AR TARGET SHEET

The following document was too large to scan as one unit, therefore it has been broken down into sections.

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SECTION 2 OF 2

APPENDIX A

SUPPLEMENTAL DATA

APPENDIX A.1

GEOPHYSICAL DATA

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A-1.1 INTRODUCTION

Geophysical well logging has been conducted in monitoring wells located within the 200 East and West Areas since 1954 and in the B Plant Aggregate Area since at least as early as 1958. Such logging can be used to map lithologic boundaries (Additon et al. 1978; Last et al. 1989; Brodeur and Koizumi 1989), soil moisture content (Lane 1990) and to evaluate the location and extent of radionuclides in the subsurface due to waste disposal activities (Fecht et al. 1977; Additon et al. 1978; Lane 1990). The geophysical borehole logging techniques that have been used include density, neutron, temperature and gross gamma radiation logging. The most successful of these for mapping lithologic boundaries and monitoring radionuclides in the subsurface has been the gross gamma logging. The other techniques have been less successful either because they are not suitable for use in cased holes or they do not measure radiation (Lane 1990).

Previous studies based on the gross gamma logs collected from wells monitoring various waste management units in the 200 East and West Areas were conducted in 1964, 1969, 1977, 1978, and 1986. The tank farms located in the 200 East and West Areas were not considered in these reports. Additon et al. (1978) report that the 1964 study (Raymond and McGhan 1964) discusses the disposition of radionuclides beneath most of the waste management units active between 1945 and 1963. The 1969 study (Tillson and McGhan 1969) is reported by Additon et al. (1978) to be a discussion of the waste management units where significant changes in the gross gamma logs were observed after 1963. The report by Fecht et al. (1977) is a qualitative study of the distribution, redistribution and decay of radionuclides beneath approximately 100 waste management units in the 200 East and West Areas. Fecht et al. (1977) included a summary of the waste disposal history of each facility evaluated and based their conclusions on approximately 300 selected gross gamma logs collected between 1954 and 1976. Plots of the logs used were provided with the report. Additon et al. (1978) provide a complete summary of the logging systems used and a discussion of the limitations of using gross gamma logs to evaluate the distribution and composition of radionuclides in the subsurface. The methodologies employed to qualitatively evaluate the gross gamma logs collected from wells monitoring the waste disposal facilities in the 200 East and West Areas were also summarized. Plots of the gross gamma logs collected from 154 monitoring wells outside the tank farms in the 200 East Area was included in the report by Additon et al. (1978). Chamness (1986) reviewed gross gamma logs available from selected wells in the 200 Areas and qualitatively summarized any changes in the logs between 1976 and 1986.

In the B Plant Aggregate Area 87 active and inactive waste management units that are monitored by wells where gross gamma logs were collected were evaluated in this study. These waste management units were grouped into 16 geographically related areas and were qualitatively evaluated in terms of the location and extent of radionuclides in the subsurface, any evidence of vertical or lateral migration, and the potential for radionuclides reaching the groundwater (Figure A1-1). The results of the evaluations for these waste management units are summarized in Table A1-1. Additionally, logs from the three inactive single-shell tank farms in the B Plant Aggregate Area were reviewed and the approximate extent, location and source of radionuclides in the subsurface summarized. The results of the tank farm evaluations are summarized in Table A1-1.

A-1.2 GROSS GAMMA LOGGING

Borehole gross gamma radiation measurements were used to determine the level of gamma activity with depth in the vicinity of the well bore. These measurements do not differentiate between the mechanisms through which gamma radiation is produced or the energy of the gamma radiation photons detected. The response of the gamma radiation detector to different energy levels is generally unknown, except perhaps for the lowest energy photon detectable (Arthur 1990). Gross gamma logs cannot be used to determine the isotopic composition of the subsurface since this is determined through the analysis of the energy spectra of the gamma radiation detected. The capability to measure the spectra of gamma radiation detected in the subsurface and assay the types and amounts of isotopes present is currently being developed, but has not yet reached the stage of practical application (Lane 1990; Price et al. 1990).

The bulk of the gamma logs available for the B Plant Aggregate Area were collected with scintillation probes by Pacific Northwest Laboratories (PNL) or by the Tank Farm Surveillance Analysis and Support group (TFSA&S). Scintillation probes detect the flash of light produced by the interaction between a gamma photon and a crystal of thallium-activated sodium iodide (NaI(Tl)) with a photomultiplier tube. The resulting pulse of electricity is amplified, routed through a signal generator and sent through the logging cable to the surface. The pulses are separated from the electrical signal with a discriminator, amplified, counted by a rate meter and output to a pen plotter which is driven at a rate determined by the logging speed (Fecht et al. 1977; Additon et al. 1978; Brodeur and Koizumi 1989; Arthur 1990).

The accuracy and precision of gamma activity measurements in the subsurface is determined by details of the logging system instrumentation, the field data acquisition methodology, the surrounding media and the radionuclides present. The relationship between the gamma activity detected by a scintillation probe and the actual activity, the distance gamma radiation may travel through geologic materials before being completely attenuated and the vertical resolution of changes in activity by the logging systems used will be discussed below.

