table 8.3, Appendix B, presents an historical record of the radiological measurements made on the HDTF pad and underpad runoff water from 1987 to the end of FY 1996. Samples collected in FY 1996 are from the combined pad and underpad runoff. All radiological data reported for FY 1996 are below SWSA 6 IRLs. A low level of gross beta activity was observed in all samples. The low beta activity is most likely the result of potassium leaching from the concrete pads as postulated for beta activity observed in IWMF pad runoff. The historical data show one exceedance of the gross beta IRL of 5.0 Bq/L in 1993 and one in 1995. The 1995 sample also exceeded the ^{137}Cs IRL. The IRL for gross alpha activity has been exceeded on two occasions in samples from the HDTF underpad; once in 1991 and again in 1993.

2.3 CONCLUSIONS

Data from the IWMF pad runoff indicate that no leakage of waste occurred from the vaults. Only a low-level gross beta activity was 'observed in the runoff water. This beta activity is postulated to be a result of potassium (^{40}K) leaching from the concrete. Beta activity in the infiltration sump water averaged approximately twice that of stormwater sump samples. The greater mass of concrete on the two fully loaded pads that drain to the infiltration sump probably accounts for this observed difference in beta activity. No pad-water samples exceeded the IRLs for gross alpha, gross beta, ^{137}Cs, or ^{60}Co activity, Tritium activity in pad runoff samples remains at background levels.

The IWMF French drain performed its'intended purpose of suppressing the water table beneath the pads. The absence of water in the underpad drainage system is an indication of the French drain's effectiveness.

The IWMF CO, bubbling system, installed for automatic pH control of pad water runoff, is functioning well. Only one brief period of outfall pH above the NPDES permit limit of 9.0 was observed in FY 1996.

Water continues to drain from the HDTF during the wet season. Approximately 2150 gal. of combined pad and underpad drainage was collected and sampled during FY 1996. All radiological measurements were below IRLs. Repairs to the collection tanks have been made that will allow separate collection of pad and underpad runoff to resume.

3. LOW-LEVEL LIQUID WASTE SOLIDIFICATION PROJECT

The LWSP, initially referred to as the Emergency Avoidance Solidification Campaign (EASC), was undertaken to-solidify the supernatant from the Melton Valley storage tanks (MVSTs). Table B.4, Appendix B, presents analytical results for supernatant from two of the MVSTs that was solidified during the most recent campaign, LWSP III. Supernatant is mixed with cement and other solidifying agents and allowed to cure in steel cylindrical containers with a diameter and height of 1.8 meters that weigh -12 metric tons.

For radiation shielding purposes, each steel container is loaded inside a storage cask prior to waste solidification. The waste forms are then transported to the LWSP cask storage site where they are placed inside concrete storage casks. The LWSP cask storage site is now located within SWSA 6. The casks are stored at the site on an engineered, compacted, crushed-stone storage pad.

Each storage cask contains an integral fiberglass-reinforced plastic (FRP) liner with lid. Sampling lines were cast in place through the wall of the storage cask into the annular space between the waste form and the FRP-lined concrete storage cask. One tube extends to the bottom of the annular space and is used to collect any liquid that may be found inside the cask. The other tube extends to within a few inches of the top of the annular space and can be used to collect gas samples (Figure A.27, Appendix A).

3.1 CASK-LIQUID SAMPLING

3.1 .1 Methodology

Liquid sampling is conducted annually for all LWSP casks that have been in place for a year or more. Newly prepared casks are sampled semiannually. Liquid that collects in the sampling ports is removed by pumping and analyzed for gross alpha, gross beta, and gamma activity. In addition, analyses are performed for sodium, nitrate, chloride, and other metals and anions if enough sample is available. The choice of analytes is based on the major constituents of the liquid waste prior to solidification (Table B.4, Appendix B). Cask sampling is performed by the Liquid Waste Operations Group (LWOG) of WMRAD.

3.1.2 Results

Sampling of all the LWSP casks for accumulated water was completed in March 1996. The LWSP III casks and those casks that contained water in March were again sampled in early October 1996. The October sampling was scheduled to be completed in September and is, therefore, included in FY 1996 reporting. Sufficient water for analysis was collected from ten casks in March. Nine of the ten are from the original EASC campaign and one is from the first LWSP campaign. No water was found in any LWSP III cask. Eight of those ten casks that were sampled in March also contained adequate water for sample collection in October. The history of previous cask sampling campaigns shows that some of the casks consistently accumulate water while the presence of water in others varies from one sampling to the next. Most of the casks that had sufficient water to sample provided -50 to 300 mL. However, 10 L of water was pumped from cask 3655 in March compared to 350 mL when this cask was last sampled. Cask 3655 was dry in October.

Table B.5, Appendix B, identifies the casks from which samples were collected, the volume collected, results of the anion analyses, and other selected analytical data. Table B.6 provides the analytical results for metals detected in cask water and Table B.7 summarizes the radionuclide data. These data show that the liquid pumped from the casks is contaminated with constituents of the solidified waste. The reason for the presence of such contamination is most likely that residual contamination remained on the outside of the waste form after solidification. Water that accumulates in these casks

probably evaporates to some extent thus concentrating any ions present. Relatively high concentrations of chloride, fluoride, nitrate, sulfate, as well as sodium and other cations, all of which are present in the waste at high concentrations, were found in the cask water samples. For example, concentrations of sodium up to 860 mg/L were present while nitrate and sulfate concentrations up to 2545 mg/L and 336 mg/L, respectively, were reported. Gross alpha and gross beta results show no elevated alpha activity but do indicate relatively low levels of gross beta contamination. Cesium-137 activity was detected in most of the liquid samples with the highest activity being found in cask 6709 during the March sampling (2670 Bq/L). A small amount of ^{134}Cs activity was also reported in this sample.

3.2 SOIL SAMPLING

3.2.1 Methodology

Soil samples are collected annually from five locations at the LWSP site in SWSA 6'. Surface soil samples are collected and analyzed for gross alpha, gross beta, and gamma activity according to standard operating procedures.

3.2.2 Results

Table B.2, Appendix B, includes the FY 1996 soil radiological data for the LWSP cask storage area. All samples were within normal background ranges for soil gross radiological parameters and ^{60}Co activity. However, 4 of the 5 soil samples showed slightly elevated levels of ^{137}Cs activity. The ^{137}Cs activities observed in the LWSP area indicate a problem with collecting soil samples in this location. The casks are placed on an engineered gravel pad and the only soil in the area is near numerous old trench locations above the cask storage area. Therefore, it is likely that the source of the ^{137}Cs activity is from activities associated with past waste disposal practices in the trenches and not LWSP loading operations.

3.3 CONCLUSIONS

Only -5% of the EASC/LWSP casks had sufficient water to sample in FY 1996. Low levels of gross beta activity (maximum of 38 Bq/L) were detected in water that accumulated in the casks. Gross alpha activity was absent. Some of the gross beta activity could be the result of potassium (^{40}K) leaching from the concrete casks, However, the frequent detection of elements associated with the solidified waste, such as chloride, nitrate, calcium, and sodium make it apparent that some external contamination of the waste form has occurred during loading operations.

Soil sampling in and around the LWSP II storage areas indicates that loading and storage operations have not resulted in the release of contamination from the site.

4. TRANSURANIC WASTE FACILITIES IN SWSA 5 NORTH

Transuranic wastes have been stored in SWSA 5 N since 1970 (Shoun 1987). Active TRU waste management facilities in SWSA 5 N include aboveground buildings, buildings that are below ground on three sides, and auger holes similar to the high-range wells in SWSA 6.

Before DOE Order 5820.2A went into effect, TRU wastes were also emplaced in unlined trenches in SWSA 5 N. Within the trenches, TRU wastes are contained in concrete casks and wooden and metal boxes (Stewart et al. 1989). There is evidence that the shallow aquifer extends above the bottom of at least some of the trenches during high water table conditions (Wickliff et al. 1991 b). Furthermore, TRU contamination leached from wastes in the trenches has been measured in a downgradient well (Ashwood et al. 1990; Wickliff et al. 1991a,1991 b; Ashwood et al. 1991a,1991 b) and in seeps along the bank of White Oak Creek (Ashwood et al. 1991a,1991 b). Thus, transport from the trenches is known to occur through the shallow aquifer and along discrete pathways.

Groundwater well 516, immediately downgradient from a group of TRU waste trenches (Figure A.28, Appendix A), has shown gross alpha activity as high as 210 Bq/L (Morrissey et al. 1994). The dominant radionuclide is ^{244}Cm, but traces of ^{241}Am are also detected. The TRU waste trenches also contain some RCRA-regulated wastes: primarily elemental lead (Stewart et al. 1989). Samples from Well 516 have not contained detectable concentrations of volatile organics (Wickliff et al. 1991). Metal concentrations in this well have been below regulatory concern (Ashwood et al. 1991 b).

Well 516 and the TRU waste trenches are upgradient from White Oak Creek (WOC), which drains most of ORNL and eventually enters the Clinch River. The radionuclides, ^{244}Cm and ^{241}Am, were measured in two seeps (Figure A.28, Appendix A: WOC 213 and WOC 255) in the bank of WOC (Ashwood et al. 1991 b). These seeps are along geologic strike with the trenches.

4.1 METHODOLOGY

Samples are collected from the 8 sumps that drain various SWSA 5 N waste storage areas once a month. Samples are obtained simply by lowering dedicated sample bottles below the water level in the sump, retrieving, and transferring to clean bottles appropriately labeled for the required analyses. Samples are analyzed for gross alpha, gross beta, and gamma activity.

Fifteen groundwater wells surrounding the TRU-waste storage facilities are sampled annually. Water samples are collected after the wells have been purged. All samples, with the exception of those collected for tritium analysis, are filtered through 0.45-µm filters and then acidified to a pH <2 with nitric acid. Analytes include gross alpha, gross beta, ^{60}Co, ^{137}Cs, ^{3}H, metals, and anions.

IRLs have been established for gross beta (2 Bq/L), ^{60}Co (1.5 Bq/L), and ^{137}Cs (1 Bq/L) in SWSA 5 N (Ashwood and Ashwood 1991). No IRL was established for gross alpha activity because gross alpha is not a reliable indicator of transuranic contamination at trace levels below 1 Bq/L.

4.2 RESULTS

4.2.1 Storage Facility Sumps

Sumps that drain Buildings 7855. 7826, and 7834 (Figure A.29, Appendix A) were sampled monthly during FY 1996. Samples were analyzed for gross alpha, gross beta, and gamma activity. Internal reporting limits for gross alpha or gross beta activities in water from these sumps are set at 10 and 20 Bq/L, respectively. The SWSA 5 North foreman is responsible for pumping water from the sumps and transporting to the PWTP.

A complete historical record of the radiological data from the SWSA 5 N sump samples is presented in Table 8.8, Appendix B. All sumps, except 7855, are free from any radiological activity above IRLs. Only low levels of gross beta activity, probably from potassium (^{40}K)leaching from the concrete sumps, appears in most sump water. However, gross beta activity in water from sump 7855 typically exceeds the IRL and is always associated with elevated ^{40}K activity. Water from this sump is consistently a yellowish-brown color indicating that the water has probably leached organic material from soil and/or decaying vegetation. The presence of ^{40}K activity provides assurance that the gross beta activity is not the result of any radiological component of the waste but is most likely leached from the same organic material that caused the coloration.

4.2.2 Groundwater Wells

Radiological data from the FY 1996 SWSA 5 N groundwater monitoring wells is presented in Table B.9, Appendix B. Well 516 continues to contain elevated gross alpha activity which has been previously shown to be due to the presence of ^{241}Am and ^{244}Cm.

Table B.10 presents radiological data from the SWSA 5 N seep sampling. Only one seep (258) produced sufficient water for the desired analyses at the time of collection. Seep 258 continued to show the presence of trace activities of ^{244}Cm and ^{241}Am associated with a very low level of gross alpha activity.

Anion and cation analyses were also conducted for SWSA 5 N groundwater. These data, presented in Table B.11, Appendix B, indicate no unusual groundwater chemistry. Bromide was still present in three wells as the result of a tracer test that was conducted over a year ago by injecting bromide into the waste trenches.

4.3 CONCLUSIONS

Gross beta activity is consistently present in samples of water collected from the sump that drains building 7855 and can be accounted for by the presence of ^{40}K. All other SWSA 5 N building sumps are free of any significant radiological contamination.

Alpha activity continues to be present in well 516. The reported radiological results from well 516 vary considerably over the years. Measured activities appear to be highly dependent upon some aspect of the local conditions at the time of sample collection. As suggested in an earlier ASEMP report (Wickliff et al. 1991), water table elevation may be the most important variable. At higher water table elevations, more waste in the burial trenches is directly exposed to groundwater. If buried waste in contact with the water table is indeed the source of alpha activity, then any remedial action must address either removal of the waste or isolation of the waste from the water table. Simply capping the trenches to eliminate infiltration will not prevent ground water from contacting the buried waste.

Alpha activity detected in a seep along the bank of White Oak Creek provides additional evidence for the direct hydrologic contact along geologic strike from the waste burial trenches in SWSA 5 N to well 516 and to the creek.

5. SWSA 7

Soil samples were collected from six locations around Building 7574 and submitted for radiological analyses. Data are presented in Table 8.12, Appendix B. These samples show no elevated activities above the “background” soil data obtained last year (Morrissey and Cunningham, 1996).

6. ACKNOWLEDGMENTS

Jeff Riggs and Roy Freeman of the Instrumentation and Controls Division have consistently supplied excellent guidance and craftsmanship in the design, operation, and maintenance of the electronic monitoring and sampling equipment. Personnel from the Plant and Equipment Division have provided expert craftsmanship when pipe fitting repairs have been needed., Chemical operators in WMRAD are appreciated for their

'sampling efforts at the LWSP casks. Numerous other Plant and Equipment personnel and WMRAD employees have provided valuable assistance. Their help is-gratefully acknowledged.

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‘APPENDIX A
FIGURES

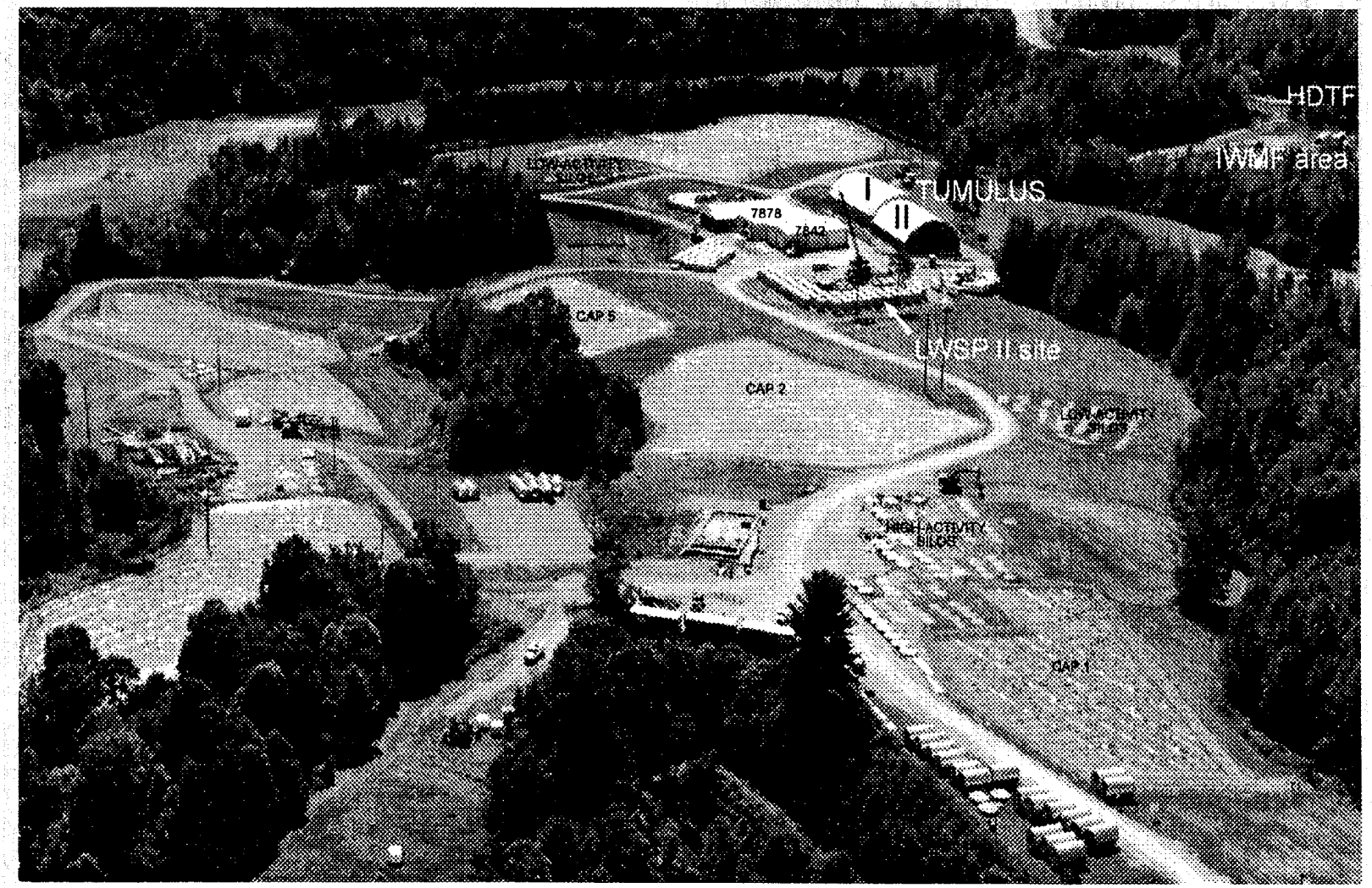

Fig. A.1. Aerial view of SWSA 6 showing the IWMF area, tumulus facilities, the LWSP II site and other waste disposal and storage areas

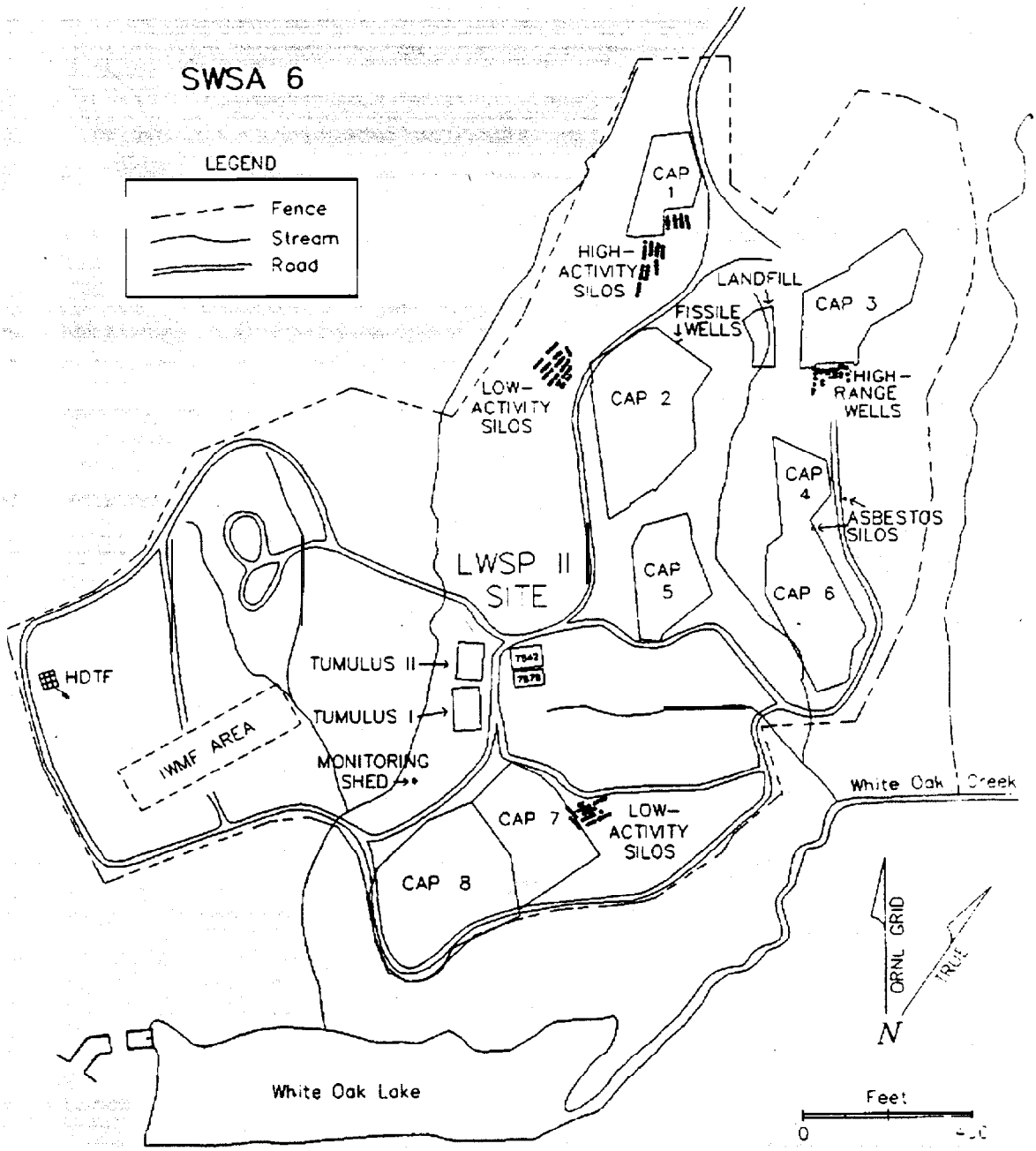

Fig. A.2. Active low-level waste disposal sites and other major facilities in SWSA 6. IWMF, HDTF, and LWSP II areas are monitored under ASEMP.