The time required for the logging system to process a detected gamma photon, or "dead time," is an important limitation in the measurement gamma activity (Brodeur and

Koizumi 1989; Arthur 1990). During this short span of time, no other photons will be processed by the instrument. The "dead time" computed for the PNL system currently in use is 17.8 microseconds (Arthur 1990). Based upon this value, the maximum count rate this logging system is capable of is about 56,000 ct/sec. If the activity is above that level, the system becomes "paralyzed" and will read 0 ct/sec until it resets itself. The maximum count rate of the TFSA&S system currently in use is about 100,000 ct/sec with Probe 4 (Strong 1980). This suggests that the "dead time" of their logging system is about 10 microseconds. There is no evidence that TFSA&S's system will become paralyzed if this activity level is exceeded.

The actual gamma activity on an interval may be computed by multiplying the "dead time" corrected activity by a factor consistent with the amount of attenuation due to well construction. The amount of attenuation the gamma radiation experiences in penetrating well casing is significant. A single string of casing reduces the count rate measured by the scintillation probe by about 25%, groundwater in an uncased hole reduces the observed count rate by 11%, and groundwater in a cased hole reduces the observed count rate by about 33% (Brodeur and Koizumi 1989; Arthur 1990).

The relationship between the gamma activity observed with a scintillation probe and the actual activity is linear over much of the system's range. However, above some threshold activity level, the relationship between the observed and actual activity becomes nonlinear. At this point the tool is said to be saturated. The gross gamma logging system currently in use by PNL becomes saturated around 14,500 ct/sec (Brodeur and Koizumi 1989; Arthur 1990), and that currently in use by TFSA&S with Probe 4 becomes saturated around 70,000 ct/sec (Strong 1980).

Where the relationship between the observed and actual gamma activity is linear, and complete details of well construction are available, the activity may be converted to standard units related to decay rates or to concentrations of specific radionuclides (thorium or uranium for example). Such conversions allow the direct comparison of data collected by different logging systems and quantitative analyses of the concentrations of gamma emitters with depth. To achieve this, it is necessary to calibrate the scintillation probes used with a model borehole containing intervals with known activities (Strong 1980; Brodeur and Koizumi 1989; Arthur 1990). The rigorous procedures and facilities necessary for calibrating scintillation probes have not yet been completed.

A scintillation probe is calibrated by periodically adjusting the components of the system to meet established specifications and by logging a test well with intervals of known activity under standard conditions. The probe's calibration is then verified in the field before and after each logging run using portable equipment and procedures that are correlated with those of the calibration procedure. Standard conditions are established by constructing the test borehole in a known geologic environment with background radiation levels similar to those found in the area where the probe is used. The test well should be constructed in a similar fashion to the wells to be logged by the probe (Brodeur and Koizumi 1989).

The average distance through which gamma radiation penetrates geologic and well construction materials and is still detected by the scintillation probe is known as the radius of investigation. This distance is determined by the density of the media surrounding the borehole, the well construction materials, and the energy and intensity of the gamma radiation. The average radius of investigation for gross gamma radiation measurements in an open hole is about 0.3 m (1 ft) from the wall of the borehole in sedimentary rocks (Schlumberger 1972). The radius of investigation is larger on intervals where there are high concentrations of radionuclides since higher intensities of gamma radiation will penetrate a greater thickness of a given material. The radius of investigation is decreased by well casing, grout, and groundwater since they increase the effective density of sediments. Another factor in determining the radius of investigation is the tool response to low energy (frequency) gamma photons. The scintillation probe currently used by PNL has a low energy cutoff of between 46.5 and 59.5 keV (Arthur 1990). Gamma radiation with energies below this value will not be detected by that probe. The low energy cutoff for the probes used by TFSA&S is unknown.

The vertical resolution and apparent location of a change in the gamma activity measured by a scintillation probe depends upon details of how the probe signal is processed by the rate meter and the logging speed. The rate meter used in PNL's logging system differs from that used by TFSA&S. The rate meter used by PNL smooths its output using an electronic circuit (an RC circuit). The amount of smoothing is determined by the time constant of the circuit used. This removes statistical variations in the signal detected by the scintillation probe and improves the reproducibility and sensitivity of the data. However, a "lag" is introduced between the depth at which a change in the gamma activity is first encountered by the scintillation probe and the depth at which it is plotted. The size of this "depth lag" is the distance traveled before half of the amplitude of the change in activity is recorded. One time constant is required to reach 63% of the amplitude of any change in activity. So, the "depth lag" is approximately the product of the logging speed and the time constant used (Schlumberger 1972). Before 1989, the logging speed used by PNL had been 4.6 m/min (15 ft/min) (0.25 ft/sec) and the time constant used had been 3 seconds. This results in a depth lag of 0.2 m (0.75 ft). The thinnest interval of elevated activity that could have been resolved was also 0.2 m (0.75 ft) on these older profiles. In 1989, the logging speed was reduced to 1.5 m (5 ft/min) (1 in./sec) and the time constant to 1 second. The expected vertical resolution and "depth lag" of these logs is 1 in. (2.54 cm).

The rate meter used by TFSA&S sums the pulses over the period of time required for the probe to ascend through 0.3 m (1 ft) and averages the reading over time. This process does not remove the statistical variations from the data so the data are less reproducible. Since no time constant is used, no "lag" between the depth a change in gamma activity is encountered and the depth where it is plotted is introduced. However, the vertical resolution of changes in activity on these logs is 0.3 m (1 ft), the distance over which the activity is averaged.

A-1.3 TECHNICAL APPROACH

Scintillation probe profiles collected periodically from monitoring wells within the B Plant Aggregate Area have been used to qualitatively assess the location and extent of radionuclides in the subsurface, any evidence of vertical or lateral migration, and the potential for radionuclides from waste disposal activities reaching the groundwater. The approach used here is similar to that of Fecht et al. (1977). Scintillation probe profiles collected from wells monitoring a facility or group of facilities were compiled and analyzed to understand the subsurface distribution of gamma emitters from waste disposal activities. Each analysis was accompanied by a summary of the types and sources of wastes handled, the service dates and the volume of wastes disposed of or stored at a given facility. The conclusions reached in these evaluations should not be considered final since they are based on a limited data set which can only be used for qualitative purposes.

The approach used here differs from that of Fecht et al. (1977) and other previous evaluations in the manner in which the data were compiled and analyzed. The 87 waste management units evaluated were grouped into 16 geographic areas and evaluated as a whole (Figure A1-1). The three tank farms for which summary evaluations were made account for three additional areas. Geological methods of analysis were used extensively that incorporated cross sections and maps of subsurface attributes such as the thickness of zones of elevated gamma radiation and relevant lithologic horizons. The advantages of this approach are the clearer representation of potential subsurface conditions around the waste disposal facilities, and identification of data deficiencies. It is assumed that the activity detected on the gamma logs represent diffuse, continuous sources of radiation.

Fecht et al. (1977) attempted to "normalize" the scintillation probe profiles used in their evaluations to a level consistent with the profiles collected in 1976. This normalization scheme involved scaling the profiles from each vintage using an average "peak to background" ratio and bulk shifting the corrected curves to correspond to the 1976 profiles. Since there are distinct differences between the response characteristics of each logging system and their modifications (in the saturation levels, low energy cutoff, etc.), there are doubts to the validity of such an exercise. The logs used in the evaluations presented here have not been normalized.

There has been no attempt to quantitatively compare the activity levels detected by different vintages of scintillation probes in the evaluations presented here. If gross changes in the profiles are evident, they have been noted in a qualitative sense.

The criteria used to identify radionuclide decay are the significant, consistent decline of activity levels and the "narrowing" of the features representing elevated radiation on the logs over time. However, such changes may also be indicative of lateral migration of radionuclides away from a particular well. Identification of lateral migration is generally uncertain. The most reliable criteria for identifying lateral migration of radionuclides is the notable increase of activity on an interval in a well that is down gradient (of a stratigraphic or hydrologic boundary) from other wells with elevated activity on a similar interval. It is very important to consider the spacial and temporal context of the scintillation probe data in determining if lateral migration has occurred, even on a qualitative level.

Although the activity measured by the scintillation probes cannot be quantified to known standards, the activity in the subsurface may be reliably located. The location of features in the scintillation probe profiles such as the top and bottom of intervals of elevated gamma radiation are generally found at the same depth on successive logs. Care must be taken in comparing the logs collected by TFSA&S and PNL. Depth discrepancies of up to 5 ft have been noted between these logs. This error is due in part to the "depth lag" of the PNL logging system. This "depth lag" will place equivalent features on PNL logs (collected before 1989) 0.2 m (0.75 ft) shallower than those on TFSA&S logs. Also, differences in the responses of the PNL and TFSA&S systems may account for some of this discrepancy.

Three criteria were used to establish downward migration of radionuclides in the vicinity of a well. The most important of these was an unambiguous downward displacement of the top and bottom of a region of elevated radiation with time. Downward migration of other correlatable features on an interval of elevated activity may be used in support of this evidence. Secondly, the total amount of downward migration should exceed the vertical resolution of the logging system used (0.2m, 0.75 ft, for the PNL pre-1989 logs and 0.3 m, 1 ft, for TFSA&S logs). Finally, any change in the point from which depths are measured during logging should be identified and accounted for; this can be inferred from stationary subsurface features, such as lithologic boundaries and bottoms of casing strings.

All of the available well data were reviewed for each area evaluated, and selected logs were used to construct cross sections representative of subsurface conditions. These cross sections were correlated with stratigraphic information from nearby wells, regional cross sections and regional mapping. Boundaries of zones of elevated gamma radiation were also marked. Any mappable attributes that could be used to represent the location and extent of the region of elevated gamma radiation were compiled into maps. The evaluation of the scintillation probe profiles referenced these graphical representations to describe the location and extent of any zones of elevated gamma radiation, and the behavior of this zone over time, particularly in regards to vertical or lateral migration. Any evidence of gamma emitters reaching the groundwater was also noted.

To represent the logs used in the cross sections in a clear, yet compact format and to help compare different vintages of data, it was necessary to digitize the original logs and to redisplay them on a semilogarithmic scale. Depth in feet from the top of casing was represented on the linear scale, and activity in ct/sec on the logarithmic scale. The logs used in these evaluations collected before 1976, and some of the 1976 vintage logs, had been previously digitized by PNL, who provided text files of the information. Unfortunately, it was not realized until late in the evaluations that the 1970 vintage and earlier logs had been plotted on a scale of ct/min. The reader should be aware that these logs are not plotted in ct/sec, but in ct/min. The apparent wide difference between these earlier logs and those collected in 1976 and later is due to an error in scaling. Logs plotted on a scale of ct/min were denoted on the legend for each plot of scintillation probe profiles. Additionally the cross sections are not scaled horizontally. To obtain a true picture of the spacial relationship between the wells used in the cross sections, the reader is instructed to inspect the location map provided on each figure containing cross sections.