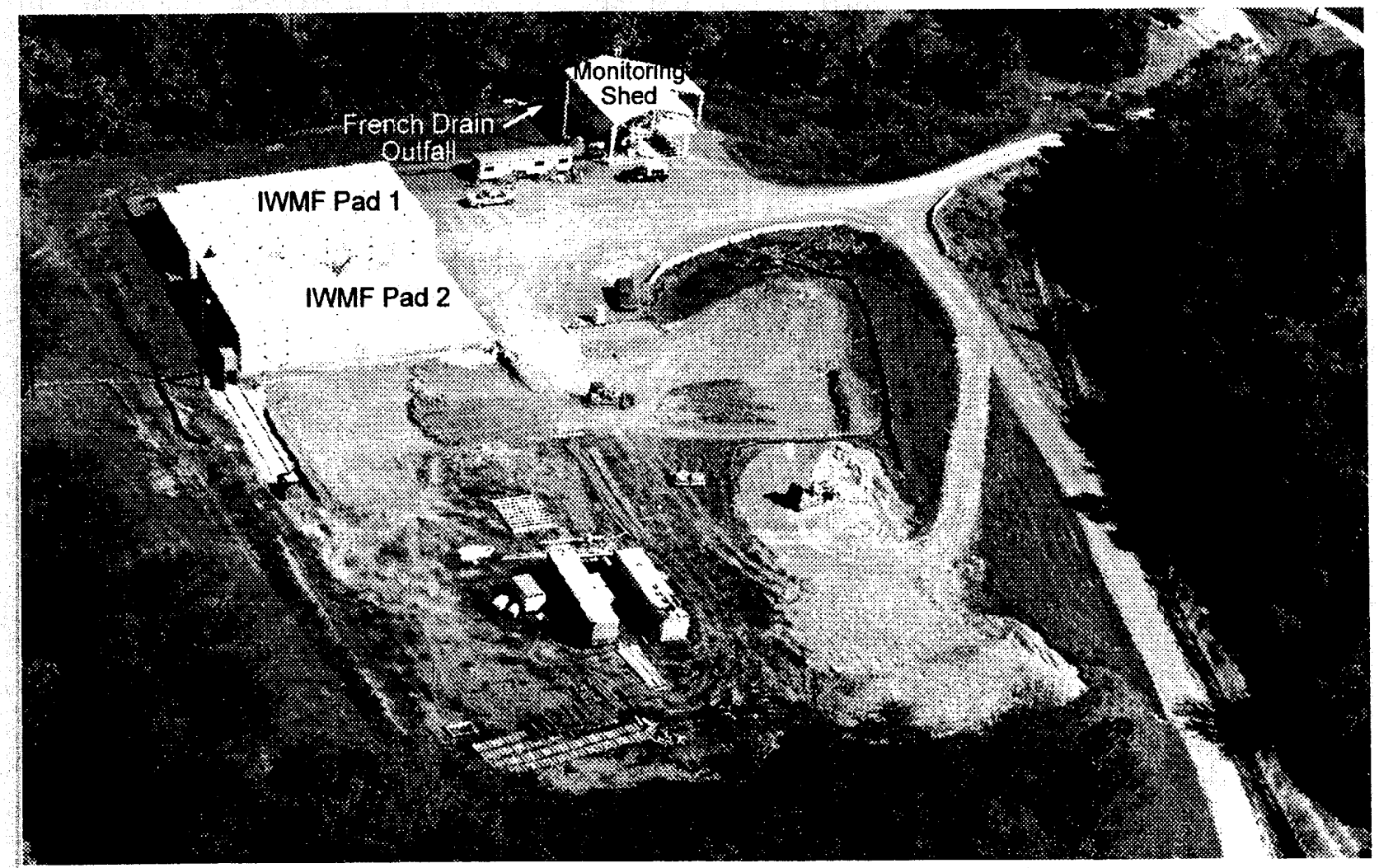

Fig. A.3. Aerial view of the IWMF area showing the disposal pads, monitoring shed, and French drain outfall.

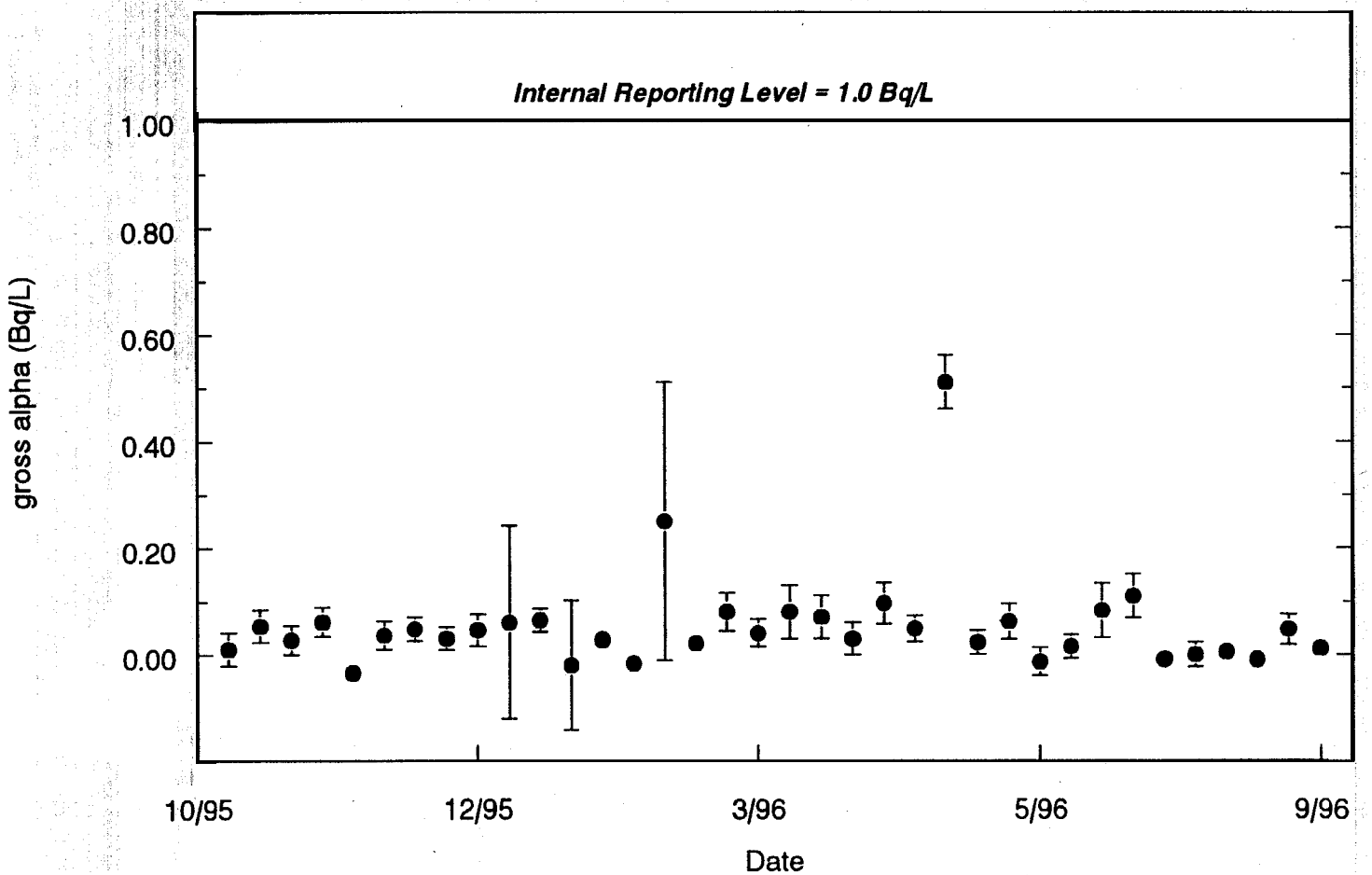

Fig. A.4. IWMF stormwater sump gross alpha data.

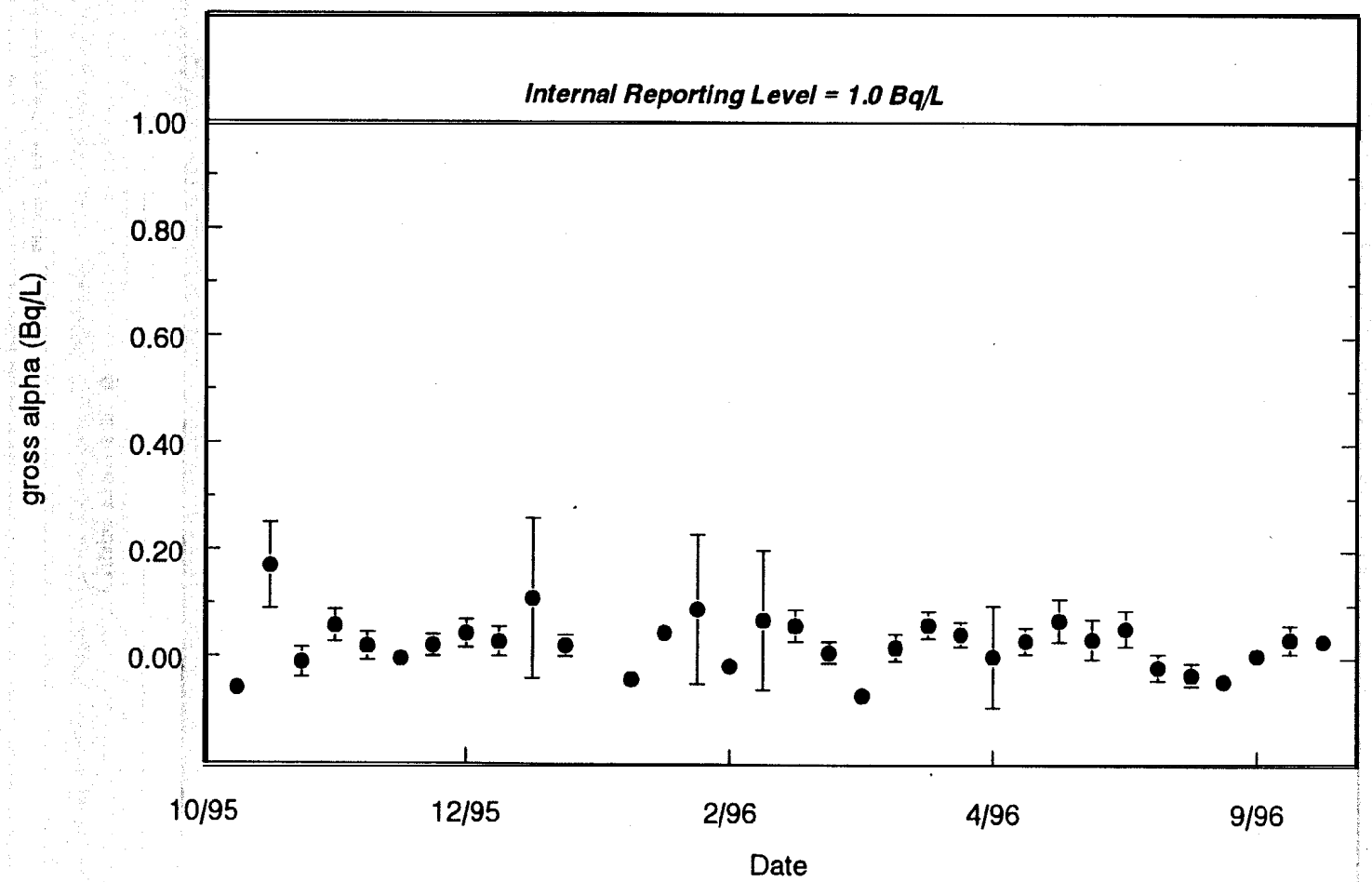

Fig. A.5. IWMF infiltration sump gross alpha data.

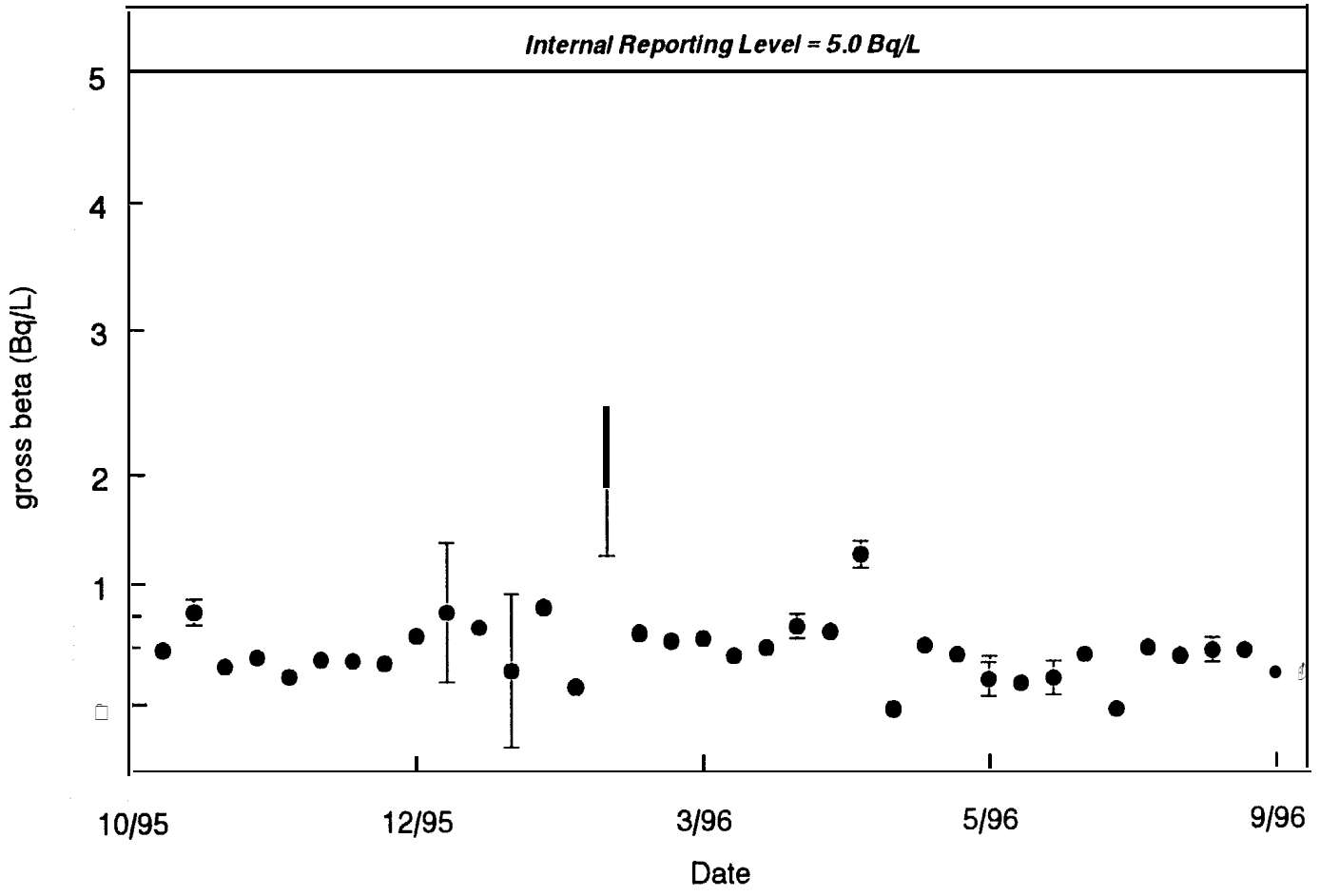

Fig. A.6. IWMF stormwater sump gross beta data.

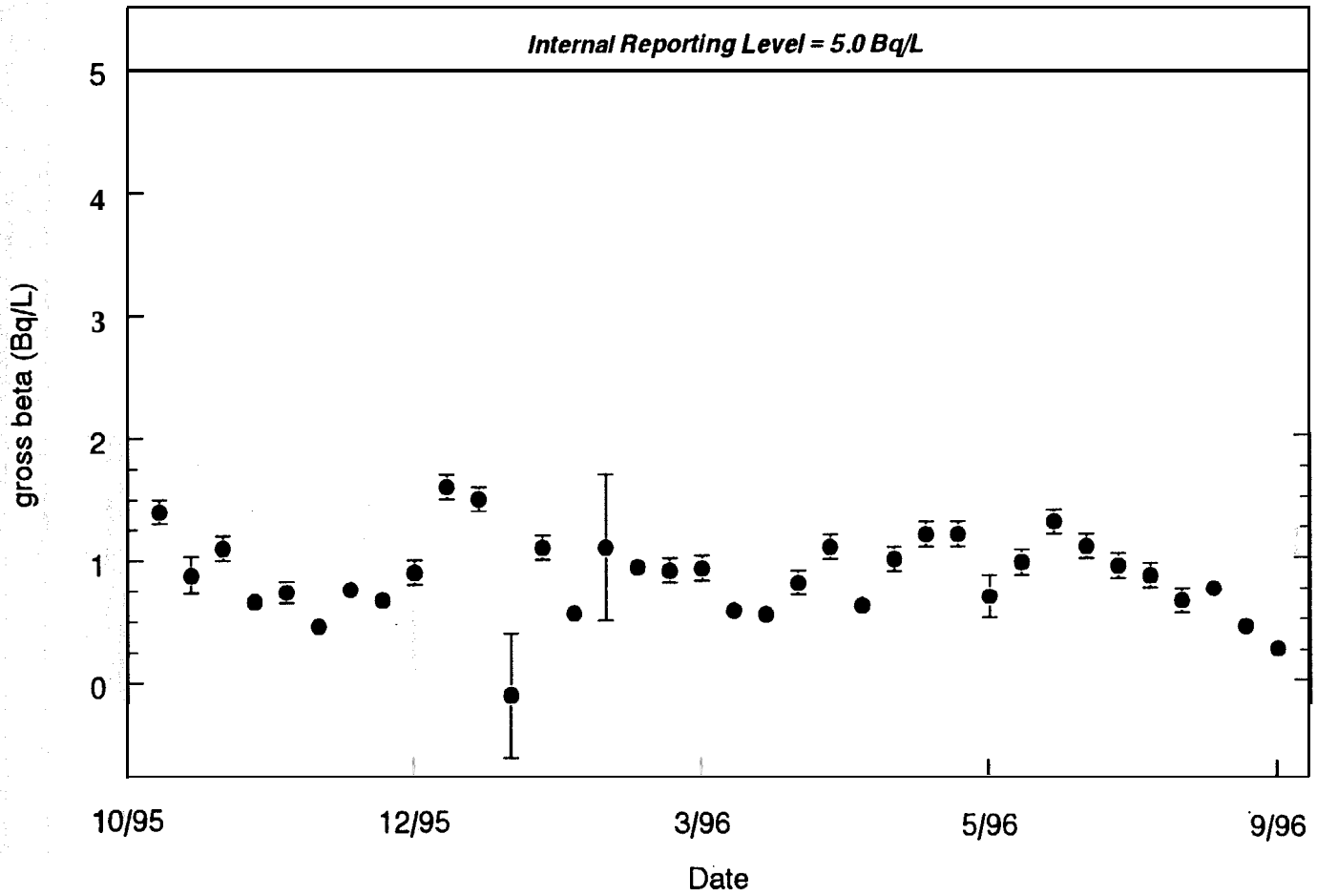

Fig. A.7. IWMF infiltration sump gross beta data.

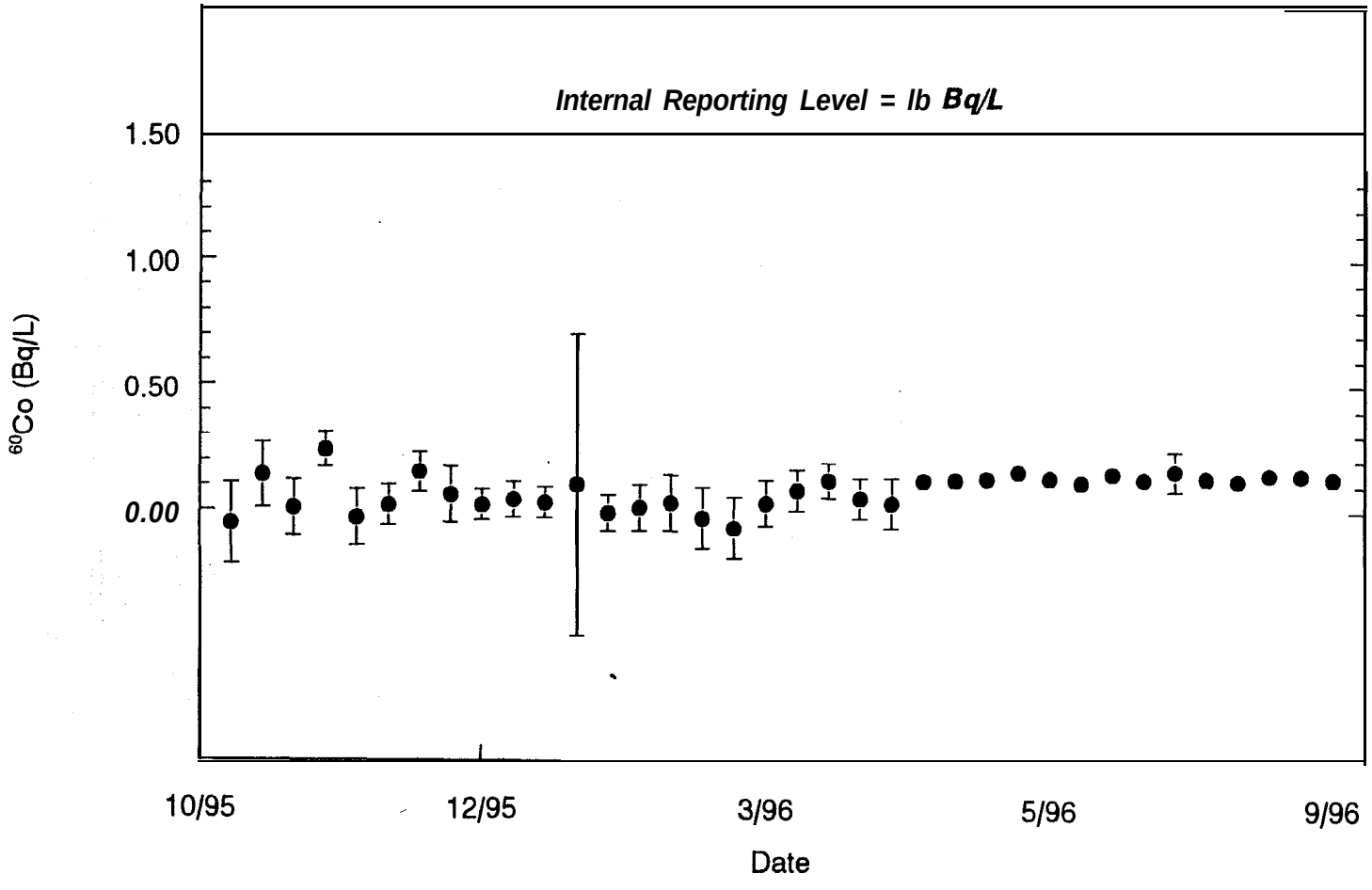

Fig. A.8. IWMF stormwater sump ^{60}Co data.

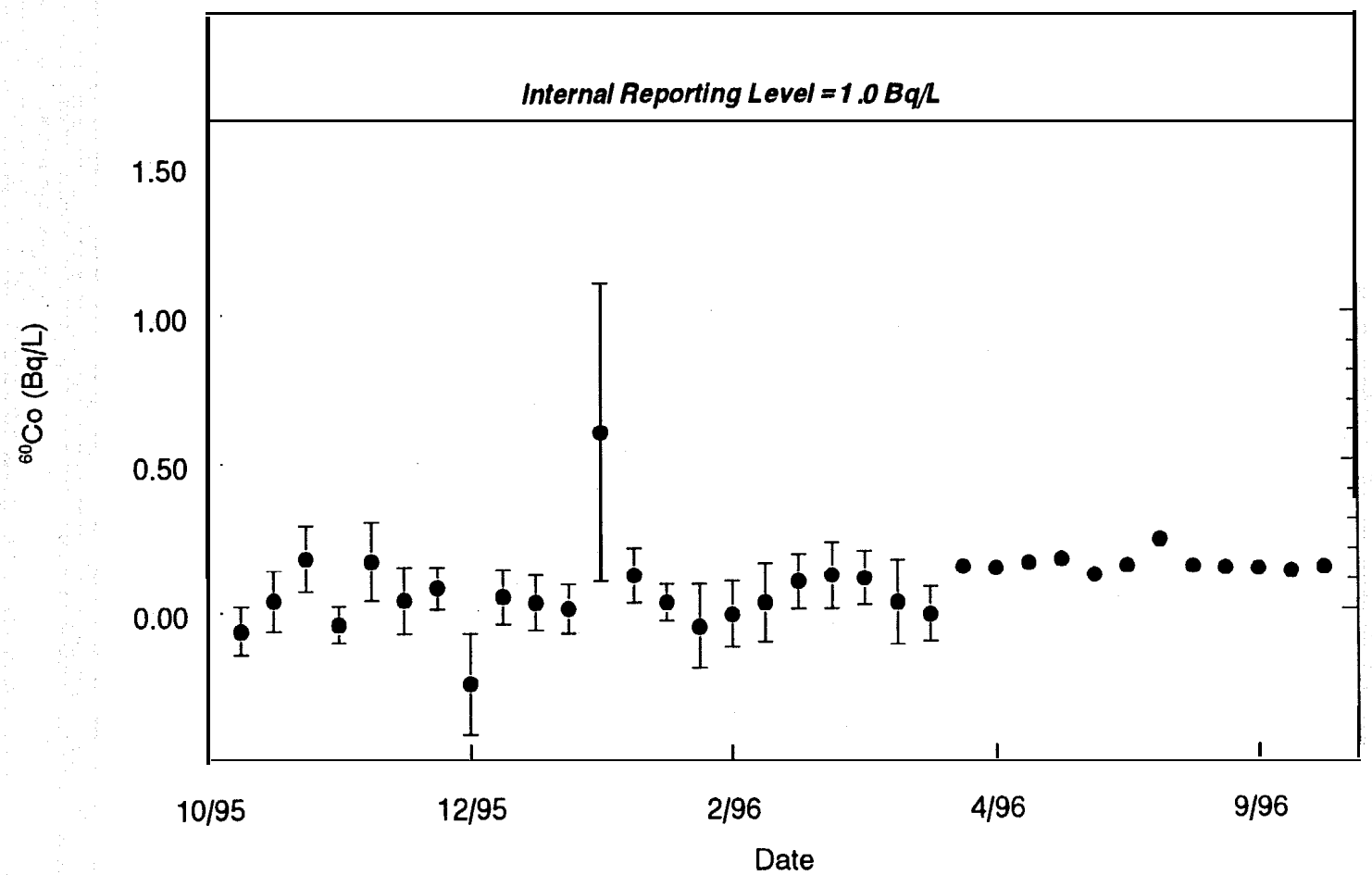

Fig. A.9. IWMF infiltration sump ^{60}Co data.

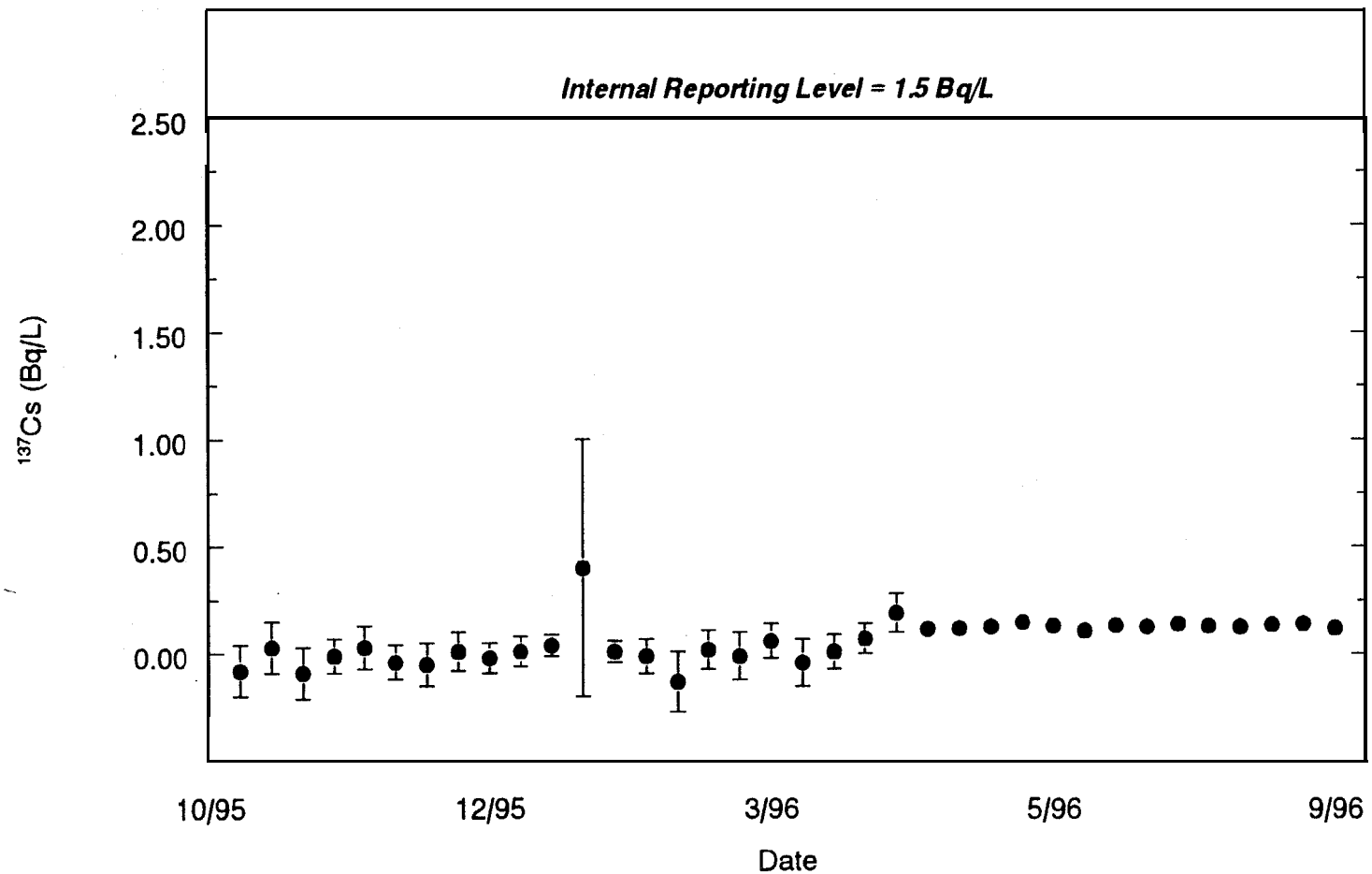

Fig. A.10. IWMF stormwater sump ^{137}Cs data.

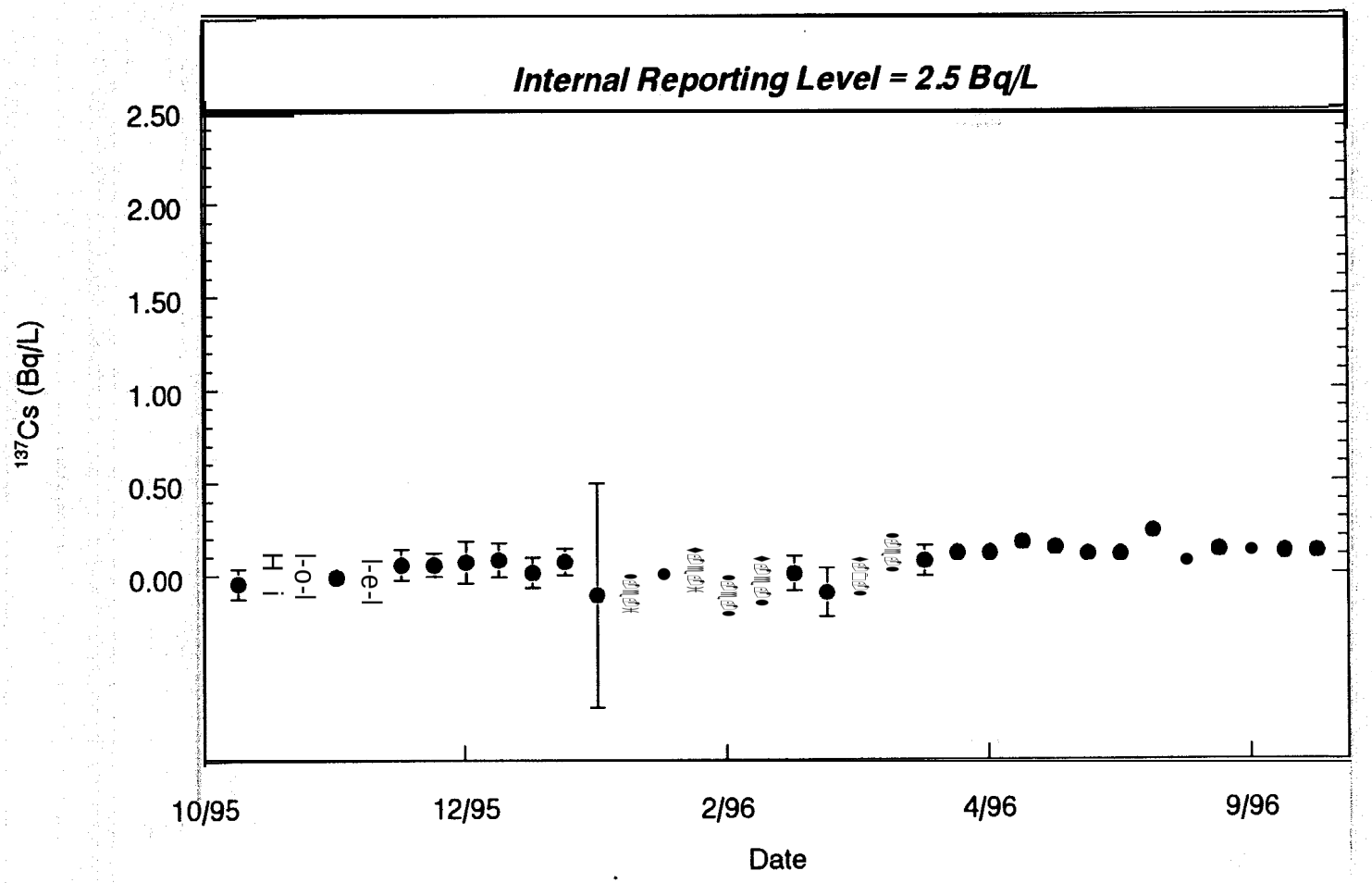

Fig. A.11. IWMF infiltration sump ^{137}Cs data.

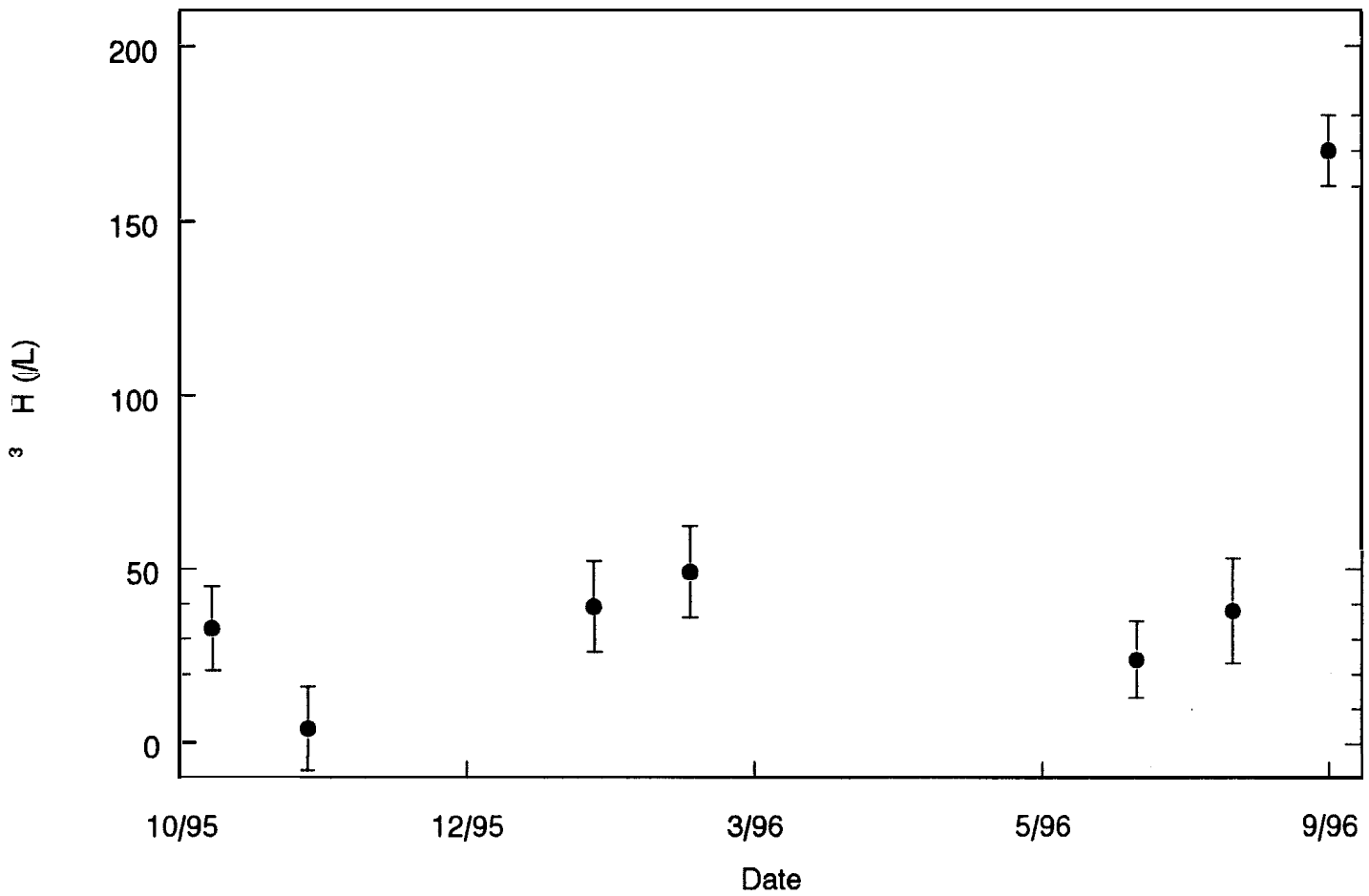

Fig. A.12. IWMF stormwater sump ^{3}H data.

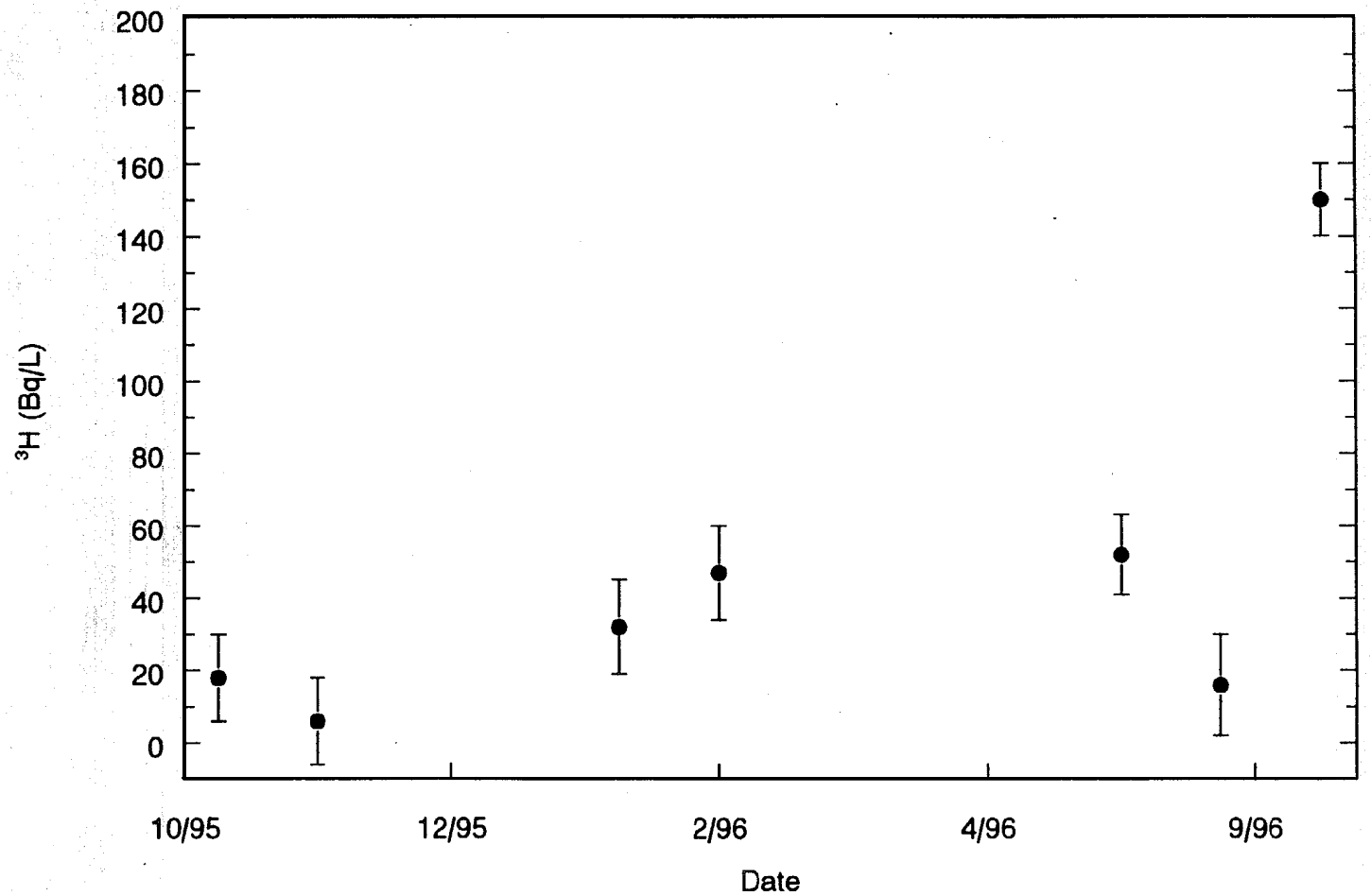

Fig. A.13. IWMF infiltration sump ^{3}H data.

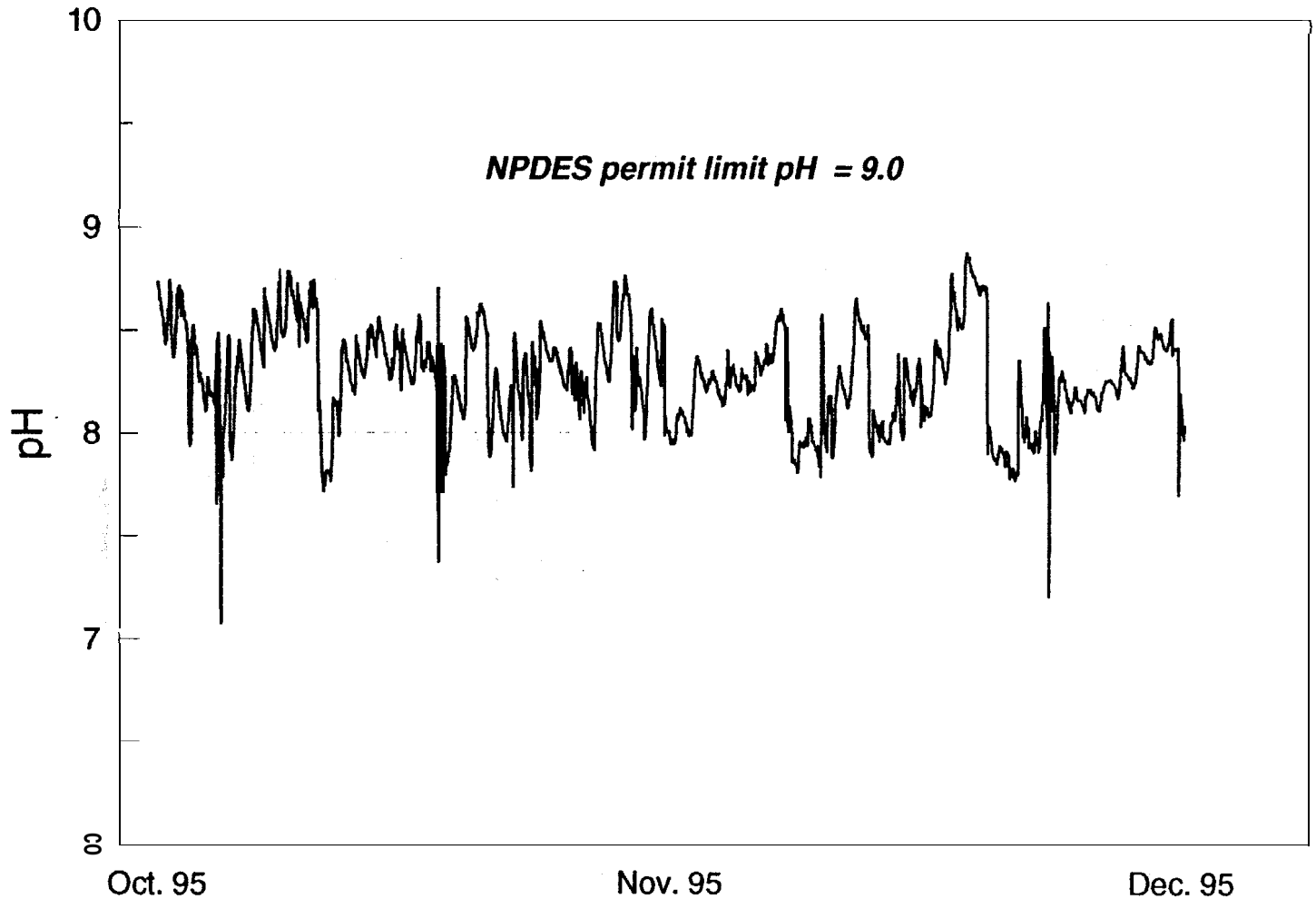

Fig. A.14. First quarter IWMF outfall pH.