Features that were mapped in the evaluations for the B Plant Aggregate Area include the thickness of the interval of elevated gamma radiation, the top of the elevated gamma radiation and the top of any correlatable lithologic horizon which is useful in explaining the distribution of radionuclides in the subsurface. The most commonly used map was the thickness of the interval of elevated gamma radiation. Although such maps do not give any indication of gamma activity, they do provide a reasonable representation of the potential extent of gamma emitters. Use of activity data was avoided since the data are not suitable to be used in such a quantitative fashion.

A-1.4 EVALUATION OF WASTE MANAGEMENT UNITS AREAS

A-1.4.1 216-B-43 through -50, -57, and -61 Waste Management Units

Waste Description:
216-B-43 through 49 Cribs: Scavenged mixed waste from uranium recovery (tributyl phosphate solvent extraction) process in 221-U Building.
216-B-50 Crib: Waste storage tank condensate (mixed waste) from the ITS #1 unit in the 241-BY Tank Farm.
216-B-57 Crib: Waste storage tank condensate (mixed waste) from the ITS #2 unit in the 241-BY Tank Farm.
216-B-61 Crib: Never used.

Service Dates:
216-B-43 Crib: November 1954 to November 1954.
216-B-44 Crib: November 1954 to March 1955.

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216-B-45 Crib: April 1955 to June 1955.
216-B-46 Crib: September 1955 to December 1955.
216-B-47 Crib: September 1955 to September 1955.
216-B-48 Crib: November 1955 to November 1955.
216-B-49 Crib: November 1955 to December 1955.
216-B-50 Crib: January 1965 to January 1974.
216-B-57 Crib: February 1968 to June 1973.
216-B-61 Crib: Never used.

<u>Waste Volume:</u>
216-B-43 Crib: 2,120,000 L (560,000 gal).
216-B-44 Crib: 5,600,000 L (1,500,000 gal).
216-B-45 Crib: 4,920,000 L (1,300,000 gal).
216-B-46 Crib: 6,700,000 L (1,800,000 gal).
216-B-47 Crib: 3,710,000 L (980,000 gal).
216-B-48 Crib: 4,090,000 L (1,100,000 gal).
216-B-49 Crib: 6,700,000 L (1,800,000 gal).
216-B-50 Crib: 54,800,000 L (14,500,000 gal).
216-B-57 Crib: 84,400,000 L (22,300,000 gal).
216-B-61 Crib: 0 liters.

<u>Evaluation of Scintillation Probe Profiles</u>

The 216-B-43 through -50 Cribs, also known as the BY Cribs, the 216-B-57 Crib and the 216-B-61 Crib are all located within the 200-BP-1 Operable Unit, immediately north of the 241-BY Tank Farm. The 216-B-43 through -50 Cribs are monitored by Wells E33-1, -2, -3, -4, -5, -6, -7, -13, -22, -23 and -90. The 216-B-57 Crib is monitored by Well E33-24 and the 216-B-61 Crib is monitored by Wells E33-25 and -26. Details of these monitoring wells and the scintillation probe profiles used in this evaluation are given in Table A1-2.

Scintillation probe profiles from the wells monitoring the 216-B-43 through -50 Cribs were evaluated by Fecht et al. (1977) and Chamness (1986). Fecht et al. (1977) found high levels of activity from near the surface to the water table beneath these cribs. They noted that levels of activity had been slowly declining since waste disposal activities ceased in these units. No evidence of radionuclide migration was found. They concluded that gamma emitters from these cribs may have reached the groundwater in this area. Profiles from selected wells in the 216-B-43 to -50 Crib area were reviewed by Chamness (1986). The activity in those wells was found to be slowly declining over time. The results of this evaluation do not differ significantly from those of these previous studies.

Scintillation probe profiles from the wells monitoring the 216-B-57 and -61 Cribs have been evaluated by Fecht et al. (1977). They concluded that the increased gamma activity over time in the well monitoring the 216-B-57 Crib was due to continuing waste disposal activities in that crib. They also concluded that radionuclides had not reached the water table in that area. Low levels of activity on an unspecified interval in the wells monitoring the 216-B-61 Crib were noted by Fecht et al. (1977). The results of this evaluation for the 216-B-57 and -61 Cribs do not differ from those of Fecht et al. (1977).

Scintillation probe profiles from wells monitoring the 216-B-43 through -50, -57 and -61 waste management units were compiled into cross sections and correlated with the stratigraphy found in Well E33-4 and with regional maps of the lithologic units (Lindsey et al. 1992) (Figures A1-2 and A1-3). The lithologic correlations used should be considered approximate since high levels of gamma activity on many of the profiles obscured the subtle features caused by lithologic changes.

High levels of gamma activity over a thick interval of the subsurface is evident on the scintillation probe profiles collected from the wells monitoring the 216-B-43 through -50 and -57 waste management units (Figures A1-2 and A1-3). The thickness of this interval and the area beneath the 216-B-43 through -50 Cribs where elevated levels reach the top of the basalt were mapped (Figure A1-4). The region of elevated gamma radiation under the 216-B-43 through -50 and -57 Cribs appears to have a considerable lateral extent, reaching the area of the 216-B-57 Crib, 75 m (250 ft) to the west-southwest, and to Well E33-13, 75 m (250 ft) to the east-southeast. No well control is available to the north and east of the 216-B-43 through -50 Cribs.

There are several explanations for the distribution of radionuclides beneath the 216-B-43 to -50 Cribs. The simplest of these is that during operations, the radionuclides disposed of in the 216-B-43 to -50 Cribs migrated downward and laterally with little influence by lithologic conditions. This is supported by the southerly extent of the gamma emitters, against the northerly dip of the alluvium (Lindsey et al. 1992) and by the fair to poor correlation between a silty interval found in Well E33-4 and features on the scintillation probe profiles from the wells monitoring this area. Alternative explanations for the lateral distribution of radionuclides below the 216-B-43 to -50 Cribs include contributions from the 216-B-57 Crib and the 241-BY Tank Farm, and local features in the lithologic units. The scintillation probe profile data are inadequate to evaluate these alternative explanations.

It appears that the silty interval within the Hanford sand found in Well E33-4 acted as a barrier to the downward movement of wastes under the 216-B-57 Crib while it was active. The top of this layer correlates with the base of the plume in this area. The lateral extent of the gamma emitters detected in this area cannot be delineated with the data available from the single well monitoring this crib.

The top of the interval of elevated gamma radiation detected under the 216-B-43 through -50 and -57 Cribs is commonly 2 to 3 m (6 to 10 ft) below the surface, but may be found at the surface near Well E33-22 and at a depth of 15 m (50 ft) near Wells E33-38 and -90 (Figures A1-2 and A1-3). The shallowest depths to the elevated radiation are found under cribs 216-B-46, -49 and -50, in an area adjacent to cribs 216-B-43 and -44, and beneath crib 216-B-57. This is consistent with the waste disposal activities which occurred in those areas.

In Well E33-90, elevated levels of gamma radiation near the ground surface are evident on the scintillation probe profiles collected in 1965 and 1968 (Figure A1-2). An unplanned release (UN-200-E-63) discovered in 1981 is located in the vicinity of Well E33-90. However, the details of this unplanned release suggest that its location was in the area of the BC Cribs, well south of the BY Crib area. Alternatively, the elevated levels detected near the surface in Well E33-90 may be related to those detected below the 216-B-43 through -50 Cribs. This seems unlikely since gamma emitters would have had to travel upwards to reach the surface elevation of Well E33-90. It is possible that the top of casing (TOC) for this well is in error on the GIS listing used. The actual TOC for Well E33-90 may be closer to that of the other wells in the area. However, if a more consistent TOC is used for Well E33-90, the scintillation probe profiles for that well do not correlate with those of the neighboring wells. Without more current logs, it is not possible to determine the present conditions in the near surface in the vicinity of Well E33-90.

There is no evidence of measurable vertical or lateral migration of radionuclides beneath the 216-B-43 through -50, -57 and -61 waste management units. No changes in the scintillation probe profiles over time are evident except for those associated with radionuclide decay.

Elevated gamma radiation levels are detected in the groundwater in all of the monitoring wells reaching the water table around the 216-B-43 through -50, -57 and -61 waste management units, except in Well E33-38. The background gamma radiation levels found below the water table in Well E33-38 could be due to actual conditions in the groundwater or by contamination of the neighboring wells by gamma emitters. The simplest explanation is that the measurements in Well E33-38 represent the most current conditions below the water table and since 1987 radiation levels have been at background. Another possibility is that elevated radiation levels are found everywhere but in the vicinity of Well E33-38. Perhaps the basalt surface is higher or lower in this area, and radionuclides in the groundwater do not reach the well. It is also possible that the elevated gamma activity detected below the water table by the other wells monitoring the 216-B-43 through -50, -57 and -61 waste management units is due to radionuclides adhering to rust in the casing of these wells (Smith 1980). Since Well E33-38 was drilled in late 1990 and was probably constructed with stainless steel components, such an effect is not seen.

A-1.4.2 216-B-14 through -19 Waste Management Units

Waste Description: Scavenged tributyl phosphate supernatant from 221-U during uranium recovery operations.

Service Dates:

216-B-14 Crib: January 1956 to February 1956
216-B-15 Crib: April 1956 to December 1956
216-B-16 Crib: April 1956 to August 1956
216-B-17 Crib: January 1956 to January 1957
216-B-18 Crib: March 1956 to April 1956
216-B-19 Crib: February 1957 to October 1957

Waste Volume:

216-B-14 Crib: 8,710,000 L (2,300,000 gal)
216-B-15 Crib: 6,320,000 L (1,660,000 gal)
216-B-16 Crib: 4,560,000 L (1,500,000 gal)
216-B-17 Crib: 3,410,000 L (901,000 gal)
216-B-18 Crib: 8,520,000 L (2,250,000 gal)
216-B-19 Crib: 6,400,000 L (1,690,000 gal)

Evaluation of Scintillation Probe Profiles: The 216-B-14 through 19 Cribs are located in the eastern part of the 200-BP-2 Operable Unit. The cribs are monitored by eight monitoring wells. Well E-13-1 monitors crib 216-B-14. Well E13-2 monitors crib 216-B-15. There is a discrepancy between the location of Well E13-2 given by the GIS coordinates and the location used by Fecht et al. (1977). This evaluation uses the location of Fecht et al. (1977). Wells E13-3 and E13-21 monitor crib 216-B-16. Well E13-4 monitors crib 216-B-17. Well E13-5 monitors crib 216-B-18. Well E13-6 monitors crib 216-B-19. Well E13-20 is also used in evaluating crib 216-B-18. Table A1-3 provides details on the construction of the wells used in this evaluation.

Cribs 216-B-14 through -19 have been previously evaluated by Fecht et al. (1977). They concluded that measurable migration of contaminants has occurred beneath all the cribs and that possible breakthrough to the water table has occurred under cribs 216-B-14 and 216-B-16. The conclusions of the present evaluation agrees with the previous evaluation of Fecht et al. (1977).