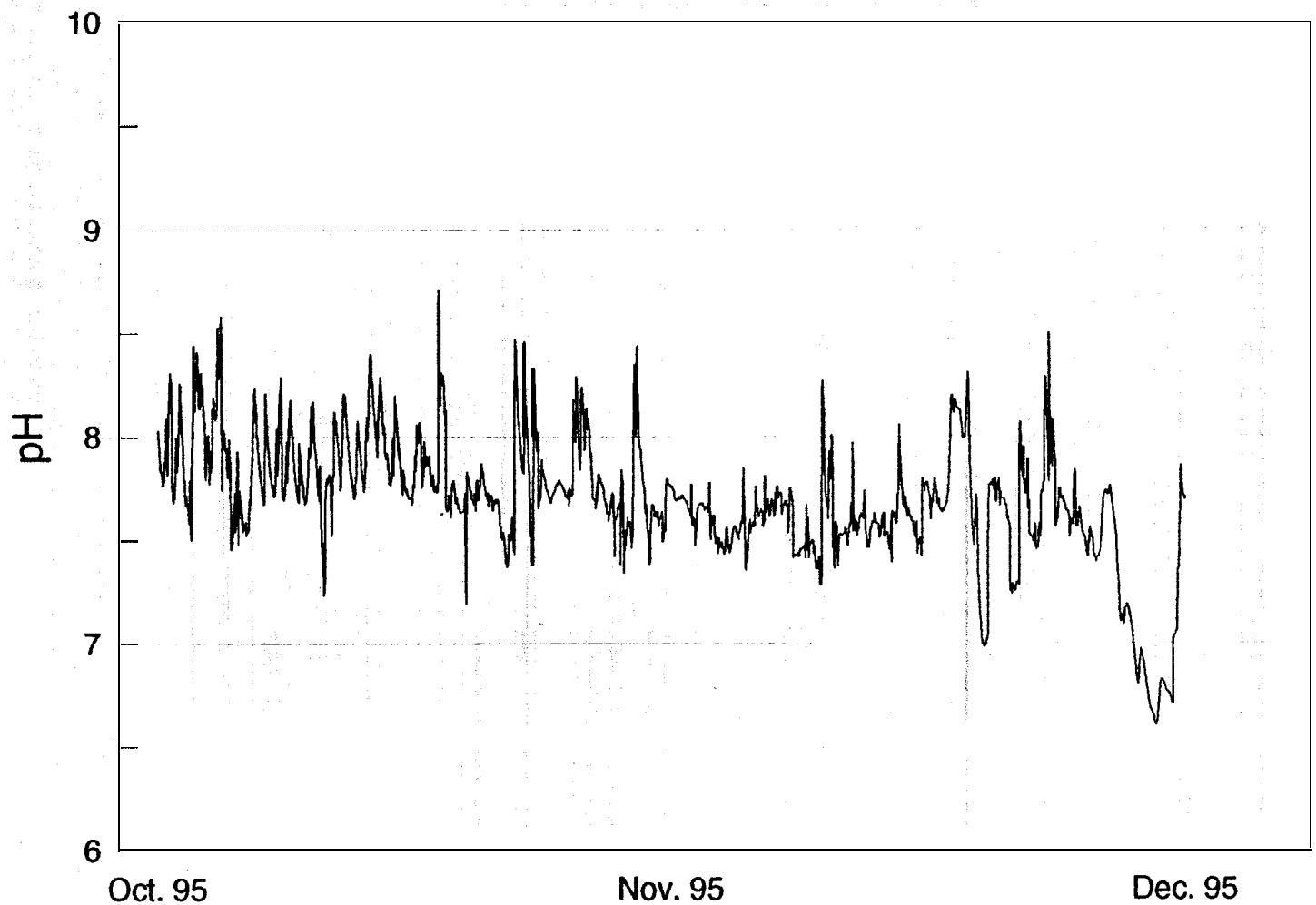

Fig. A.15. First quarter IWMFstormwater sump pH.

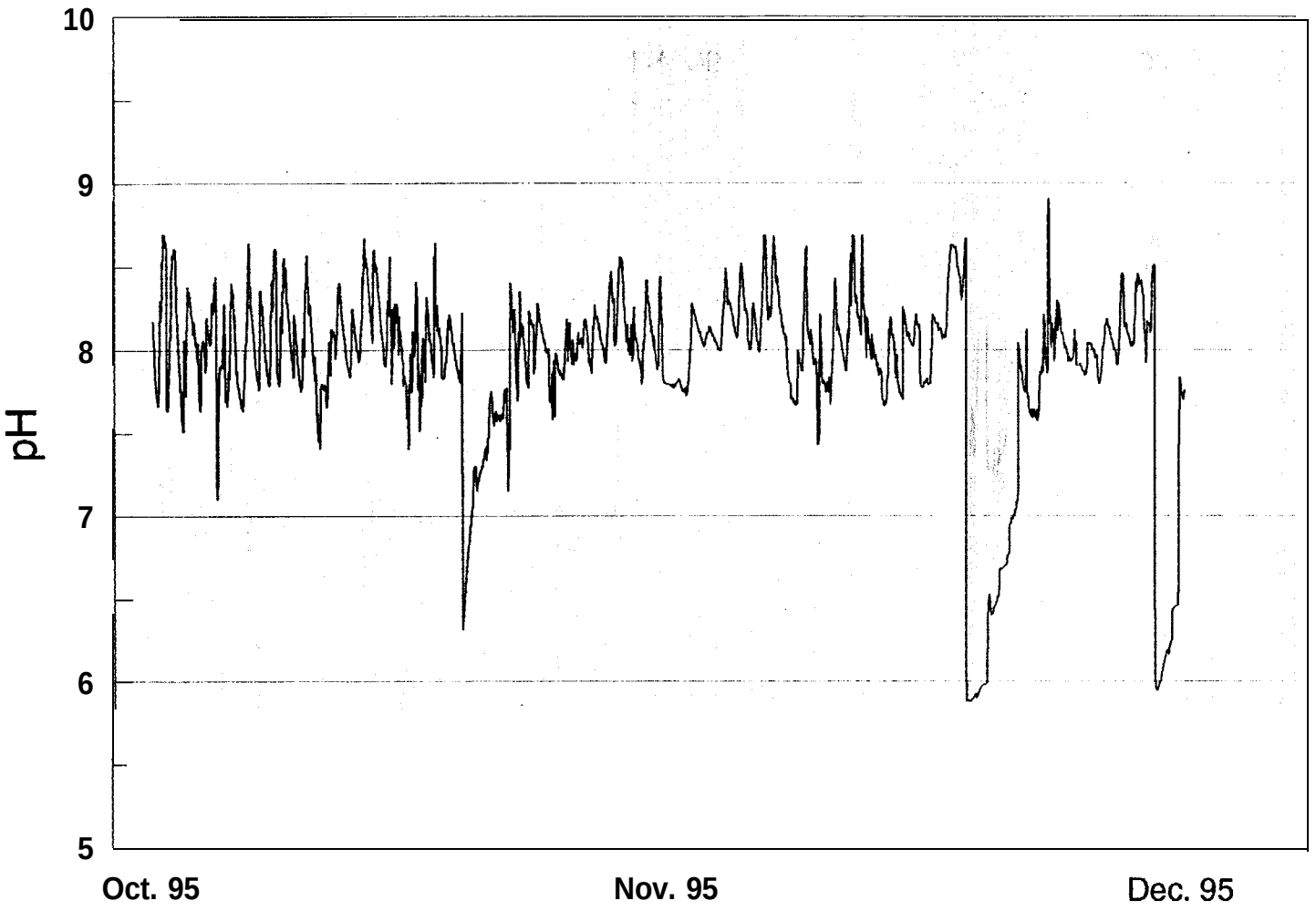

Fig. A.16. First quarter lWMFinfiltration sump pH.

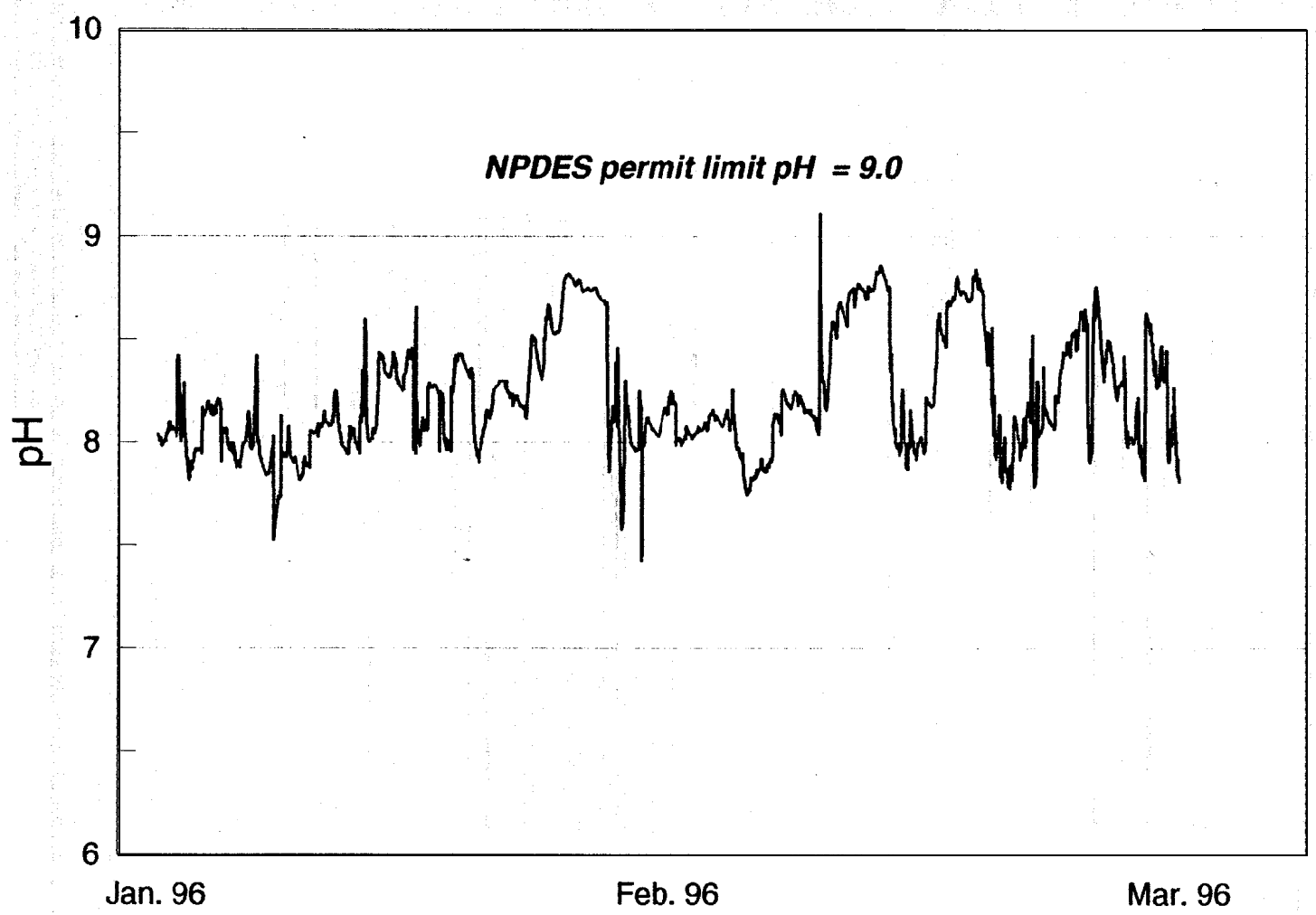

Fig. A.17. Second quarter IWMF outfall pH.

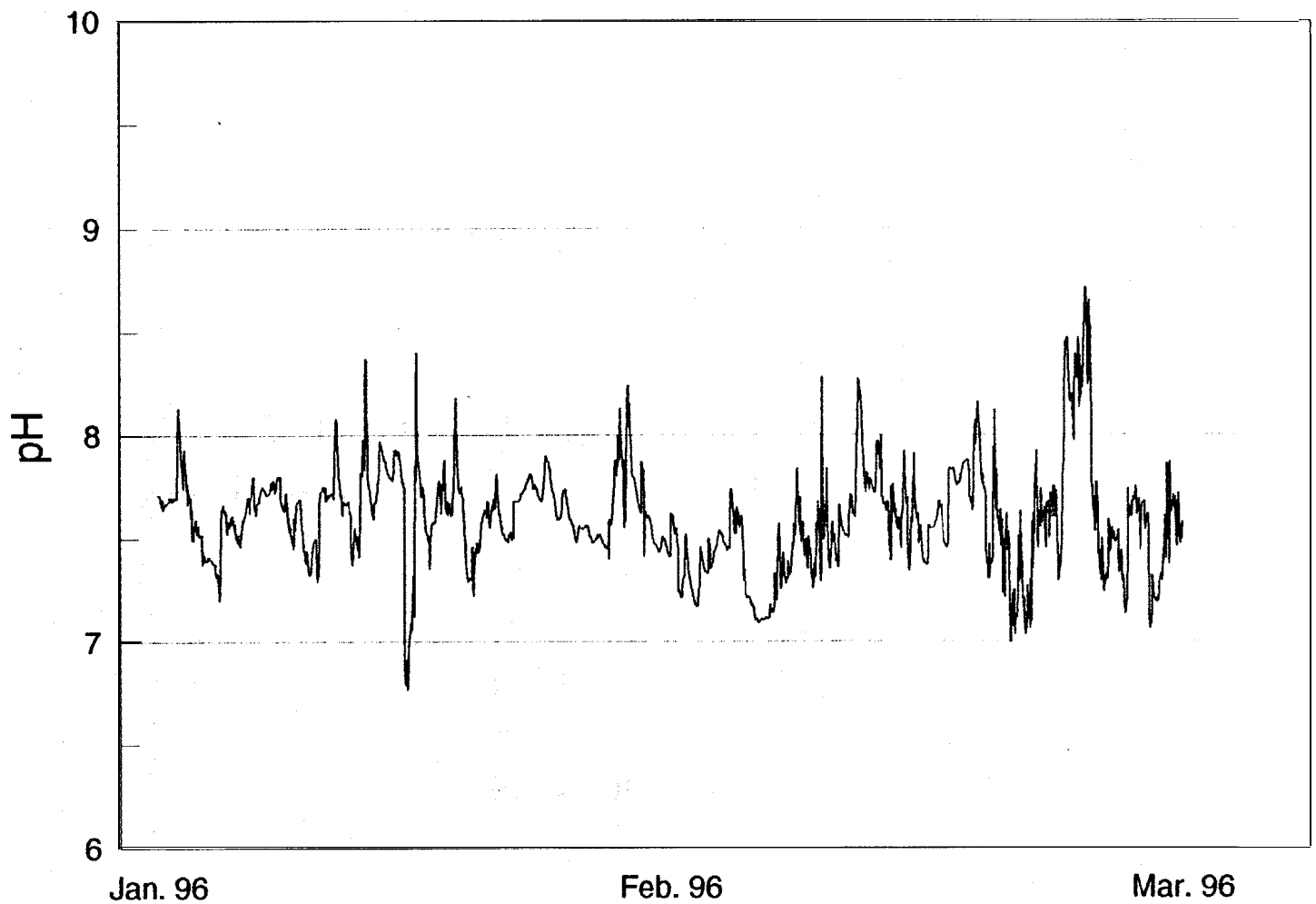

Fig. A.18. Second quarter IWMF stormwater sump pH.

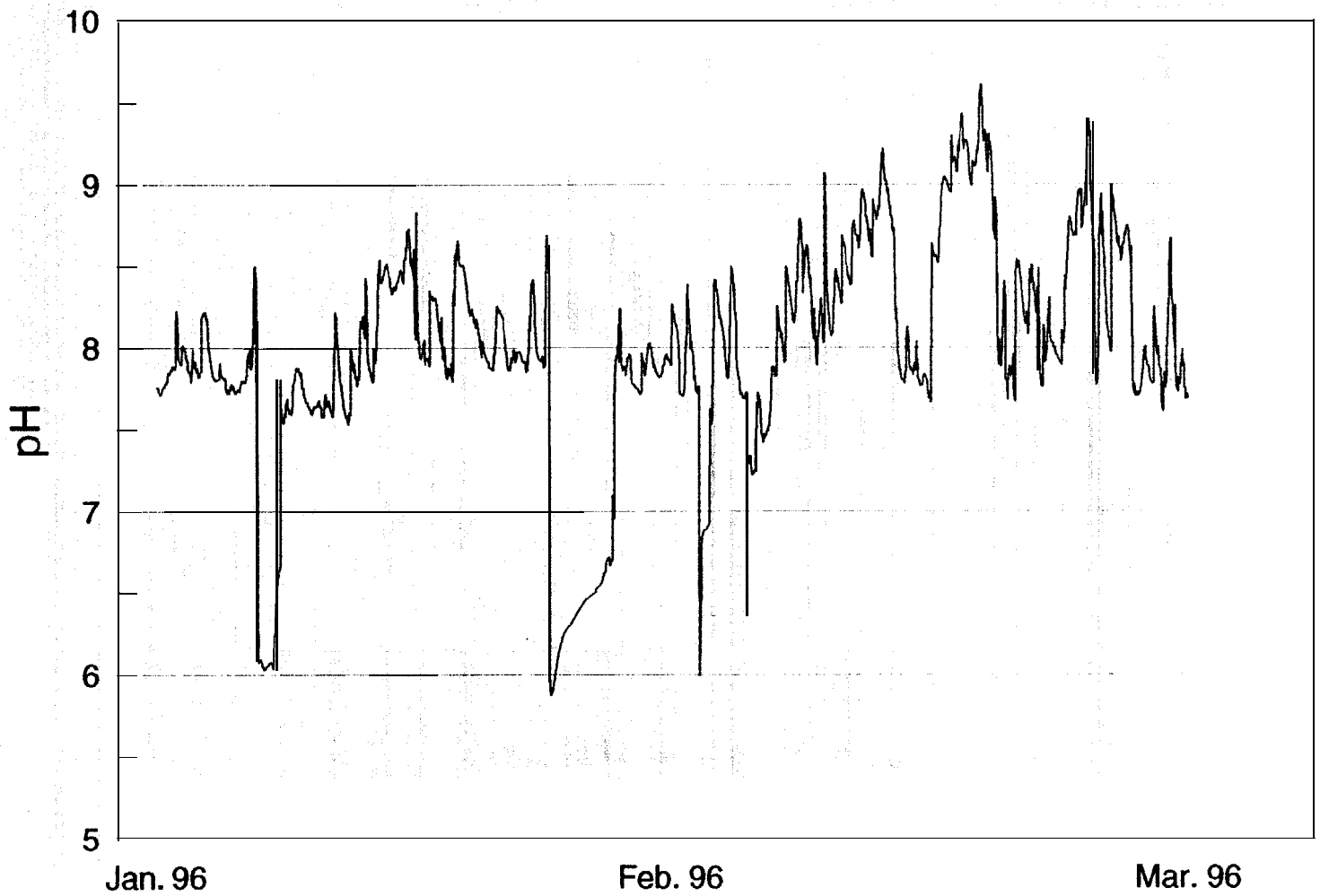

Fig. A.19. Second quarter IWMFinfiltration sump pH.

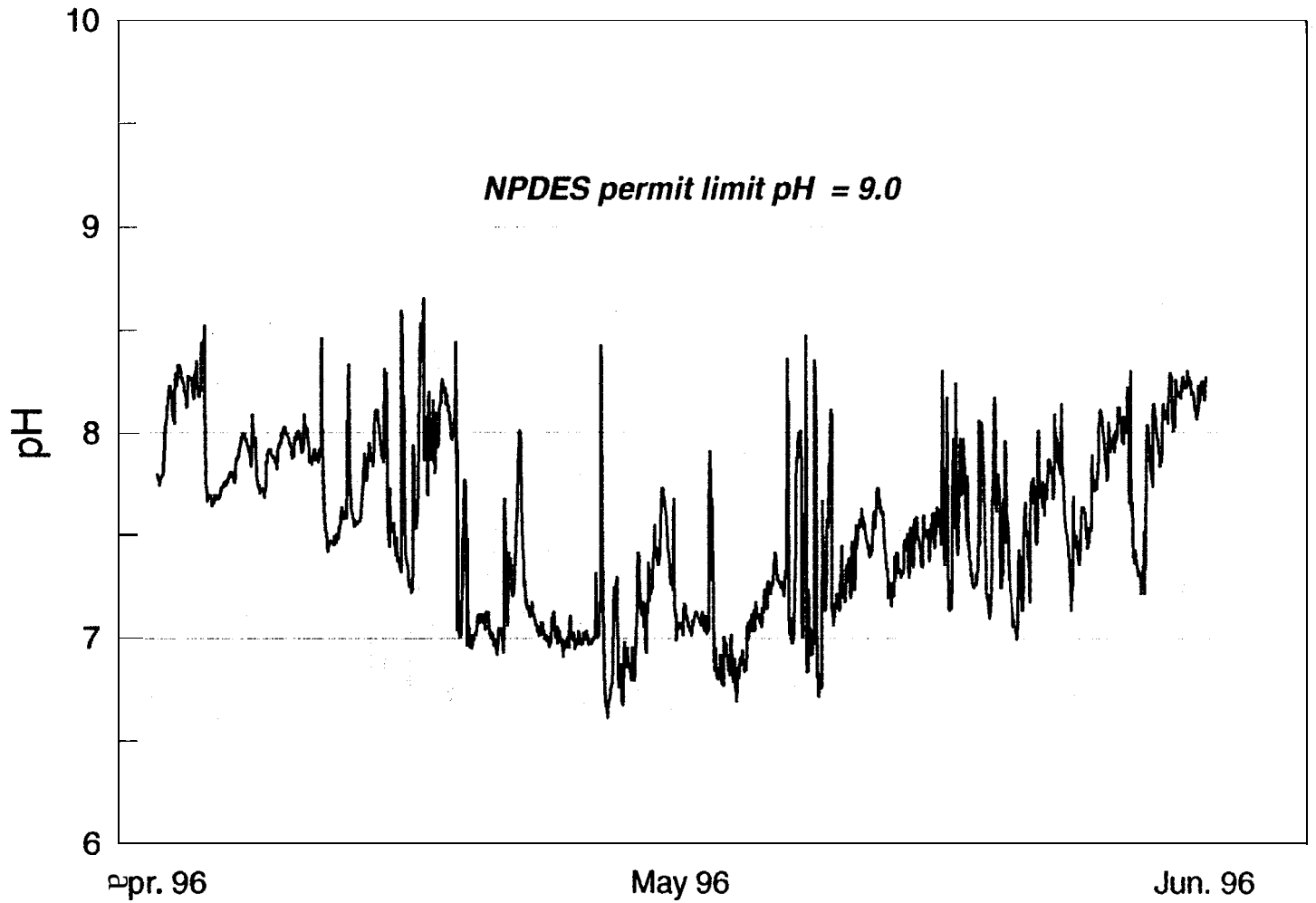

Fig. A.20. Third quarter IWMF outfall pH.

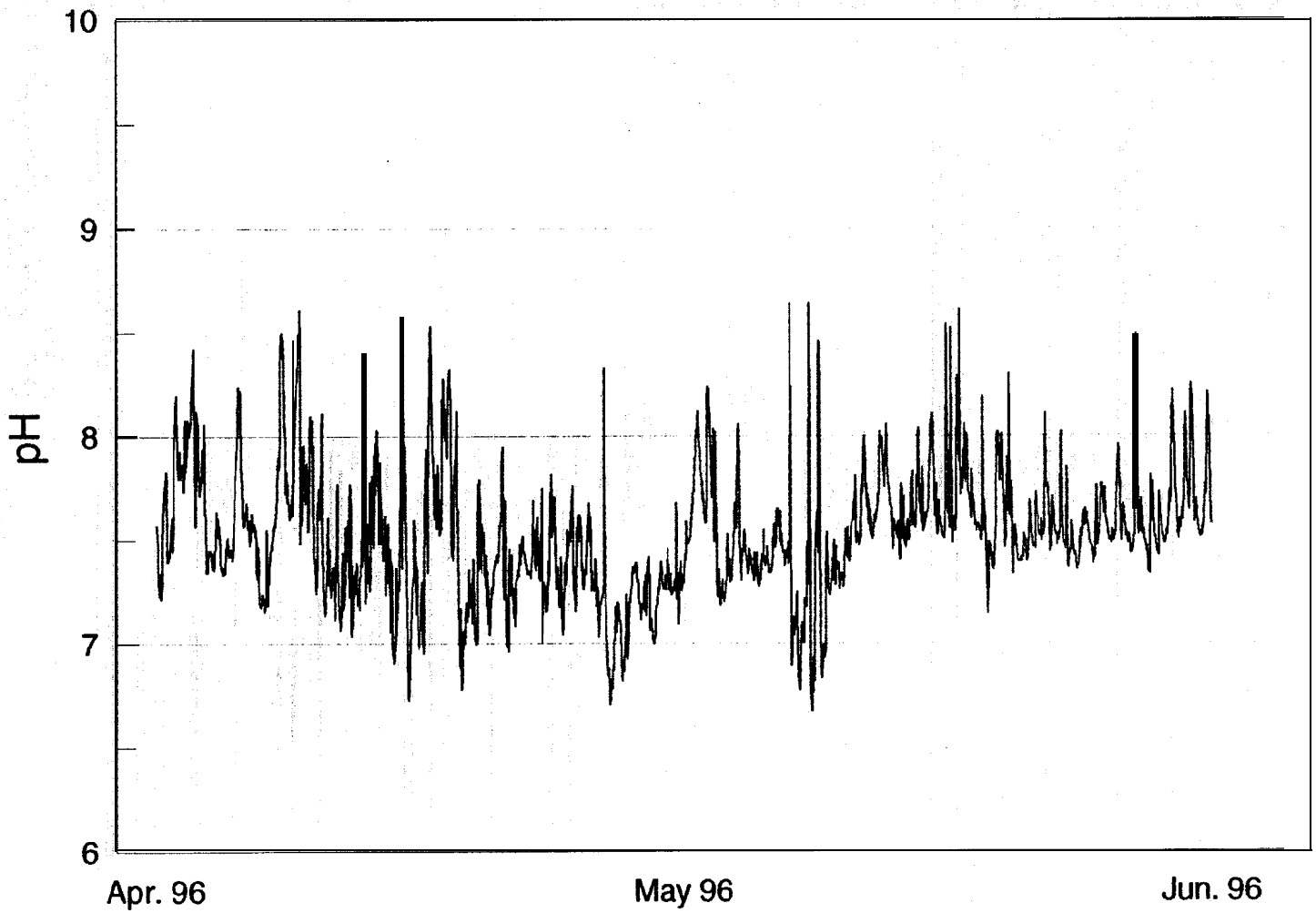

Fig. A.21. Third quarter IWMF stormwater sump pH.