The wells monitoring the 216-B-14 through -19 Cribs were compiled into two cross sections (Figure A1-5) and correlated with the lithologic columns from Wells E13-14 and E13-18 (Lindsey et al. 1991) and the regional mapping of Lindsey et al. (1992). Although the expression of the lithologic changes is subtle on the scintillation profiles, the correlation is probably a reasonable one since Wells E13-14 and E13-18 are located about 450 m (1,500 ft) from the area.

Intervals of elevated gamma radiation occur in all of the monitoring wells in the 216-B-14 through -19 area. The thickness and extent of elevated areas of gamma radiation are shown in Figure A1-6. The distribution of the monitoring wells around the crib area is inadequate to fully define the lateral extent and potential for lateral migration of radionuclides in the subsurface.

Vertical migration of radionuclides may be in part controlled by the top of a fine silty layer that occurs at a depth of 29 m (95 ft) in Well E13-18. This is supported by the fact that elevated gamma readings are limited to a maximum depth of 29 m (95 ft) in all but two wells in the crib area. Previous high gamma activity below 29 m (95 ft) has declined to near background levels due to radionuclide decay. This suggests that strong gamma emitters with long half-lives were retained about the fine silty layer. Evaluation of older gamma logs indicate that in all but two wells elevated gamma activity did not reach the water table.

Elevated gamma activity is detected in Wells E13-1 and E13-21 from just below the ground surface to the water table. This indicates that gamma emitters may have reached the groundwater below the 216-B-14 and 216-B-16 Cribs. There is a discrepancy between the thicknesses of the intervals of elevated gamma radiation detected in Wells E13-21 and E13-3 which monitor the 216-B-16 Crib. Well E13-3 shows elevated gamma readings to a depth of 23 m (75 ft) whereas Well E13-21 has elevated readings to a depth greater than 90 m (300 ft). This difference may have been caused by a greater amount of waste concentrated on the west side of Crib 216-B-16. An alternative explanation is that waste may have traveled along a pathway provided by the E13-21 Monitoring Well.

An evaluation of scintillation probe profiles from Wells E13-6 and E13-2 taken prior to disposal to the 216-B-15 and 216-B-19 Cribs indicates that lateral migration had occurred in the crib area. Elevated gamma radiation was recorded both in Well E13-6 from 3 m (8 ft) to a depth of 23 m (75 ft), and in Well E13-2 to 32 m (105 ft), even before the cribs they were monitoring became active. The gammas emitters that migrated to Wells E-13-2 and -6 may have come from cribs 216-B-14, -16, -17, or -18.

A-1.4.3 216-B-20 through -34, -52, -53A, -53B, -54, and -58 Waste Management Units

Waste Description:

216-B-20 through -34 and -52 Trenches: Scavenged tributyl phosphate from the 221-U Building.

216-B-53A, -53B, -54 and -58 Trenches: Liquid waste from Hanford Laboratories operations.

Service Dates:

216-B-20 through -26 Trenches: 1956.
216-B-27 through -34 Trenches: 1957.
216-B-52 Trench: December 1957 to January 1958.
216-B-53A Trench: October 1965 to November 1965.
216-B-53B Trench: November 1962 to March 1963.
216-B-53 Trench: March 1963 to October 1964.
216-B-58 Trench: November 1965 to June 1967.

Waste Volume:

216-B-20 Trench: 4,680,0000 L (1,230,000 gal).
216-B-21 Trench: 4,670,000 L (1,250,000 gal).
216-B-22 Trench: 4,740,000 L (1,250,000 gal).
216-B-23 Trench: 4,510,000 L (1,190,000 gal).
216-B-24 Trench: 4,700,000 L (1,250,000 gal).
216-B-25 Trench: 3,760,000 L (993,000 gal).
216-B-26 Trench: 5,880,000 L (1,550,000 gal).
216-B-27 Trench: 4,420,000 L (1,170,000 gal).
216-B-28 Trench: 5,050,000 L (1,330,000 gal).
216-B-29 Trench: 4,840,000 L (1,280,000 gal).
216-B-30 Trench: 4,780,000 L (1,260,000 gal).
216-B-31 Trench: 4,740,000 L (1,250,000 gal).
216-B-32 Trench: 4,770,000 L (1,260,000 gal).
216-B-33 Trench: 4,740,000 L (1,250,000 gal).
216-B-34 Trench: 4,870,000 L (1,290,000 gal).
216-B-52 Trench: 8,530,000 L (2,250,000 gal).
216-B-53A Trench: 549,000 L (145,000 gal).
216-B-53B Trench: 15,000 L (3,990 gal).
216-B-54 Trench: 999,000 L (264,000 gal).
216-B-58 Trench: 413,000 L (109,000 gal).

Evaluation of Scintillation Probe Profiles:

The 216-B-20 through -34, -52, -53A, -53B, -54 and -58 Cribs are located in Operable Unit 200-BP-2. The crib area is monitored by 23 wells: Wells E13-7 through E13-19 and Wells E13-51, E13-52, E13-54 through E13-61. Table A1-4 provides details of the wells used in this evaluation.

This waste management unit area has previously been evaluated by Fecht et al. (1977). Fecht et al. (1977) concluded that contamination of the groundwater was not indicated and that vertical migration of contaminants had stopped. The conclusions of this present evaluation are consistent with Fecht et al. (1977).