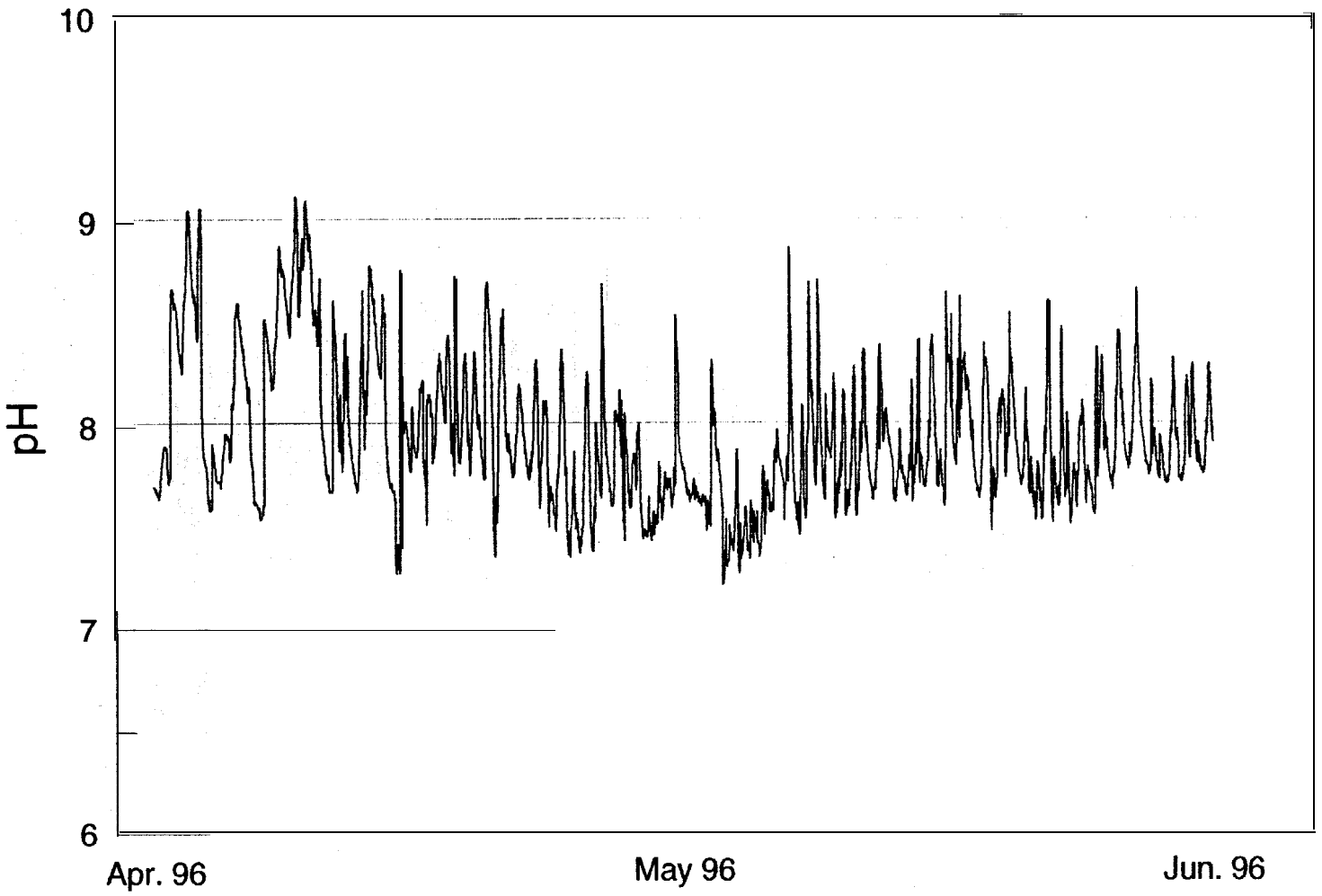

Fig. A.22. Third quarter IWMF infiltration sump pH.

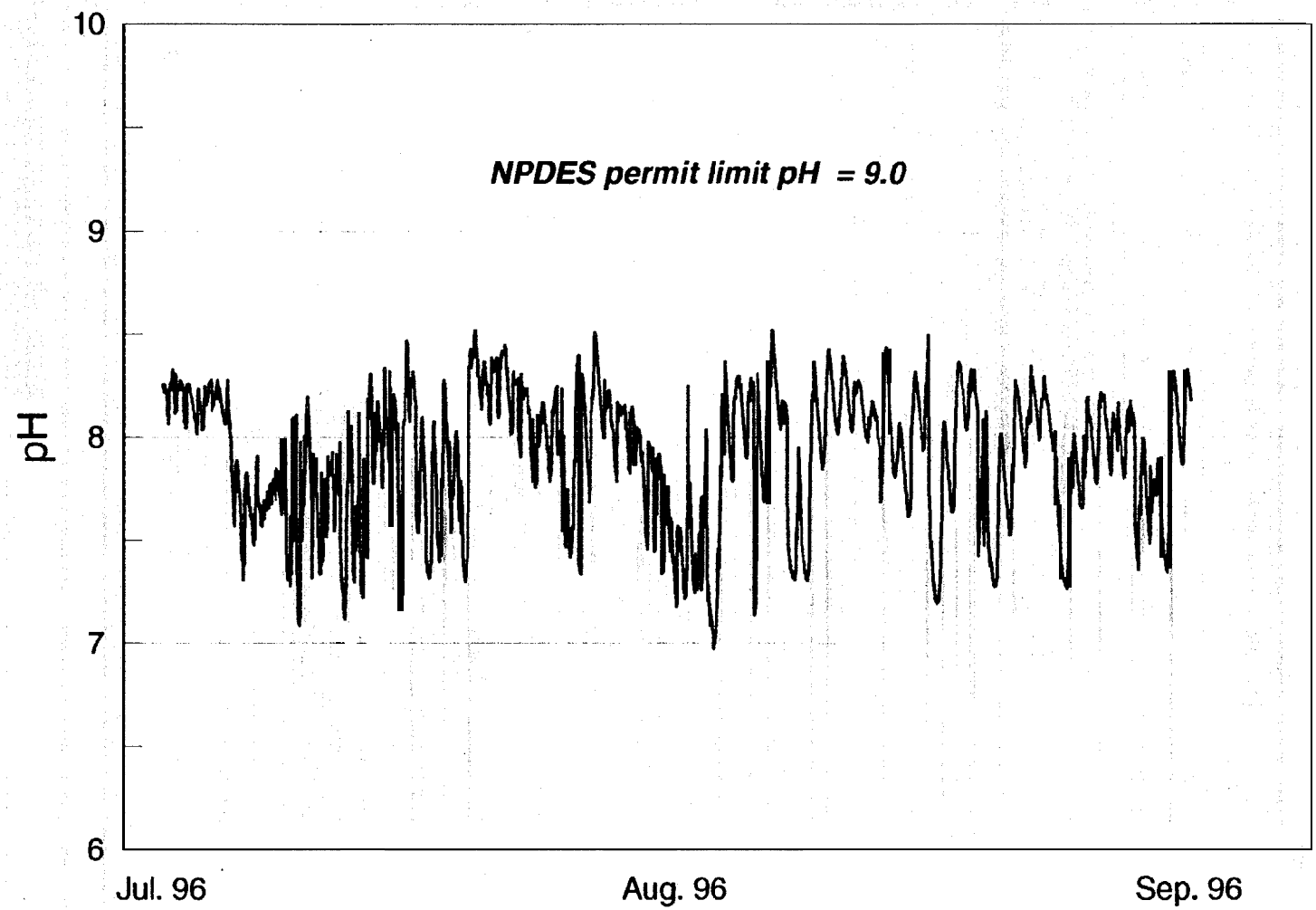

Fig. A.23. Fourth quarter IWMF outfall pH.

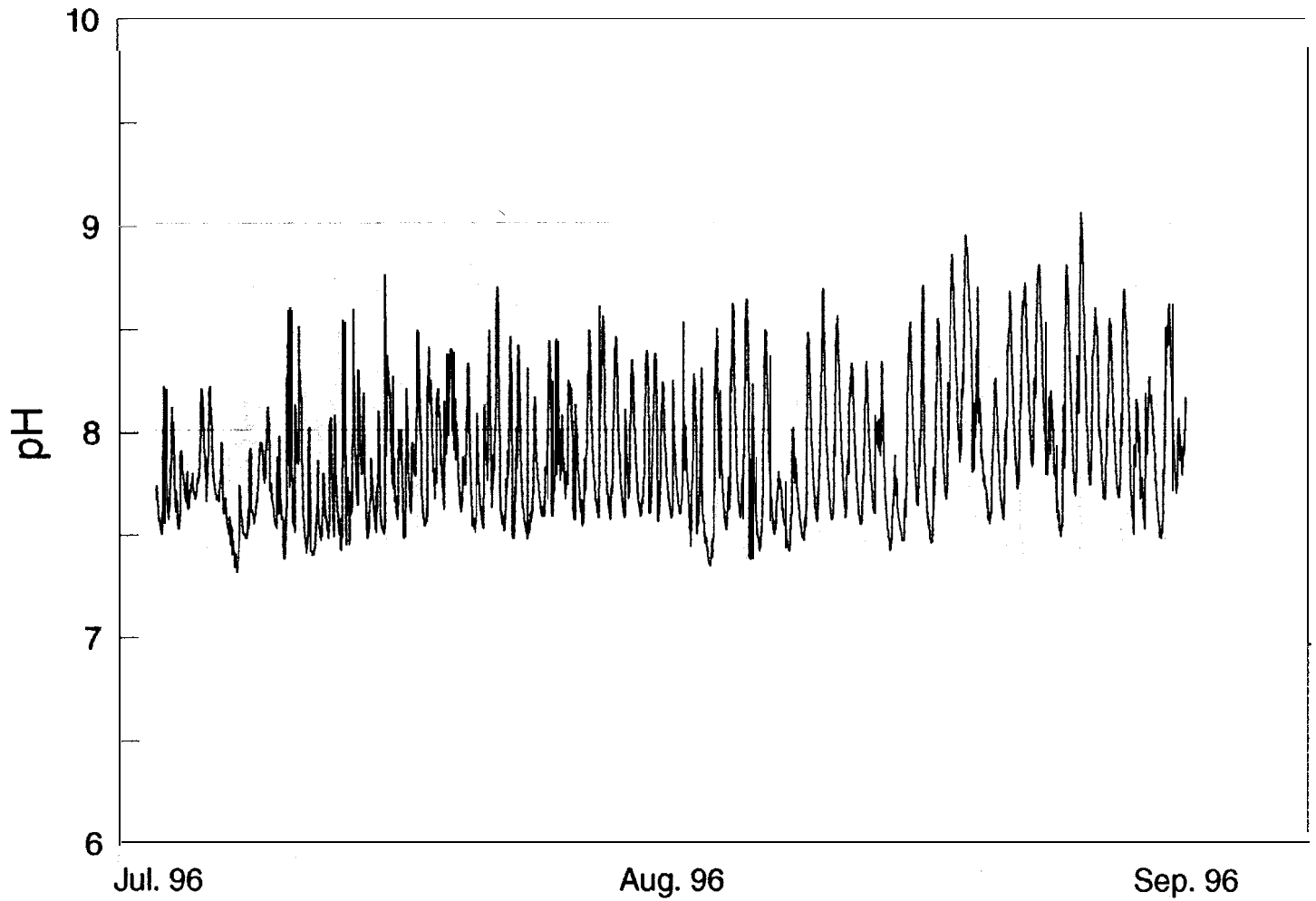

Fig. A.24. Fourth quarter IWMF stormwater sump pH.

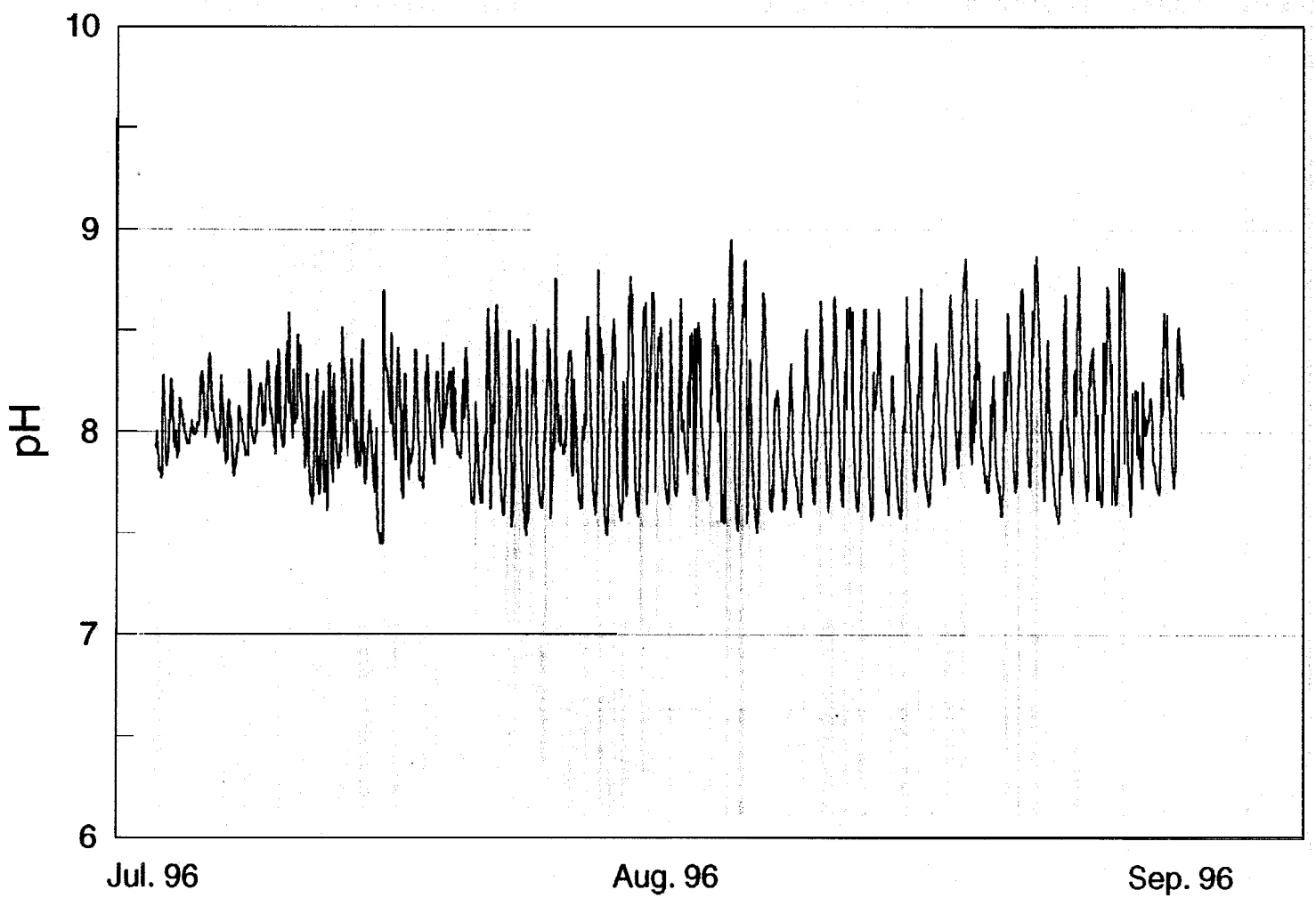

Fig. A.25. Fourth quarter IWMF infiltration sump pH.

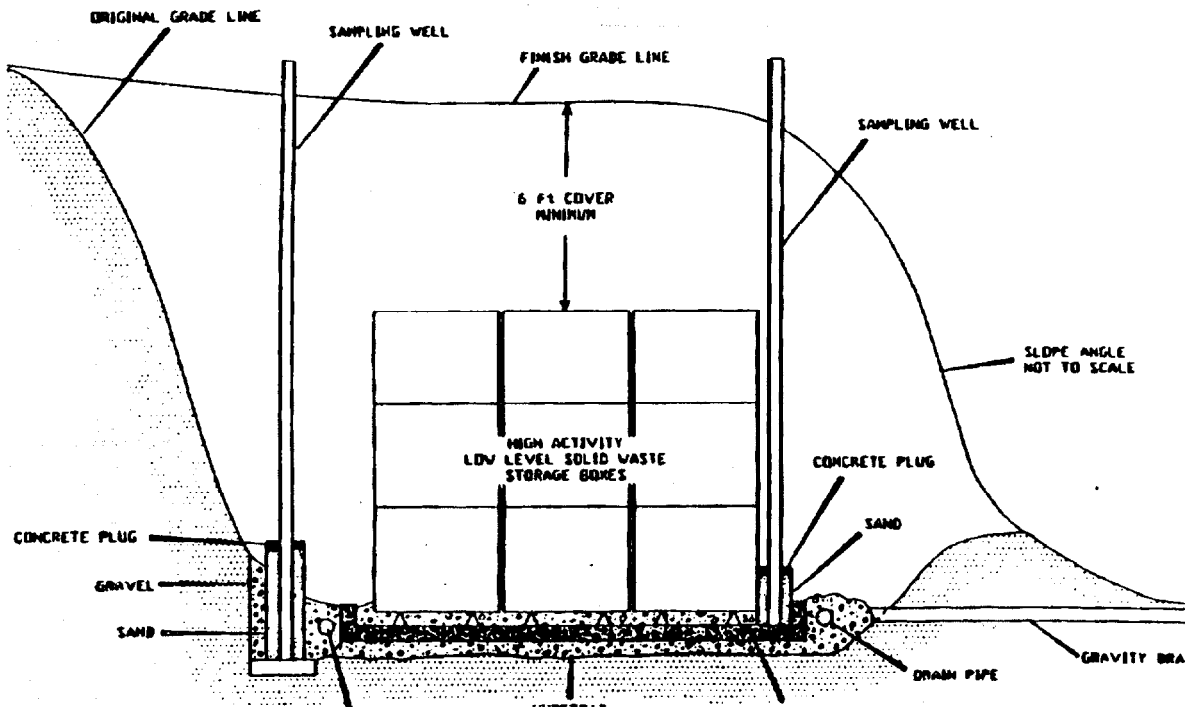

Fig. A.26. Cross sectional view through the Hillcut Disposal Test Facility.

ORNL-DWG 93M-15138

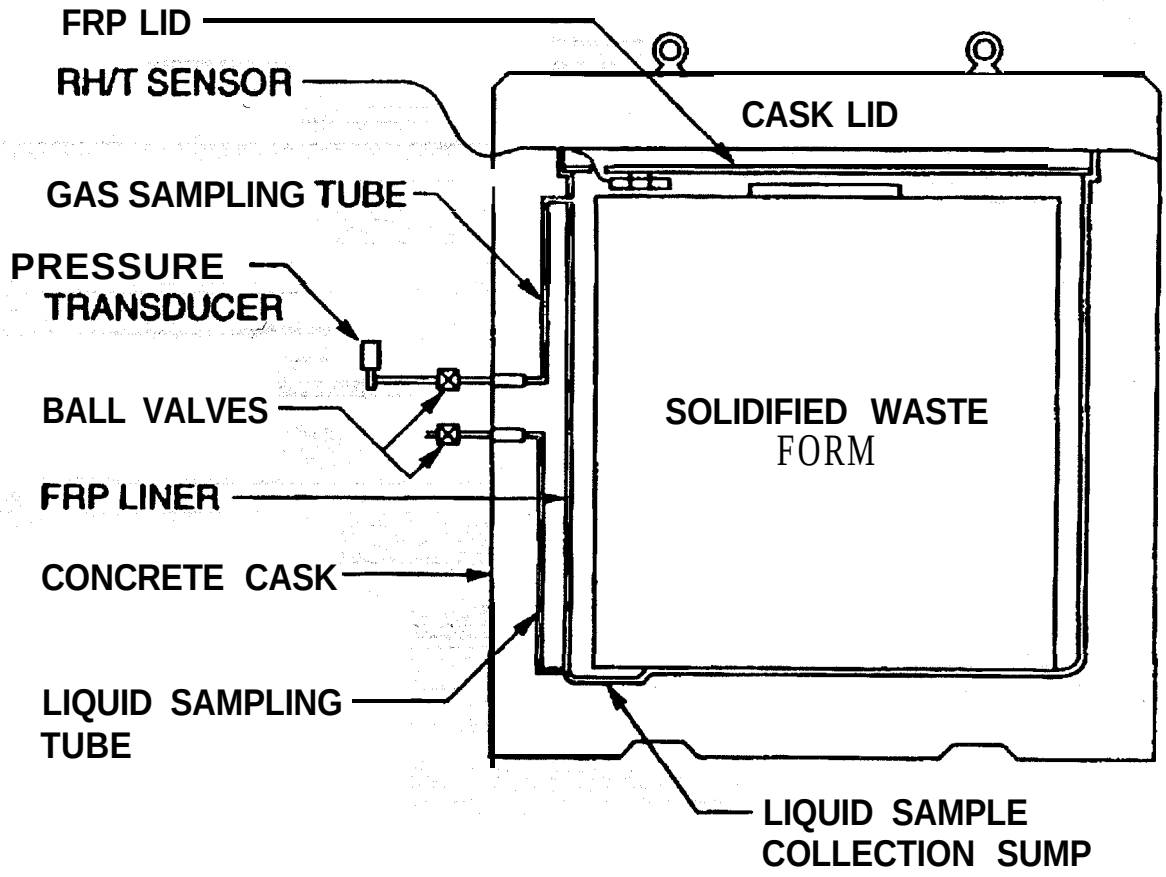

Fig. A.27. Cross section through a typical EASC/LWSP waste storage cask.