Scintillation probe profiles from Wells E13-52, E13-59, E13-60, E13-17, E13-14, E13-9, E13-54, E13-56, E13-57, and E13-19 were used to construct two cross sections of the crib area (Figure A1-7). These cross sections were correlated with the geology of Lindsey et al. (1992) and the E13-14 boring log.

Intervals of elevated gamma radiation occur in most of the vadose wells located in between the cribs. Several wells (E13-52, E13-54, E13-56 and E13-57) do not extend below the interval of elevated gamma radiation, therefore the depth to which radionuclides may have migrated beneath the cribs is uncertain. It is therefore possible that radionuclides may have reached the groundwater, but groundwater wells do not indicate breakthrough has occurred.

The thickness and extent of elevated areas of gamma radiation are shown in Figure A1-8. Some lateral migration occurred around the cribs. Evidence for lateral migration is indicated by 1958 gross gamma logs. In the 1958 logs, most of the perimeter wells, E13-7 through E13-19, record elevated gamma activity. The extent of lateral migration cannot be ascertained as the monitoring wells are placed immediately adjacent to the waste management units. The elevated gamma activity has declined to background levels in all of the wells except E13-7.

A-1.4.4 216-B-35 through -42 Waste Management Units

Waste Description: First cycle supernatant waste from the 221-B Building. 216-B-37 also received first cycle bottom supernatant from the 242-B Waste Evaporator.

Service Dates:
216-B-35 Trench: February 1954 to March 1954.
216-B-36 Trench: March 1954 to April 1954.
216-B-37 Trench: August 1954.
216-B-38 Trench: July 1954 to 1954.
216-B-39 Trench: December 1953 to November 1954.
216-B-40 Trench: April 1954 to July 1954.
216-B-41 Trench: November 1954.
216-B-42 Trench: January 1955 to February 1955.

Waste Volume:
216-B-35 Trench: 1,060,000 L (280,000 gal).
216-B-36 Trench: 1,940,000 L (513,000 gal).
216-B-37 Trench: 4,320,000 L (1,141,000 gal).
216-B-38 Trench: 1,430,000 L (378,000 gal).
216-B-39 Trench: 1,540,000 L (407,000 gal).
216-B-40 Trench: 1,640,000 L (433,000 gal).
216-B-41 Trench: 1,440,000 L (380,000 gal).
216-B-42 Trench: 1,500,000 L (396,000 gal).

Evaluation of Scintillation Probe Profiles:

The 216-B-35 through -42 Trenches are located within the 200-BP-3 Operable Unit, in the northwest portion of the 200 East Area. The 216-B-35 Trench is monitored by Well E33-286, the 216-B-36 Trench by Well E33-21, the 216-B-37 Trench by Wells E33-287 and -288, the 216-B-38 Trench by Wells E33-289 and -290, and the 216-B-42 Trench by Well E33-8. The 216-B-39, -40 and -42 Trenches have no monitoring wells in their immediate vicinity. Wells E33-10, -28, -29 and -32 lie on the perimeter of the 216-B-35 through -42 waste management unit area. These outlying wells were used to define the lateral extent of radionuclides originating from these trenches. All of the monitoring wells in this area are occasionally logged by PNL. Details of the monitoring wells and the scintillation probe profiles used in this evaluation are given in Table A1-5.

Fecht et al. (1977) evaluated the scintillation probe profiles from Wells E33-8 and -21, which monitor the 216-B-41 and -36 Trenches respectively. They concluded that the interval of elevated gamma radiation, found between 7.1 and 18.9 m (23 and 62 ft) in Well E33-8 and between the surface and 16.8 m (55 ft) in Well E33-21, was not migrating and that activity levels were declining over time. Activity below 16.8 m (55 ft) in Well E33-21 was reported to be minor and had reached background by 1976.

The evaluation in this report is consistent with that of Fecht et al. (1977) except for the interpretation of the activity detected in Well E33-21. The significant gamma activity reaches 70 ft (21.3 m) rather than 16.8 m (55 ft) as reported by Fecht et al. (1977). Also, Fecht et al. (1977) made no mention of the development of a peak below the water table, at a depth of 82.3 to 85.4 m (270 to 280 ft), between 1970 and 1976.

The scintillation probe profiles from the wells monitoring the 216-B-35 through -42 Trenches were compiled into 2 cross sections and correlated with the stratigraphy for the area (Lindsey et al. 1992; Last et al. 1989) (Figure A1-9). The correlation between the scintillation probe profiles and the lithology is good because complete stratigraphic information is available for many of the wells in this area. Well construction data is also available for Wells E33-29 and -32 (Figure A1-9). There is a clear correlation between the scintillation probe profiles and the various lengths of telescoping casing used in the construction of these wells.

High levels of gamma radiation are detected within the top of the Hanford upper coarse and a gravelly interval at the top of the Hanford sand. The thickness and lateral extent of the elevated activity are shown in Figure A1-10. The top of the elevated activity is found at the surface in Wells E33-21, -288 and -289 and at a depth of 8.5 m (28 ft) in Well E33-8. The bottom of this interval is found between 13.1 and 21.3 m (43 and 70 ft) in Wells E33-10 and E33-21, respectively.

The vertical and lateral extent of gamma emitters in the vadose zone is poorly constrained due to a lack of adequate well control. Although Wells E33-286, -287, -288, -289 and -290 are well placed to define the vertical extent of gamma emitters, they do not penetrate the interval of elevated gamma radiation (Figure A1-9). The lateral extent of the region of elevated gamma radiation is well constrained to the east and to the southeast. However, no wells have been placed in optimal locations to constrain the northerly or southerly extent of radionuclides which originated from the 216-B-35 through -42 Trenches (Figure A1-10).