ORNL-DWG 91-15062 RI

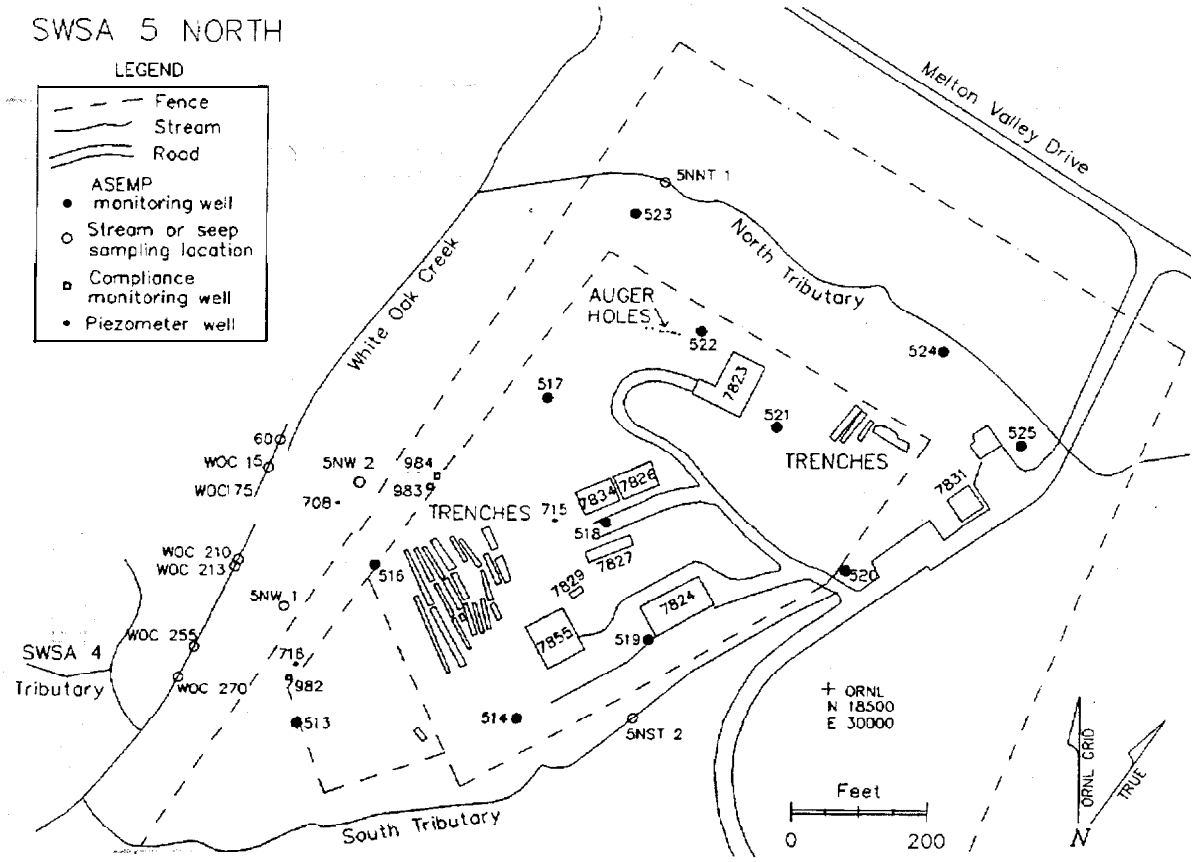

Fig. A.28. Transuranic waste storage areas, groundwater monitoring wells, and other major facilities in SWSA 5 N.

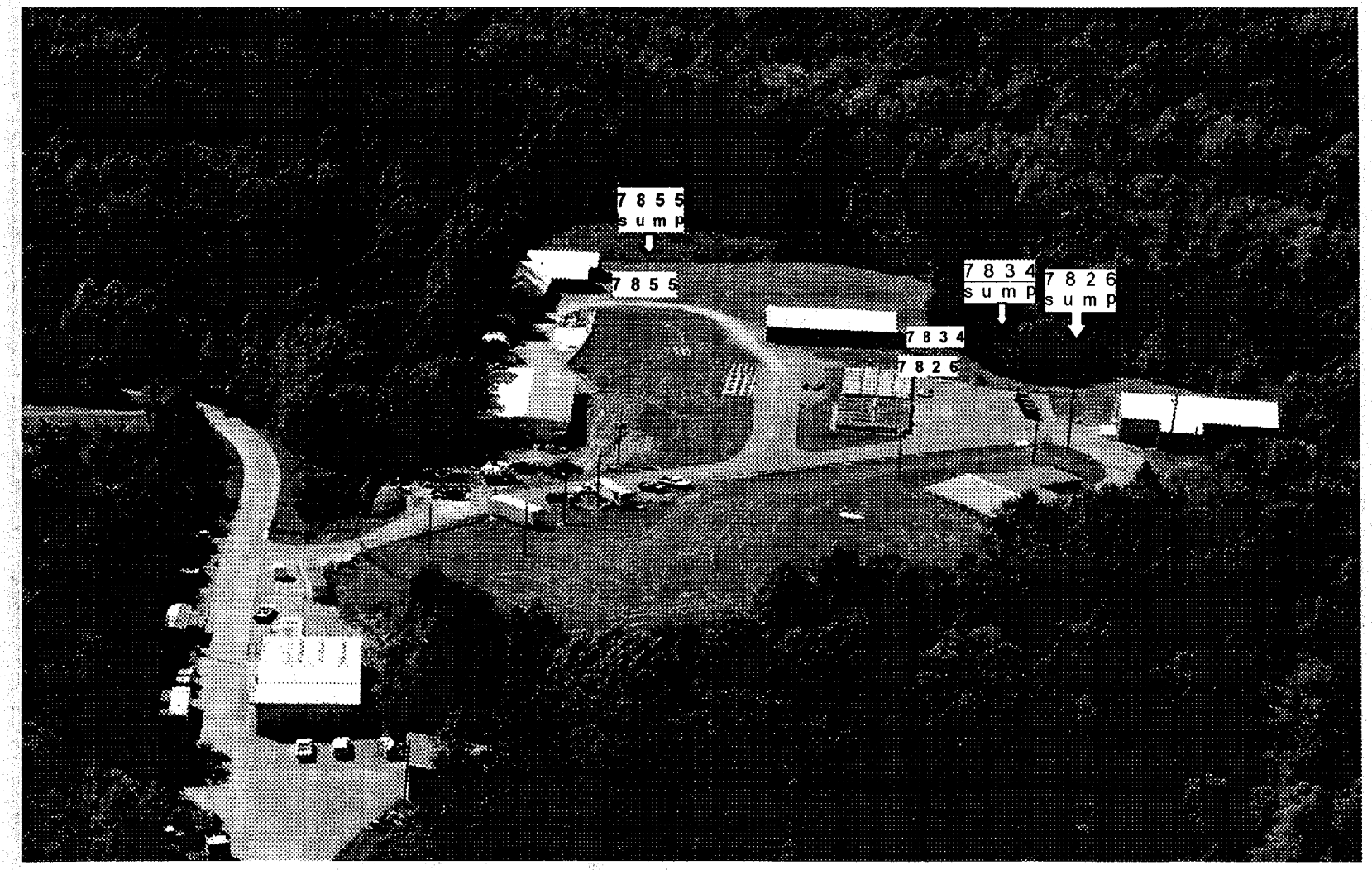

Fig. A.29. Aerial view of SWSA 5 North showing location of main TRU waste storage buildings and associated sumps.

APPENDIX B
TABLES

APPENDIX B
DATA TABLES

Table B.1. Runoff and French Drain samples from the Interim Waste Management Facility for FY96.[a]

Sample No.[b]	Date	Gross a	Gross β	^{40}K	^{60}Co	^{137}Cs	^{3}H
Stormwater sump:							
IWMF/STM/261	10/06/95	0.022 ± 0.030	0.01 ± 0.05		0.10 ± 0.11	0.02 ± 0.12	
IWMF/STM/262	10/06/95	0.010 ± 0.030	0.48 ± 0.08		-0.05 ± 0.16	-0.08 ± 0.12	33 ± 12
IWMF/STM/263	10/27/95	-0.012 ± 0.018	-0.028 ± 0.048		0.08 ± 0.06	0.01 ± 0.06	
IWMF/STM/264	10/27/95	0.054 ± 0.030	0.78 ± 0.10		0.14 ± 0.13	0.03 ± 0.12	
IWMF/STM/265	11/01/95	0.11 ± 0.04	0.01 ± 0.05		-0.04 ± 0.08	-0.02 ± 0.07	
IWMF/STM/266	11/01/95	0.028 ± 0.026	0.35 ± 0.07		0.01 ± 0.11	-0.09 ± 0.12	
IWMF/STM/267	11/06/95	0.065 ± 0.025	0.059 ± 0.034		0.01 ± 0.08	0.01 ± 0.09	
IWMF/STM/268	11/06/95	0.062 ± 0.026	0.42 ± 0.06		0.24 ± 0.07	-0.01 ± 0.08	4 ± 12
IWMF/STM/269	11/08/95	0.017 ± 0.018	0.10 ± 0.06		-0.02 ± 0.08	-0.03 ± 0.08	
IWMF/STM/270	11/08/95	-0.035 ± 0.019	0.27 ± 0.07		-0.03 ± 0.11	0.03 ± 0.10	
IWMF/STM/271	11/13/95	-0.036 ± 0.006	0.008 ± 0.048		0.01 ± 0.14	0.08 ± 0.11	
IWMF/STM/272	11113195	0.036 ± 0.026	0.40 ± 0.08		0.02 ± 0.08	-0.04 ± 0.08	
IWMF/STM/273	11/27/95	0.035 ± 0.020	0.052 ± 0.031		0.05 ± 0.10	-0.02 ± 0.10	
IWMF/STM/274	11/27/95	d.048 ± 0.022	0.39 ± 0.06		-0.15 ± 0.08	-6.05 ± 0.10	
IWMF/STM/275	12/01/95	0.028 ± 0.021	0.13 ± 0.06		-0.07 ± 0.08	-0.04 ± 0.07	
IWMF/STM/276	12/01/95	0.030 ± 0.022	0.37 ± 0.07		0.06 ± 0.11	0.01 ± 0.09	
IWMF/STM/277	12/13/95	0.041 ± 0.024	0.20 ± 0.06		-0.13 ± 0.14	0.06 ± 0.11	
IWMF/STM/278	12/13/95	0.046 ± 0.029	0.58 ± 0.08		0.02 ± 0.06	-0.02 ± 0.07	
IWMF/STM/279	12/20/95	-0.23 ± 0.09	0.47 ± 0.50		0.13 ± 0.11	-0.04 ± 0.10	
IWMF/STM/280	12/20/95	0.06 ± 0.18	0.76 ± 0.55		0.04 ± 0.07	0.01 ± 0.07	
IWMF/STM/281	01/02/96	0.006 ± 0.008	0.004 ± 0.027		0.01 ± 0.11	0.11 ± 0.07	
IWMF/STM/282	01/02/96	0.064. ± 0.021	0.64 ± 0.05	7.2 ± 0.6	0.03 ± 0.06	0.04 ± 0.05	
IWMF/STM/283	01/10/96	0.25 ± 0.20	0.20 ± 0.48		-0.2 ± 0.6	-0.1 ± 0.6	
IWMF/STM/284	01/10/96	-0.02 ± 0.12	0.3 ± 0.6		0.1 ± 0.6	0.4 ± 0.6	

Table B.I (continued)

Sample No.[b]	Date	Gross a	Gross β	^{40}K	^{60}Co	^{137}Cs	^{3}H
IWMF/STM/285	01II6/96	0.011 ± 0.011	0.049 ± 0.028		-0.07 ± 0.12	0.11 ± 0.10	
IWMF/STM/286	01/16/96	0.028 ± 0.015	0.800 ± 0.055	6.7 ± 0.6	-0.01 ± 0.07	0.01 ± 0.05	39 ± 13
IWMF/STM/287	01/26/96	-0.006 ± 0.009	0.054 ± 0.026		0.06 ± 0.06	0.05 ± 0.06	
IWMF/STM/288	01/26/96	-0.017 ± 0.006	0.15 ± 0.03		0.01 ± 0.09	-0.01 ± 0.08	
IWMF/STM/289	02/13/96	0.24 ± 0.22	1.0 ± 0.6		-0.02 ± 0.09	0.05 ± 0.06	
IWMF/STM/290	02/13/96	0.25 ± 0.26	1.8 ± 0.6		0.03 ± 0.11	-0.13 ± 0.14	
IWMF/STM/291	02/20/96	0.039 ± 0.020	-0.018 ± 0.040		0.03 ± 0.07	-0.01 ± 0.09	
IWMF/STM/292	02/20/96	0.021 ± 0.018	0.59 ± 0.07		-0.03 ± 0.12	0.02 ± 0.09	49 ± 13
IWMF/STM/293	03/06/96	0.040 ± 0.020	0.11 ± 0.05		-0.02 ± 0.07	-0.05 ± 0.08	
IWMF/STM/294	03/06/96	0.080 ± 0.035	0.53 ± 0.08		-0.07 ± 0.12	-0.01 ± 0.11	
IWMF/STM/295	03/18/96	-0.04 ± 0.025	0.16 ± 0.06		0.04 ± 0.13	-0.04 ± 0.13	
IWMF/STM/296	03/18/96	0.04 ± 0.025	0.55 ± 0.08		0.03 ± 0.09	0.06 ± 0.08	
IWMF/STM/297	03/27/96	0.06 ± 0.03	0.06 ± 0.06		0.17 ± 0.06	0.03 ± 0.07	
IWMF/STM/298	03/27/96	0.08 ± 0.05	0.35 ± 0.08		0.08 ± 0.08	-0.04 ± 0.11	
IWMF/STM/299	03/29/96	-0.01 ± 0.01	-0.04 ± 0.05		-0.11 ± 0.16	-0.07 ± 0.13	
IWMF/STM/300	03/29/96	0.07 ± 0.04	0.41 ± 0.08		0.12 ± 0.07	0.01 ± 0.08	
IWMF/STM/301	04/03/96	0.04 ± 0.02	-0.02 ± 0.05		-0.11 ± 0.16	-0.01 ± 0.13	
IWMF/STM/302	04/03/96	0.03 ± 0.03	0.64 ± 0.09		0.05 ± 0.08	0.07 ± 0.07	
IWMFISTMI303	04/12/96	0.055 ± 0.023	0.20 ± 0.05		-0.06 ± 0.09	-0.04 ± 0.08	
IWMF/STM/304	04/12/96	0.096 ± 0.037	0.60 ± 0.06		0.03 ± 0.10	0.19 ± 0.09	
IWMF/STM/305	04/18/96	0.028 ± 0.017	0.18 ± 0.05				
IWMF/STM/306	04/18/96	0.048 ± 0.023	1.20 ± 0.10	<2.76	co.120	co.115	
IWMF/STM/307	04/25/96	0.007 ± 0.011	0.03 ± 0.03				
IWMF/STM/308	04/25/96	0.04 ± 0.02	0.51 ± 0.05	<2.55	co.122	co.117	
IWMF/STM/309	05/01/96	-0.050 ± 0.023	0.08 ± 0.06				

Table B.1 (continued)

Sample No.[b]	Date	Gross a	Gross β	^{40}K	^{60}Co	^{137}Cs	^{3}H
IWMFlSTMl310	05/01/96	0.022 ± 0.022	0.43 ± 0.08	<2.73	co.129	<0.126	
IWMF/STM/311	05/07/96	0.029 ± 0.021	0.06 ± 0.05				
IWMF/STM/312	05/07/96	0.062 ± 0.032	0.36 ± 0.08	0.7 ± 0.9	<0.156	co.145	
IWMF/STM/313	05/22/96	0.029 ± 0.042	-0.09 ± 0.10				
IWMFISTMI314	05/22/96	-0.014 ± 0.026	0.22 ± 0.13	<2.75	co.130	co.129	
IWMF/STM/315	05/29/96	-0.061 ± 0.018	0.08 ± 0.06				
IWMF/STM/316	05/29/96	0.015 ± 0.022	0.19 ± 0.06	<2.32	co.115	<0.107	
IWMF/STM/317	06/11/96	0.031 ± 0.039	-0.19 ± 0.11				
IWMFlSTMl318	06/11/96	0.083 ± 0.050	0.23 ± 0.13	<2.79	co.149	<0. 132	
IWMF/STM/319	06/28/96	0.50 ± 0.037	0.12 ± 0.07				
IWMF/STM/320	06/28/96	0.11 ± 0.040	0.51 ± 0.08	2.2 ± 1.0	<0.128	<0.126	24 ± 11
IWMF/STM/321	07/25/96	-0.012 ± 0.018	-0.02 ± 0.07				
IWMF/STM/322	07125196	-0.01 ± 0.014	0.45 ± 0.08	<2.92	0.16 ± 0.08	<0.138	
IWMF/STM/323	08/01/96	-0.002 ± 0.013	0.05 ± 0.06				
IWMF/STM/324	08/01/96	-0.001 ± 0.023	0.46 ± 0.08	0.2 ± 1.1	<0. 133	<0.128	
IWMF/STM/325	08/14/96	0.042 ± 0.025	-0.08 ± 0.05				
IWMF/STM/326	08/14/96	0.005 ± 0.013	0.40 ± 0.08	<2.23	<0.123	<0.124	38 ± 15
IWMF/STM/327	09103196	-0.009 ± 0.014	-0.01 ± 0.05				
IWMF/STM/328	09/03/96	-0.010 ± 0.014	0.44 ± 0.09	0.086 ± 1.06	<0.146	<0.136	
IWMFISTMl329	09/17/96	-0.022 ± 0.004	-0.04 ± 0.06				
IWMF/STM/330	09/1 7/96	0.047 ± 0.028	0.44 ± 0.07	0.8 ± 0.9	<0.146	co.139	
IWMF/STM/331	09/30/96	0.008 ± 0.006	-0.02 ± 0.01				
IWMF/STM/332	09/30/96	0.012 ± 0.008	0.26 ± 0.03	1.4 ± 1.1	co.133	<0.119	170 ± 10

Table B.l (continued)

Sample No.[b]	Date	Gross a	Gross β	^{40}K	^{60}Co	^{137}Cs	^{3}H
Infiltration sump:							
IWMF/INF/112	10/06/95	-0.058 ± 0.008	1.4 ± 0.1		-0.06 ± 0.08	-0.03 ± 0.08	18 ± 12
IWMF/INF/114	10/27/95	0.17 ± 0.08	0.88 ± 0.15		0.04 ± 0.10	0.03 ± 0.11	
IWMF/INF/116	11/01/95	-0.010 ± 0.028	1.1 ± 0.1		0.18 ± 0.11	0.01 ± 0.12	
IWMF/INF/118	11/06/95	0.058 ± 0.030	0.66 ± 0.07		-0.04 ± 0.06	0.002 ± 0.050	6 ± 12
IWMF/INF/120	11/08/95	0.020 ± 0.026	0.74 ± 0.09		0.17 ± 0.13	-0.02 ± 0.12	
IWMF/INF/122	11/13/95	-0.003 ± 0.014	0.46 ± 0.08		0.04 ± 0.11	0.07 ± 0.08	
IWMF/INF/124	11/27/95	0.022 ± 0.020	0.76 ± 0.07		0.08 ± 0.07	0.07 ± 0.06	
IWMF/INF/126	12/01/95	0.044 ± 0.026	0.67 ± 0.085		-0.24 ± 0.17	0.08 ± 0.11	
IWMF/INF/128	12/13/95	0.029 ± 0.027	0.90 ± 0.10		0.05 ± 0.09	0.09 ± 0.09	
IWMF/INF/130	12/20/95	0.11 ± 0.15	1.6 ± 0.1		0.03 ± 0.09	0.02 ± 0.08	
IWMF/INF/132	01/02/96	0.022 ± 0.020	1.5 ± 0.1		0.01 ± 0.08	0.08 ± 0.07	
IWMF/INF/134	01110196	-0.30 ± 0.10	-0.1 ± 0.5		0.6 ± 0.5	-0.1 ± 0.6	
IWMF/INF/136	01/16/96	-0.041 ± 0.004	1.1 ± 0.1		0.12 ± 0.09	-0.09 ± 0.10	32 ± 13
IWMF/INF/138	01/26/96	0.046 ± 0.017	0.56 ± 0.045		0.03 ± 0.06	0.01 ± 0.05	
IWMF/INF/140	02/13/96	0.09 ± 0.14	1.1 ± 0.6		-0.05 ± 0.14	0.03 ± 0.12	
IWMF/INF/142	02/20/96	-0.016 ± 0.016	0.94 ± 0.08		-0.01 ± 0.11	-0.11 ± 0.11	47 ± 13
IWMF/INF/144	03/06/96	0.07 ± 0.13	0.91 ± 0.10		0.03 ± 0.13	-0.03 ± 0.13	
IWMF/INF/146	03/18/96	0.06 ± 0.03	0.93 ± 0.10	1.8 ± 1.4	0.10 ± 0.09	0.01 ± 0.09	
IWMF/INF/148	03/27/96	0.01 ± 0.02	0.58 ± 0.08		0.12 ± 0.11	-0.09 ± 0.13	
IWMF/INF/150	03129196	-0.07 ± 0.015	0.55 ± 0.085		0.11 ± 0.09	-0.01 ± 0.10	
IWMF/INF/152	04/03/96	0.02 ± 0.025	0.81 ± 0.10		0.03 ± 0.14	0.12 ± 0.10	
IWMF/INF/154	04/12/96	0.062 ± 0.025	1.1 ± 0.1		-0.01 ± 0.09	0.08 ± 0.08	
IWMF/INF/156	04/18/96	0.045 ± 0.023	0.62 ± 0.075	1.31 ± 1.05	co.147	<0.121	
IWMF/INF/158	04/25/96	0.003 ± 0.095	1.0 ± 0.1	<2.70	co.141	<0.121	

Table B.l (continued)

Sample No.[b]	Date	Gross α	Gross β	^{40}K	^{60}Co	^{137}Cs	^{3}H
IWMF/INF/160	05/01/96	0.033 ± 0.024	1.2 ± 0.1	1.59[d] ± 1.05	<0.159[d]	<0.177[d]	
IWMF/INF/162	05/07/96	0.071 ± 0.040	1.2 ± 0.1	0.73 ± 1.33	co.171	<0.148	
IWMF/INF/164	06/11/96	0.036 ± d.037	0.69 ± 0.18	0.68 ± 1.01	<0.118	co.112	
IWMF/INF/166	06/28/96	0.056 ± 0.033	0.97 ± 0.10	1.52 ± 1.10	<0.148	<0.112	52 ± 11
IWMF/INF/168	07/25/96	-0.016 ± 0.025	1.3 ± 0.1	0.081 ± 0.82	<0.236	~0.234	
IWMF/INF/170	08/01/96	-0.030 ± 0.021	1.1 ± 0.1	0.461 ± 1.08	co.145	0.07 ± 0.03	
IWMF/INF/172	08/14/96	-0.042 ± 0.015	0.94 ± 0.10	<2.61	co.140	co.131	16 ± 14
IWMF/INF/174	09/03/96	0.006 ± 0.014	0.86 ± 0.10	0.189 ± 0.934	co.137	<0.124	
IWMF/INF/176	09/17/96	0.036 ± 0.026	0.65 ± 0.10	0.746 ± 0.949	<0.128	co.121	
IWMF/INF/178	09/30/96	0.033 ± 0.012	0.75 ± 0.04	3.52 ± 0.973	co.140	<0.124	150 ± 10
French drain:							
FD-112795	11/27/95	0.038 ± 0.028	0.14 ± 0.05		-0.02 ± 0.06	0.01 ± 0.05	58 ± 13
FD-021496	02/14/96	0.35 ± 0.24	0.21 ± 0.55		0.02 ± 0.09	0.04 ± 0.08	39 ± 13
FD-081696	08/16/96	0.038 ± 0.027	-0.02 ± 0.07	<5.40	<0.276	<0.284	67 ± 18

[a] All data are in Becquerel per liter, mean ± 1 standard error (counting error only); blank spaces indicate not reported by Analytical Services Organization; less than (<) data reported from ESD lab.
[b] IWMF = Interim Waste Management Facility; STM = stormwater; INF = infiltration; FD = French drain.
[c] Gross beta analysis does not include tritium.
[d] Sample not diluted to 1 liter in Marinelli beaker prior to counting; therefore, incorrect geometry for gamma counting.

Table B.2. Soil radionuclide data from the IWMF and LWSP cask area.[a]

Sample No.	Date	Gross a	Gross β	^{60}Co	^{137}Cs	^{40}K
IWMFI	11/20/95	390 ± 120	600 ± 165	0.7 ± 2.2	2.6 ± 1.2	890 ± 40
IWMF2	11/20/95	190 ± 95	430 ± 165	0.9 ± 2.0	2.7 ± 2.2	830 ± 40
IWMF3	11/20/95	210 ± 100	680 ± 145	3.5 ± 1.0	4.0 ± 1.3	600 ± 35
IWMF4	11/20/95	300 ± 110	220 ± 160	1.7 ± 2.1	2.5 ± 2.2	700 ± 40
IWMF5	11/20/95	420 ± 140	1100 ± 300	-0.1 ± 1.9	2.1 ± 2.2	880 ± 40
IWMF6	11/20/95	270 ± 105	670 ± 140	-0.5 ± 2.0	0.2 ± 2.0	920 ± 40
IWMF7	11/20/95	420 ± 120	670 ± 140	-1.3 ± 2.6	1.0 ± 2.0	980 ± 40
IWMF8	11/20/95	260 ± 100	1100 ± 150	0.7 ± 2.1	1.9 ± 1.2	880 ± 40
IWMF9	11/20/95	310 ± 95	760 ± 145	-1.0 ± 2.6	3.0 ± 2.2	870 ± 45
IWMFI 0	11/20/95	380 ± 115	650 ± 170	-0.2 ± 1.8	1.1 ± 2.3	940 ± 40
LWSP1	11/20/95	350 ± 120	1200 ± 200	1.9 ± 2.0	350 ± 5	1100 ± 100
LWSP2	11/20/95	460 ± 13.5	740 ± 145	2.0 ± 2.1	62 ± 3	880 ± 50
LWSP3	11/20/95	150 ± 110	1100 ± 200	-1.1 ± 2.8	22 ± 2	870 ± 45
LWSP4	11/20/95	640 ± 145	820 ± 165	0.4 ± 2.3	24 ± 2	880 ± 40
LWSP5	11/20/95	210 ± 40	390 ± 155	-1.9 ± 3.1	4.8 ± 1.7	820 ± 45

[a] All data are in Bq/kg, mean ± standard error (counting error only). IWMF = Interim Waste Management Facility; LWSP = Liquid Waste Solidification Project.

Table B.3. Runoff samples from the Hillcut Disposal Test Facility."

Date	Gross α	Gross β[c]	^{40}K	^{60}Co	^{137}Cs	^{141}Ce
HDTF Pad:						
1/16/87	1.2 ± 1.8	3.2 ± 2.7		co.20	co.20	
3/3/87	1.0 ± 1.8	3.3 ± 2.7		co.10	co.10	
6/26/87	3.4 ± 2.6	3.2k2.7		co.10	co.10	0.27 ± 0.22
3/21/88	0.26 ± 0.34	3.8 ± 0.7		co.10	co.10	
1/4/89				<0.40	co.30	
1/18/89	0.31 ± 0.15	1.8 ± 0.3		co.40	co.30	
2/21/89	0.50 ± 0.04	2 ± 0.2		co.40	co.30	
4/10/89	0.03 ± 0.04	1.4k0.2		co.40	co.40	
6/26/89	0.15 ± 0.09	2.1 ± 0.3		0.27 ± 0.26	-0.01 ± 0.26	
1 O/I8/89	-0.21 ± 0.80	2.5k2.7		-0.05 ± 0.19	0.08 ± 0.19	
1/3/90	0.05 ± 0.08	3.1 ± 0.3		-0.25 ± 0.63	0.14 ± 0.41	
1/30/90	0.01 ± 0.07	0.9 ± 0.4		0.03 ± 0.43	-0.05 ± 0.53	
2/8/90	0.11 ± 0.35	1.5 ± 1.5		-0.02 ± 0.19	-0.04 ± 0.19	
2/23/90	0.12 ± 0.38	0.9 ± 1.4		-0.11 ± 0.21	0.06 ± 0.15	
3/21/90	0.18 ± 0.15	1 ± 0.3		0.06 ± 0.12	0.03 ± 0.13	
8/23/90	0.01 ± 0.05	1.2 ± 0.2		-0.08 ± 0.22	-0.03 ± 0.20	
12/28/90	0.20 ± 0.24	1.3 ± 0.5		0.02 ± 0.31	0.07 ± 0.29	
1/22/91	0.007 ± 0.058	0.26 ± 0.23			0.03 ± 0.36	
2/20/91	0.49 ± 0.57	1.2 ± 1.4		0.15 ± 0.57	0.10 ± 0.66	
3/6/91	0.07 ± 0.11	0.66 ± 0.26		-0.09 ± 0.26	0.22 ± 0.26	
4/2/91	0.029 ± 0.076	0.84 ± 0.3		0.18 ± 0.36	0.11 k0.38	
7/18/91	0.28 ± 0.13	1.8k0.3		1.4 ± 1.4	0.2 ± 2.1	
3/00/92[d]		all radionuclide data below action levels[e]				
12/8/92	0.09 ± 0.11	1.5 ± 0.04		0.12 ± 0.15	-0.01 ± 0.18	
12/29/92	0.10 ± 0.08	1.4 ± 0.2		-0.06 ± 0.13	0.091 ± 0.09	

Table B.3 (continued)

Date	Gross a	Gross β[c]	^{40}K	^{60}Co	^{137}Cs	^{3}H
2/2/93	0.049 ± 0.070	5.2 ± 0.4		1.1 ± 0.2	1.5kO.2	
3/31/93	0.075 ± 0.076	0.98 ± 0.20		-0.09 ± 0.24	0.10 ± 0.16	
4/27/93	0.10 ± 0.09	0.83 ± 0.20		0.21 i-o.19	-0.02 ± 0.21	
12/7/93	0.015 ± 0.024	0.88 ± 0.10		-0.04 ± 0.12	0.03 ± 0.20	
2/23/94	0.021 ± 0.021	0.70 ± 0.08	18 ± 2	-0.06 ± 0.14	-0.02 ± 0.12	
4/11/94	0.082 ± 0.036	0.15 ± 0.06		-0.03 ± 0.12	-0.03 ± 0.10	
4/22/94	0.003 ± 0.022	0.49 ± 0.08		0.32 ± 0.10	0.48 ± 0.09	
11/1/94	0.01 ± 0.02	1.9 ± 0.2		0.01 ± 0.14	-0.07 ± 0.15	
11/28/94	0.19 ± 0.08	1.2 ± 0.2		0.10 ± 0.11	0.13 ± 0.2	210 ±15
3/22/95[f]	0.08 ± 0.04	5.2rt0.2		0.11 ± 0.06	5.1 ± 0.1	240 ±20
3/22/95[g]	-0.016 ± 0.038	0.65 ± 0.09		-0.10 ± 0.14	0.01 ± 0.10	200 ±15
7/17/95[f]	0.066 ± 0.034	0.84 ± 0.10		0.06 ± 0.12	0.01 ± 0.14	
12/20/95[f]	-0.10 ± 0.15	2.0 ± 0.6		-0.04 ± 0.14	0.09 ± 0.09	
1/16/96[f]	0.001 ± 0.038	0.60 ± 0.10		0.07 ± 0.08	-0.01 ± 0.08	
3/18/96[f]	0.06 ± 0.04	0.52 ± 0.08		0.06 ± 0.12	0.16 ± 0.1	
5/13/96[f]	0.043 ± 0.027	0.32 ± 0.08	<5.69	<0.244	co.315	
6/11/96[g]	0.03 ± 0.06	0.58 ± 0.14	1.10 ± 1.54	<0.241	<0.240	
8/14/96[f]	0.041 ± 0.030	0.66 ± 0.10	0.58 ± 1.39	<0.172	<0.198	150 ± 20
HDTF Underpad:						
1/18/89	0.20 ± 0.11	0.39 ± 0.12		co.30	co.30	
2/23/89	0.12 ± 0.06	0.59 ± 0.09		co.30	co.30	
6/26/89	0.15 ± 0.09	0.28 ± 0.14		-0.35 ± 0.66	0.14 ± 0.51	
10/18/89	0.22 ± 0.07	0.40 ± 0.22		0.03 ± 0.19	0.15 ± 0.16	
2/20/91	4.0 ± 1.4	4.8 ± 1.6		-0.29 ± 0.86	-0.22 ± 0.19	
2/21/91[h]	0.47 ± 0.12	1.5k0.2		0.11 ± 0.22	0.23 ± 0.19	
4/7/93	3.6k0.7	3.1lko.5		0.09 ± 0.16	0.26 ± 0.12	

Table B.3 (continued)

Date	Gross a	Gross β	^{40}K	^{60}Co	^{137}Cs	^{3}H
4/7/93[i]	0.14 ± 0.12					
12/7/93	0.010 ± 0.042	1.0 ± 0.1		0.01 ± 0.06	0.01 ± 0.05	
2/23/94	0.067 ± 0.034	0.26 ± 0.07	5.0 ± 1.2	-0.02 ± 0.20	-0.21 ± 0.17	
4/11/94	0.026 ± 0.025	0.19 ± 0.06		0.027 ± 0.048	0.03 ± 0.06	

[a] All data are in Bq/L, mean ± 1 standard error (counting error only); blank spaces indicate not reported by Analytical Services Organization.
[b] HDTF = Hillcut Disposal Test Facility.
[c] Gross beta analysis does not include tritium.
[d] Sample collected sometime in March 1992; no date specified in previous report.
[e] See page 10, ASEMP FY 1992 Annual Report, ORNLIM-3183; no specific data given in report.
[f] Sample collected from HDTF storage tank no. 1.
[g] Sample collected from HDTF storage tank no. 2.
[h] Analyses also performed for uranium isotopes and total radium with the following results:

^{234}U	0.051 ± 0.026
^{235}U	0.008 ± 0.013
^{238}U	0.002 ± 0.007
Ra (total)	0.90 ± 0.23

"Analysis of archived duplicate sample.

Table B.4. Liquid waste analysis for Tanks W-29 and W-30 prior to the LWSP III campaign.[a]

Analyte	Tank W-29	Tanks W-30
CO_3	0.43 mol/L	0.34 mol/L
OH	<0.01 mol/L	<0.01 mol/L
total inorganic carbon	8720 mg/L	7800 mg/L
total organic carbon	<10 mg/L	<10 mg/L
total carbon	8750 mg/L	'7700 mg/L
Ag	0.0438	0.0313
As	co.125	co.125
Ba	0.656	0.853
Cd	1.45	1.12
Cr	4.06	5.18
Hg	0.161	0.298
Ni	2.10	1.54
Pb	2.04	1.70
Se	0.140	co.125
Ti	co.125	co.125
Be	0.0131	0.0138
Br	364	355
Ca	6.04	6.20
Cl	3120	2210
cu	0.645	0.531
F	96	70
Fe	0.0706	0.0188
K	37600	28800
Mg	2.55	1.17
Mn	<0.00563	0.00563
Na	77600	83800
Sb	<0.813	<0.813
V	0.165	0.138
Zn	2.34	1.40
HCO,	CO.01 mol/L	<0.01 mol/L
NO_3	237000	363000
PO_4	123	51
SO_4	2130	1280
co	0.103	0.0981
^{60}Co	11,000 Bq/mL	6100 Bq/mL
^{137}Cs	505,000 Bq/mL	425,000 Bq/mL
gross alpha	60 Bq/mL	30 Bq/mL
gross beta	305,000 Bq/mL	275,000 Bq/mL
U	163	143
Th	13.8	16.2
density	1.251 g/mL	1.254 g/mL
pH	11.98	11.92

[a] Metals and anion data in µg/mL; others as indicated.

Table B.5. Analytical data from the LWSP II cask sampling.”

Cask	data sampled	volume collected (mL)	Cl	NO,	SO,,	PO.,	NO,	TOC	TIC	pH	cond. (µS/cm)
3656	3/96	300	233	33	175	32		1030		6.0	
3656	10/96	690	140	69	81		0.23	341	30.7	9.491	1160
3660	3/96	250	15	45	272	<25		762		7.0	
3660	10196	810	44	80	71		230	512	41.6	8.93	1657
3672	3/96	100	396	30	336	62		2645		7.0	
3672	10/96	70	40	1.4	66		1.1	776	79.8	9.42	1186
3680	3/96	60	99	24	166	<25		1363		8.5	
3489	3/96	100	138	2545	209	35		728		5.5	
3489	10/96	65	51	2500	100		<0.2	527	3.7	7.54	4880
3492	3/96	250	302	149	100	<25		431		5.5	
3492	10/96	230	53	130	68		340	541	14.3	8.53:	2060
3627	3/96	60	73	21	34	<5		300		6.0	
3627	10196	80	22	3.6	26		0.27	290	26.5	8.96'	507
3638	3/96	60	208	48	50	<25		174		6.0	
3638	10196	100	26	5.6	2.2		0.73	92.8	18.5	9.15	361
3655	3196	10000	15	5.4	37	<5		212		6.0	
6709	3196	230	48	453	218	<25		535		10.0	
6709	10196	45	53	470	95		<0.2	407	112	9.13	2150

[a] Blank spaces indicate data not reported by Analytical Services Organization because of insufficient sample size; all data in mg/L; LWSP = low-level liquid waste solidification project.

Table B.6. Metals data from the LWSP II cask sampling.”

Cask	Date	Al	B	Ba	Ca	Cd	Co	Cr	Cu	Fe	K	Li	Mg	Mn	Na	Ni	Pb	Si	Sr	V	Zn
3656	3/96	0.36	4.7	0.08	87	<0.025	2.7	0.81	22	4.5		1.1	9.6	0.099	320	<0.20	1.8	30	0.61	0.08	0.90
3656	10/96	0.078		0.13	25	0.0025		0.42	0.32	1.5	43		1.95	0.032	152		0.26	50	0.37		0.15
3660	3/96	0.33	11	0.06	50	<0.025	4.5	0.82	6.6	3.3		2.3	24	0.059	560	<0.10	0.54	19	0.26	0.11	0.27
3660	10/96	0.022		0.23	78	<0.002		0.35	0.61	1.1	76		8.28	0.067	155		0.19	20	0.31		0.22
3672	3/96	<0.25	3.7	0.24	29	0.029	5.5	0.60	18	3.3		10	2.6	0.067	860	<0.23	1.6	41	0.14	0.12	0.82
3672	10196	0.046		0.23	12	co.002		0.24	2.2	1.4	96		1.97	0.015	175		0.19	20	0.31		0.22
3680	3/96	0.53	8.1	0.10	27	<0.025	3.2	0.81	21	2.8		2.8	4.6	0.045	410	0.20	1.4	20	0.09	0.06	0.80
3489	3/96	0.41	10	0.25	350	<0.025	3.9	0.40	28	2.1		3.7	38	0.32	340	0.25	0.61	26	0.48	0.03	1.5
3489	10/96	0.26		0.25	266	<0.002		0.25	1.2	23	144		28.1	0.46	167		0.29	25	0.63		0.57
3492	3/96	0.42	9.4	0.24	370	0.072	4.7	0.58	7.5	2.1		1.2	28	0.49	300	co.10	0.71	19	0.68	<0.01	0.63
3492	10196	0.031		0.17	132	0.0021		0.34	0.39	1.1	56		11.5	0.11	150		0.15	21	0.43		0.19
3627	3/96	0.74	3.6	0.06	37	<0.025	0.8	0.17	15	4.4		0.26	5.5	0.047	49	co.10	1.4	4.2	0.12	co.01	0.37
3627	10196	0.19		0.23	26	0.004		0.13	0.50	3.2	33		2.73	0.033	33		0.28	8.1	0.10		0.28
3638	3/96	<0.25	2.4	0.06	76	co.025	0.51	0.076	6.2	0.72		0.22	13	0.046	47	co.10	co.25	6.2	0.23	<0.01	0.21
3638	10/96	0.021		0.077	24	<0.002		0.019	0.20	0.19	3.6		2.11	0.010	6.3		0.082	9.1	0.16		0.16
3655	3/96	<0.25	1.2	0.02	8.9	<0.025	0.21	0.046	0.18	0.37		0.17	1.5	0.013	40	<0.10	co.25	29	0.09	0.04	0.11
6709	3/96	0.4	11	0.02	7.9	<0.025	0.93	0.072	3.2	1.0		0.69	7.4	0.028	380	<0.11	0.48	14	0.05	0.31	0.27
6709	10196	0.12		0.13	16	co.002		0.18	0.97	1.4	439		2.94	0.024	150		0.22	25	0.22		0.24

[a] Blank spaces indicate data not reported by Analytical Services Organization because of insufficient sample size; all data in mg/L; LWSP = low-level liquid waste solidification project.

Table B.7. Radionuclide data from the EASC/LWSP cask sampling.[a]

Cask	Date	Gross a	Gross β[b]	^{40}K	^{137}Cs	^{134}Cs	^{60}Co	^{241}Am	^{3}H
3656	3/96				111 ± 6.9	<9.35			
3656	10196	0.19 ± 0.09	38 ± 1	<8.58	123 ± 1.6		<6.02	2.43 ± 1.56	
3660	3/96	0.75 ± 0.44	28 ± 2		11.4 ± 0.5	<0.585			
3660	10/96	0.20 ± 0.07	3.1 ± 0.2	1.07 ± 1.98	0.65 ± 0.14		co.413	co.413	
3672	3/96				252 ± 8.9	<6.45			
3672	10196	0.38 ± 0.22	11 ± 1	47.5 ± 41.5	15.1 ± 3.02		<5.89	co.00	
3680	3/96				409 ± 11.4	<7.59			
3680*	3/96				406 ± 5.8	<3.85			
3489	3196				27.1 ± 0.93	<1.00			
3489	10/96	-0.10 ± 0.14	3.5 ± 0.8	<113	2.92 ± 2.15		<6.48	co.00	
3492	3/96				23.6 ± 1.1	<1.02			
3492	10196	0.007 ± 0.050	1.7 ± 0.2	0.399 ± 3.96	0.551 ± 0.254		<0.634		
3627	3/96				162 ± 3.8	<3.24			
3627	10/96	0.20 ± 0.14	3.3 ± 0.6	33.7 ± 33.4	<5.18		<5.70	co.00	
3638	3/96				527 ± 13.9	Cl.31			
3638	10196	0.07 ± 0.05	0.12 ± 0.12	30.9 ± 37.9	<4.88		<6.02	co.00	
3655	3/96	0.04 ± 0.04	4.9 ± 0.3		5.12 ± 0.1	<0.092			
6709	3/96				2672 ± 5.89	4.2 ± 0.8			
6709	10196	0.10 ± 0.26	27 ± 2	78.3 ± 35.4	54.3 ± 3.21		<5.64	<0.00	

[a] Blank spaces indicate analysis not performed due to insufficient sample size; all data in Bq/L, mean ± 1 SE (counting error only); LWSP = low-level liquid waste solidification project.
[b] Gross beta analysis does not include tritium.

Table B.8. Radionuclide data for water from SWSA 5 N building sumps.

Date	Gross a	Gross β[c]	^{40}K	^{60}Co	^{137}Cs	^{90}Sr
			7826-1			
04/07/89*	<10	<20				
09/26/89*	<10	<20				
10/30/89*	<10	<20				
11/28/89*	<10	<20				
01/30/90*	<10	<20				
02/09/90*	<10	<20				
03/07/90*	<10	<20				
03/12/90*	<10	<20				
04/19/90*	<10	<20				
05/21/90*	<10	<20				
06/14/90*	<10	<20				
08/20/90*	<10	<20				
09/10/90*	<10	<20				
10/10/90*	<10	<20				
11/09/90*	<10	<20				
12/06/90*	<10	<20				
12/20/90*	<10	<20				
12/27/90*	<10	<20				
01/03/91*	<10	<20				
01/17/91*	<10	<20				
02/21/91*	<10	<20				
03/13/91*	<10	<20				
03/21/91*	<10	<20				
04/04/91*	<10	<20				
05/02/91*	<10	<20				
05/23/91*	<10	<20				
05/29/91*	<10	<20				
06/06/91*	<10	<20				
06/20/91*	<10	<20				
06/27/91*	<10	<20				
07/03/91*	<10	<20				
08/07/91*	<10	<20				
08/22/91*	<10	<20				
09/26/91*	<10	<20				
11/07/91*	<10	<20				
12/03/91*	<10	<20				
12/13/91*	<10	<20				
12/20/91*	<10	<20				
01/10/92*	<10	<20				
02/27/92*	<10	<20				
03/12/92*	<10	<20				
04/02/92*	<10	<20				

Table B.8 (continued)

Date	Gross α	Gross β[c]	^{40}K	^{60}Co	^{137}Cs	^{90}Sr
06/11/92*	<10	<20				
07/07/92*	<10	<20				
07/30/92*	<10	<20				
08/13/92*	<10	<20				
09/10/92*	<10	<20				
09/24/92*	<10	<20				
10/14/92*	<10	<20				
11/05/92*	<10	<20				
11/30/92*	<10	<20				
12/30/92*	<10	<20				
01/28/93*	<10	<20				
03/24/93*	<10	<20				
03/31/93*	<10	<20				
05/28/93*	<10	<20				
07/07/93*	<1000	<1000				
08/11/93*	<10	<20				
08/19/93*	<10	<20				
08/25/93*	<10	<20				
09/22/93*	<10	<20				
11/09/93	0.041 ± 0.036	0.27 ± 0.07	0.3 ± 0.9	0.01 ± 0.05	0.01±0.06	
11/19/93	0.11 ± 0.05	0.35 ± 0.07	1.9 ± 1.2	-0.02 ± 0.06	0.05 ± 0.06	
12/02/93*	<10	<20				
12/27/93*	<10	<20				
01/24/94	0.042 ± 0.035	0.55 ± 0.08	2.9 ± 2.6	0.01 ± 0.17	0.3 ± 0.11	
02/23/94	0.003 ± 0.19	0.66 ± 0.09	1.3 ± 1.2	0.22 ± 0.12	0.04 ± 0.13	
04/11/94	-0.016 ± 0.024	0.43 ± 0.08		-0.01 ± 0.12	0.07 ± 0.09	
06/27/94	0.003 ± 0.024	0.56 ± 0.08		-0.01 ± 0.1	-0.02 ± 0.08	
08/29/94	0.079 ± 0.046	0.52 ± 0.08		-0.04 ± 0.07	0.05 ± 0.06	
09/29/94	0.24 ± 0.12	0.58 ± 0.20		-0.04 ± 0.13	-0.05 ± 0.32	
10/14/94	0.091 ± 0.047	0.33 ± 0.07		0.01 ± 0.10	0.02 ± 0.08	
01/25/95	0.18 ± 0.26	0.70 ± 0.80		-0.06 ± 0.13	0.01 ± 0.10	
02/17/95	0.006 ± 0.041	0.32 ± 0.14		-0.06 ± 0.09	0.08 ± 0.08	
03/16/95	0.01 ± 0.22	-0.30 ± 0.60		-0.11 ± 0.14	0.15 ± 0.12	
04/25/95	0.15 ± 0.06	0.38 ± 0.13		0.05 ± 0.08	-0.01 ± 0.08	
08/09/95	-0.03 ± 0.06	0.36 ± 0.12		-0.01 ± 0.07	0.03 ± 0.06	
09/20/95	0.23 ± 0.06	1.1 ± 0.1		-0.13 ± 0.14	-0.03 ± 0.12	
11/08/95	0.066 ± 0.039	0.27 ± 0.07		0.03 ± 0.14	0.03 ± 0.13	
12/19/95	-0.1 ± 0.13	1.1 ± 0.6		0.01 ± 0.06	0.04 ± 0.065	
02/17/96	0.35 ± 0.24	0.21 ± 0.6		0.02 ± 0.09	0.04 ± 0.08	
04/30/96	0 ± 0.031	0.42 ± 0.07				
06/13/96	0.031 ± 0.04	0.26 ± 0.14	0.08 ± 1.77	<0.245	<0.255	
08/16/96	0.004 ± 0.027	0.14 ± 0.10	1.06 ± 1.73	co.297	<0.262	

Table B.8 (continued)

Date	Gross a	Gross β[c]	^{40}K	^{60}Co	^{137}Cs	^{90}Sr
			7826-2			
04/07/89*	<10	<20				
09/26/89*	<10	<20				
12/06/90*	<10	<20				
12/20/90*	<10	<20				
01/17/91*	<10	<20				
02/21/91*	<10	<20				
03/13/91*	<10	<20				
06/27/91*	<10	<20				
07/03/91*	<10	<20				
09/26/91*	<10	<20				
12/03/91*	<10	<20				
02/27/92*	<10	<20				
11/05/92*	<10	<20				
11/30/92*	<10	<20				
08/19/93*	<10	<20				
12/02/93*	<10	<20				
12/27/93*	<10	<20				
02/23/94	0.017 ± 0.024	0.12 ± 0.06	0.9 ± 1.5	0.14 ± 0.10	0.03 ± 0.13	
04/11/94	0.031 ± 0.028	0.13 ± 0.06		0.02 ± 0.06	0.03 ± 0.05	
06/27/94	0.061 ± 0.036	0.26 ± 0.06		0.18 ± 0.11	-0.01 ± 0.12	
12/19/95	0.240 ± 0.185	0.56 ± 0.48		0.07 ± 0.075	-0.01 ± 0.08	
02/17/96	-0.06 ± 0.2	-0.15 ± 0.49		-0.13 ± 0.21	-0.05 ± 0.14	
04/30/96	0.046 ± 0.021	0.17 ± 0.04				
06/13/96	0.11 ± 0.05	0.17 ± 0.12	0.44 ± 1.48	co.295	<0.262	
08/16/96	-0.018 ± 0.004	0.25 ± 0.06	<5.98	co.340	<0.284	
			7834-I			
04/07/89*	<10	<20				
09/26/89*	<10	<20				
10/30/89*	<10	<20				
11/28/89*	<10	<20				
01/30/90*	<10	<20				
02/09/90*	<10	<20				
02/21/90*	<10	<20				
03/07/90*	<10	<20				
03/12/90*	<10	<20				
04/19/90*	<10	<20				
05/21/90*	<10	<20				
06/14/90*	<10	<20				
08/20/90*	<10	<20				
09/10/90*	<10	<20				
12/06/90*	<10	<20				
12/27/90*	<10	<20				

Table B.8 (continued)

Date	Gross a	Gross β[c]	^{40}K	^{60}Co	^{137}Cs	^{90}Sr
01/03/91*	<10	<20				
02/21/91*	<10	<20				
04/04/91*	<10	<20				
06/20/91*	<10	<20				
07/03/91*	<10	<20				
12/03/91*	<10	<20				
12/20/91*	<10	<20				
01/10/92*	<10	110				
01/13/92*	<10	<20				
02/27/92*	<10	<20				
04/16/92*	<10	<20				
07/30/92*	<10	<20				
09/24/92*	<10	<20				
11/05/92*	<10	<20				
11/30/92*	<10	<20				
12/30/92*	<10	<20				
01/28/93*	<10	<20				
02/24/93*	<10	<20				
03/24/93*	<10	<20				
05/28/93*	<10	<20				
07/07/93*	<1000	<1000				
08/11/93*	<10	<20				
11/19/93	0.22 ± 0.06	0.68 ± 0.08	17 ± 2	-0.04 ± 0.12	0.19 ± 0.08	
12/02/93*	<10	<20				
12/27/93*	<10	<20				
01124194	0.17 ± 0.06	0.45 ± 0.08	8.3 ± 1.8	0.02 ± 0.14	1.6 ± 0.1	
02/23/94	0.093 ± 0.039	0.29 ± 0.08	-2.4 ± 1.8	-0.03 ± 0.07	0.02 ± 0.06	
04/11/94	0.094 ± 0.040	0.16 ± 0.06		0.18 ± 0.07	-0.06 ± 0.11	
06127194	0.11 ± 0.04	0.27 ± 0.07		0.08 ± 0.08	-0.01 ± 0.09	
08/29/94	0.04 ± 0.03	0.36 ± 0.07		-0.02 ± 0.11	0.06 ± 0.09	
09/29/94	0.07 ± 0.12	0.91 ± 0.26		0.14 ± 0.14	0.20 ± 0.14	
10/14/94	0.029 ± 0.027	0.41 ± 0.08		0.20 ± 0.06	0.02 ± 0.07'	
01/25/95	-0.26 ± 0.24	1.4 ± 0.8		-0.04 ± 0.14	0.01 ± 0.10	
02/17/95	-0.003 ± 0.017	0.10 a 0.07		0.01 ± 0.11	-0.03 ± 0.20	
03/16/95	-0.072 ± 0.024	0.5 ± 0.5		0.05 ± 0.10	-0.04 ± 0.10	
04/25/95	0.091 ± 0.009	0.64 ± 0.24		0.03 ± 0.08	0.02 ± 0.20	
08/09/95	0.16 ± 0.07	0.21 ± 0.13		-0.02 ± 0.12	-0.01 ± 0.11	
09/20/95	0.13 ± 0.04	0.48 ± 0.08		-0.09 ± 0.16	0.11 ± 0.11	
11/08/95	0.003 ± 0.033	0.41 ± 0.08		-0.06 ± 0.15	0.02 ± 0.12	
12/19/95	-0.23 ± 0.085	0.21 ± 0.50		-0.01 ± 0.15	0.05 ± 0.10	
02/17/96	0.44 ± 0.28	1.2 ± 0.6		0.06 ± 0.12	0.07 ± 0.12	
04/30/96	0.100 ± 0.045	0.71 ± 0.10				
06/13/96	0.08 ± 0.06	0.40 ± 0.12	1.58 ± 1.75	<0.265	co.212	
08116196	0.017 ± 0.025	0.14 ± 0.06	<4.65	<0.276	<0.293	

Table 8.8 (continued)

Date	Gross a	Gross β[c]	^{40}K	^{60}Co	^{137}Cs	^{90}Sr
			7834-2			
04/07/89*	<10	<20				
09/26/89*	<10	<20				
10/30/89*	<10	<20				
11/28/89*	<10	<20				
01/30/90*	<10	<20				
02/09/90*	<10	<20				
02/21/90*	<10	<20				
03/12/90*	<10	<20				
04/19/90*	<10	<20				
05/21/90*	<10	<20				
06/14/90*	<10	<20				
09/10/90*	<10	<20				
12/27/90*	<10	<20				
01/03/91*	<10	<20				
02/21/91*	<10	<20				
04/04/91*	<10	<20				
12/03/91*	<10	<20				
01/13/92*	<10	<20				
09/24/92*	<10	<20				
12/30/92*	<10	<20				
08/11/93*	<10	<20				
12/27/93*	<10	<20				
01/24/94	0.077 ± 0.043	0.32 ± 0.08	1.7 ± 1.7	0.06 ± 0.07	0.53 ± 0.07	
02/23/94	0.050 ± 0.030	0.14 ± 0.06	19 ± 1.5	0.03 ± 0.14	-0.08 ± 0.12	
04/11/94	0.047 k-14.628	0.13 ± 0.06		0.03 ± 0.07	-0.01 ± 0.09	
06/27/94	0.036 ± 0.033	2.9 ± 0.2		0.11 ± 0.10	0.04 ± 0.10	
01/25/95	-0.15 ± 0.04	0.4 ± 0.7		0.16 ± 0.08	0.11 ± 0.09	
03/16/95	-0.05 ± 0.29	0.4 ± 0.6		0.07 ± 0.08	0.07 ± 0.10	
08/09/95	0.11 ± 0.08	0.86 ± 0.17		0.20 ± 0.08	0.06 ± 0.20	
09/20/95	0.24 ± 0.06	0.58 ± 0.08		0.01 ± 0.08	0.01 ± 0.08	
11/08/95	0.087 ± 0.044	0.89 ± 0.1		-0.04 ± 0.08	-0.02 ± 0.075	
12/19/95	-0.06 ± 0.13	1.4k0.6		0.08 ± 0.14	0.01 ± 0.125	
02/17/96	0.06 ± 0.24	0.2 ± 0.5		0.04 ± 0.06	0.02 ± 0.06	
04130196	0.087 ± 0.03	0.21 ± 0.04				
06/13/96	0.046 ± 0.045	0.58 ± 0.14	<4.76	<0.217	<0.190	
08/16/96	0.069 ± 0.036	0.30 ± 0.08	0.28 ± 1.78	<0.286	<0.247	
			7834-3			
09/26/89*	<10	<20				
02/09/90*	<10	<20				
05/21/90*	<10	<20				
06/14/90*	<10	<20				
02/23/94	0.33 ± 0.08	4.4 ± 0.2	4.0 ± 1.5	0.02 ± 0.16	0.04 ± 0.14	

Table B.8 (continued)

Date	Gross a	Gross β	^{40}K	^{60}Co	^{137}Cs	^{90}Sr
04/11/94	0.003 ± 0.020	1.0 ± 0.1		0.09 ± 0.10	-0.05 ± 0.10	
03/16/95	-0.14 ± 0.22	0.6 ± 0.5	8.8 ± 1.1	0.14 ± 0.10	-0.02 ± 0.11	
12/19/95	0.07 ± 0.22	0.64 ± 0.6		0.03 ± 0.06	-0.02 ± 0.07	
02117196	0.03 ± 0.24	1.6 ± 0.6		0.13 ± 0.09	-0.05 ± 0.1	
04/30/96	0.043 ± 0.022	1.7 ± 0.1				
06/13/96	-0.032 ± 0.049	0.79 ± 0.17	3.11 ± 1.66	<0.241	<0.237	
08116196	0.072 ± 0.037	1.7 ± 0.1	<4.82	<0.332	<0.287	
			7834-4			
09/26/89*	<10	<20				
02/09/90*	<10	<20				
05/21/90*	<10	<20				
06/14/90*	<10	<20				
02/23/94	0.61 ± 0.10	4.1 ± 0.2	3.5 ± 1.3	0.23 ± 0.12	0.06 ± 0.12	
04/11/94	0.044 ± 0.032	'0.96 ± 0.10		0.10 ± 0.10	-0.02 ± 0.10	
03/16/95	'0.24 ± 0.28	1.2 ± 0.6		0.03 ± 0.15	0.08 ± 0.13	
08/09/95	0.00 ± 0.07	1.9 ± 0.2		0.01 ± 0.15	0.14 ± 0.12	
12/19/95	-0.14 ± 0.20	0.34 ± 0.60		-0.01 ± 0.10	0.05 ± 0.08	
02117196	0.24 ± 0.28	0.6 ± 0.6		0.09 ± 0.10	0.05 ± 0.15	
04130196	0.11 ± 0.03	1.1 ± 0.0				
06/13/96	6.14 ± 0.06	1.5 ± 0.2	4.43 ± 1.27	<0.293	<0.203	
08/16/96	0.2 ± 0.06	1.1 ± 0.1	1.51 ± 1.58	<0.249	<0.252	
			7855-I			
04/07/89*	<10	<20				
09/26/89*	<10	<20				
02/21/90*	<10	<20				
12/29/92*	<10	46	72	<10	<10	<10
02/23/94	0.023 ± 0.024	2.2 ± 0.2	2.9 ± 1.2	-0.02 ± 0.14	0.21 ± 0.11	
04/11/94	0.09 ± 0.06	1.4 ± 0.2		0.01 ± 0.66'	0.01 ± 0.06	
06/13/96	1.7 ± 0.8	49 ± 3	72.4 ± 2.1	<0.204	0.29 ± 0.08	
			7855-2			
04/07/89*	<10	<20				
09/26/89*	<10	<23				
02/09/90*	<10	<20				
05/21/90*	<10	<20				
06/14/90*	<10	<20				
07/10/90*	<10	32				
09/10/90*	<10	44				
12/27/90*	<10	<20				
02/21/90*	<10	<20				
05/29/91*	<10	<20				
06/06/91*	<10	4 1				
06/12/91*	<10	44				
07/11/91*	<10	58				

Table B.8 (continued)

Date	Gross a	Gross β	^{40}K	^{60}Co	^{137}Cs	^{90}Sr
07/12/91*	<10	53				
08/07/91*	<10	49				
12/03/91*	<10	75				
03/12/92*	<10	<20				
04/16/92*	<10	<20				
07/22/92*	<10	<20				
10/06/92*	<10	90				
07/12/91*	<10					
12/29/92*	<10	48	57	<10	<10	<10
03/16/93*	<10	<20			3.3 ± 1	<20
05/26/93*	<10	<20		<10	<10	<20
06/21/93*	<10	46				46
08/23/93*	<10	80		<10	<10	
11/19/93	0.099 ± 0.045	0.44 ± 0.08	7.4 ± 1.2	0.1 ± 0.13	0.24 ± 0.06	
12/27/93*	<10	<20				
02/23/94	0.03 ± 0.20	11 ± 1	10 ± 2	0.11 ± 0.14	0.06 ± 0.15	
04/11/94	0.09 ± 0.07	3.7 ± 0.2	4.5 ± 1.2	0.08 ± 0.08	0.10 ± 0.08	
06/27/94[d]						
09/29/94	4.6 ± 3.2	58 ± 6	100 ± 5	0.24 ± 0.18	0.49 ± 0.10	
10/14/94	-0.09 ± 0.50	76 ± 4	91 ± 2	-0.02 ± 0.16	0.64 ± 0.09	
01/25/95	0.4 ± 0.6	65 ± 4	75 ± 3	-0.01 ± 0.14	0.54 ± 0.10	
02/17/95	-0.04 ± 0.20	43 ± 2	69 ± 2	-0.08 ± 0.14	0.31 ± 0.08	
03/16/95	0.47 ± 0.44	61 ± 2	73 ± 2	0.13 ± 0.10	0.37 ± 0.08	
08109195	1.0 ± 0.6	51 ± 2	74 ± 2	-0.17 ± 0.18	0.36 ± 0.08	
09/20/95	1.3 ± 0.6	39 ± 2	76 ± 2	0.04 ± 0.14	0.51 ± 0.10	
11/08/95	0.8 ± 0.55	1.5 ± 1.05		-0.02 ± 0.135	0.37 ± 0.075	
02/17/96	0.52 ± 0.75	90 ± 3	100 ± 5	-0.13 ± 0.2	0.47 ± 0.11	
04/30/96	-0.42 ± 0.255	78 ± 3				
06/13/96	0.20 ± 0.65	29 ± 2	56 ± 3	<0.346	co.319	
08/16/96	0.93 ± 0.47	60 ± 2	90 ± 4	co.394	0.17 ± 0.26	

[a] Radionuclide data are in Becquerel per liter, mean ± 1 standard error (counting error only); blank spaces indicate data not reported by ASO.
[b] Asterisk indicates sample collected by RSWO and analyzed at TRU. All other samples collected by ASEMP and analyzed at the AS0 low-level lab.
[c] Gross beta analysis does not include tritium.
[d] This sample was not acidified at the time of collection and was therefore not analyzed by ASO.

Table B.9. Radionuclide data from the 1996 annual sampling of SWSA 5 N groundwater.[a]

Well	Gross a	Gross β[b]	^{40}K	^{137}Cs	^{60}Co	^{3}H
513	0.014 ± 0.039	0.10 ± 0.08	<4.73	co.249	<0.256	66 ± 14
514			<5.23	<0.218	co.249	62 ± 14
516	5.3 ± 0.3	0.68 ± 0.09	1.01 ± 1.65	<0.254	co.314	20 ± 10
517	0.029 ± 0.029	0.37 ± 0.13	5.23 ± 1.55	<0.253	<0.302	21 ± 10
518	0.22 ± 0.09	3.9 ± 0.2	<5.68	<0.257	<0.257	20 ± 10
519	-0.027 ± 0.005	0.02 ± 0.08	3.56 ± 1.71	<0.252	co.290	40 ± 14
520	0.10 ± 0.04	0.12 ± 0.07	<5.55	<0.283	<0.281	33 ± 10
521	0.16 ± 0.09	0.53 ± 0.13	<5.26	co.259	<0.245	24 ± 10
522	-0.049 ± 0.050	0.17 ± 0.12	<4.77	<0.205	<0.289	18 ± 10
523	0.031 ± 0.040	0.02 ± 0.08	<5.67	<0.233	<0.262	23 ± 13
524	0.15 ± 0.08	-0.01 ± 0.07	<5.08	<0.260	<0.253	240 ± 15
525	-0.017 ± 0.026	0.16 ± 0.06	<5.14	<0.269	co.290	6 ± 10
708	0.044 ± 0.036	0.09 ± 0.08	<5.16	co.249	<0.243	79 ± 14
715	0.012 ± 0.030	0.26 ± 6.10	<5.45	<0.289	<0.256	36 ± 14
716	0.070 ± 0.035	0.13 ± 0.06	<5.88	<0.264	CO.269	6 ± 10
799[c]	0.045 ± 0.036	0.06 ± 0.08	<4.30	<0.208	<0.224	6 ± 13

[a] All data are in Becquerel per liter, mean ± 1 standard error (counting error only).
[b] Gross beta analysis does not includetritium.
[c] Deionized water blank.

Table B.10. Radionuclide data from annual sampling of SWSA 5 N seeps.[a]

Seep	Gross a	^{241}Am	^{244}Cm	Gross β[b]	^{137}Cs	^{60}Co
258	0.13 ± 0.04	0.010 ± 0.004	0.12 ± 0.01	0.14 ± 0.06	-0.01 ± 0.07	0.01 ± 0.08

[a] All data are in Becquerei per liter, mean ± 1 standard error (counting error only).
[c] Gross beta analysis does not include tritium.

Table B.11. Analytical data from the 1996 SWSA 5 N groundwater sampling.[a]

Well	Br	Cl	F	NO,	SO_4	Al	Ba	Ca	Fe	K	Li	Mg	Mn	Na	Si	Sr	Zn
513	<0.1	4.9	<0.1	0.59	17	co.05	0.19	74	co.05	<2.0	0.013	8.1	0.019	5.4	8.4	0.11	0.023
514	<0.1	4.7	<0.1	1.2	15	co.05	0.16	96	co.05	2.6	0.013	10	0.003	7.1	8.6	0.13	<0.005
516	0.68	2.1	<0.1	21	20	<0.051	0.34	130	co.10	<2.0	0.015	14	0.03	14	7	0.16	0.006
517	<0.1	6.7	<0.1	0.51	323	co.051	0.02	130	co.10	3.3	0.027	56	0.22	20	7.2	0.19	0.009
518	<0.1	2.6	co.1	1.3	155	co.051	0.04	97	co.10	2.6	0.013	34	0.037	22	5.4	0.14	0.007
519	0.2	4.3	<0.1	0.45	25	co.05	0.09	120	40.05	2.4	0.011	27	0.14	9.1	5.7	0.22	<0.005
520	<0.1	4.7	<0.1	1.5	53	co.051	0.21	99	<0.10	<2.0	0.014	8.6	0.53	6.8	10	0.15	0.013
521	<0.5	24	co.5	<0.5	1100	co.051	0.01	270	2.6	3.3	0.13	130	3.5	44	15	0.35	0.005
522	<0.1	1.3	co.1	3.2	202	0.27	0.06	80	co.10	4.3	0.053	8.9	0.16	13	8.3	0.64	0.018
523	<0.1	2	co.1	0.97	21	co.05	0.08	69	co.05	<2.0	<0.005	11	0.19	4	4.7	0.16	<0.005
524	0.27	9.7	1.11	<0.1	42	co.05	0.06	52	0.67	<2.0	0.028	11	0.62	77	7.3	0.2	<0.005
525	<0.1	16	<0.1	4.8	16	co.051	0.12	95	<0.10	<2.0	0.006	15	0.57	17	6.8	0.24	0.006
708	<0.1	3.3	<0.1	<0.1	26	<0.05	0.08	39	co.05	<2.0	co.005	7	0.97	4.4	2.9	0.08	0.08
715	<0.1	2.9	<0.1	2.3	61	co.05	<0.08	83	co.05	3.5	0.012	16	0.12	4.9	4.4	0.38	0.014
716	<0.1	1.2	0.5	0.68	8	0.06	0.08	21	co.10	5.9	0.014	2.2	0.033	30	2.7	0.21	0.011
blank	<0.1	<0.1	<0.1	<0.1	co.2	co.05	<0.001	0.01	<0.05	<2.0	<0.005	co.02	<0.001	co.05	<0.2	<0.005	<0.005

[a] All data are in mg/L. Blank spaces indicate data not reported by Analytical Services Organization.

Table B.12. Radionuclide data from soil samples collected at the NFS storage building.[a]

Sample	Gross a	Gross β	^{40}K	^{60}Co	^{137}Cs
NFS-1	120 ± 45	420 ± 70	800 ± 45	-1 ± 2.8	1.4 ± 2.4
NFS-2	200 ± 50	180 ± 60	920 ± 35	0.3 ± 1.8	0.3 ± 1.6
NFS-3	90 ± 50	240 ± 65	740 ± 30	-0.4 ± 1.8	-0.2 ± 1.4
NFS-4	250 ± 40	280 ± 20	120 ± 50	2.4 ± 1.8	-0.4 ± 1.8
NFS-5	280 ± 40	270 ± 25	990 ± 35	-0.9 ± 2.2	0.2 ± 1.6
NFS-6	230 ± 65	540 ± 80	780 ± 50	-1.3 ± 3.1	16 ± 2

[a] All data in Bq/kg, mean ± 1 SE (counting error only).

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