There appears to be an interval of slightly elevated gamma radiation extending from the top of the Hanford sand to a clayey layer found at its base in Well E33-21 (Figure A1-9). This interval is interpreted to be spurious, due perhaps to the calibration of the scintillation probe, conditions within the well itself or to local lithologic conditions. The apparent activity on this interval declines with depth to background levels between 42.7 and 64 m (140 and 210 ft). The character of the scintillation probe profiles from Well E33-8 mimics this behavior, although the activity detected is consistent with background levels. Additionally, the activity detected within the Hanford sand in Well E33-21 is exaggerated by the log scale used to represent the scintillation probe profiles.

There is no evidence of vertical or lateral migration of radionuclides in the vadose zone in the area of the 216-B-35 through -42 Trenches. The temporal control upon which this conclusion is based is only fair. Wells E33-8, -10, and -21 were emplaced in they 1950's, so many vintages of scintillation probe profiles are available for comparison. The most recent profiles for these wells were collected in 1976. More recent logs are available for the remaining wells in this area, but these wells were emplaced in the 1980's or in 1990, so fewer vintages of logs are available for comparison.

Elevated levels of gamma radiation is detected in the groundwater beneath the 216-B-35 through -42 Trenches and appears to represent gamma emitters moving along the top of the basalt in a southerly direction. In Well E33-8, the northernmost well in this area, gamma levels below the water table declined to near background between 1970 and 1976 while those detected in Wells E33-10 and -21, located in the southerly part of this area, increased in this span of time (Figure A1-9). The more recent profiles available from Wells E33-28, -29, and -32 are consistent with the temporal changes in the logs from E33-8, -10, and -21. Low levels of gamma radiation were detected below the water table in Well E33-29, located in the southern part of this area, in 1987 while background levels were detected in Wells E33-28 and 32, located in the central part of this area, in 1987 and 1989, respectively (Figure A1-9). The distribution in time and space of the elevated gamma radiation detected in the groundwater beneath the 216-B-35 through -42 area suggests that the source of gamma emitters is located to the north or northeast, possibly in the BY Crib area or in the 241-BY Tank Farm (Figure A1-10).

A-1.4.5 216-B-7, -8, -11, and -51 Waste Management Units

Waste Description:

216-B-7A and -7B Cribs: Liquid mixed wastes including cell drainage and decontamination waste from building 221-B, liquid waste directly from building 224-B and through over flow from the 201-B Settling Tank.
216-B-8 Crib and Tile Field: Liquid mixed wastes including second cycle supernatant and cell drainage from building 221-B and decontamination waste from building 224-B. Inadvertent discharge of sludge to crib from tank 241-B-104.
216-B-11A and -11B Reverse Wells: Liquid mixed wastes including low salt neutral to basic process condensate from the 242-B Evaporator.
216-B-51 French Drain: Liquid mixed waste including flush drainage from a pipeline which carried high salt, neutral to basic scavenged tributyl phosphate waste from building 221-U to the BC Cribs.

Service Dates:

216-B-7A and -7B Cribs: October 1946 to May 1967.
216-B-8 Crib and Tile Field: April 1948 to July 1953.
216-B-11A and -11B Reverse Wells: December 1951 to December 1954.
216-B-51 French Drain: January 1956 to January 1958.

Waste Volume:

216-B-7A and -7B Cribs: 43,600,000 L (11,500,000 gal).
216-B-8 Crib and Tile Field: 27,200,000 L (7,200,000 gal).
216-B-11A and -11B Reverse Wells: 29,600,000 L (7,700,000 gal).
216-B-51 French Drain: 1,000 L (300 gal).

Evaluation of Scintillation Probe Profiles:

The inactive 216-B-7, -8, -11 and -51 waste management units are located within the 200-BP-4 Operable Unit. The B and BY Tank Farms border this Operable Unit on the south and west respectively. The 216-B-7A and -7B Cribs are monitored by Wells E33-18, -58, -59, -72 and -75. The 216-B-8 Crib is monitored by Wells E33-16, -66, -67, -68, -69, -70, -71 and -89. The 216-B-8 Tile Field is monitored by Wells E33-15, -73, -64 and -76. The 216-B-11A and -11B Reverse Wells are monitored by Wells E33-20 and -91 respectively. The 216-B-51 French Drain is monitored by Wells E33-11 and -39. Wells located on the boundary of the area containing these waste management units are E33-12, -14, -61 and -84. All of these wells are occasionally logged by PNL. Details of these wells and the logs used in this evaluation are given in Table A1-6.

Scintillation probe profiles from the wells monitoring the 216-B-7, -8, -11 and -51 waste management units were reviewed by Fecht et al. (1977). They concluded that no measurable migration of radionuclides had occurred in the unsaturated zone beneath these waste management units and radionuclides had not reached the groundwater. No mention was made of elevated radiation levels in the groundwater. The conclusions of the current evaluation in regards to the gamma activity detected in the unsaturated zone do not differ significantly from those of Fecht et al. (1977). Chamness (1986) reported that two wells near the 216-B-8 Crib could not be logged due to safety concerns about the crib's wooden structure; this may account for the lack of recent scintillation probe profiles from most of the wells in the area.

Scintillation probe profiles from 16 of the 26 wells located in the vicinity of the 216-B-7, -8, -11 and -51 waste management units were compiled into three cross sections (Figures A1-11, A1-12 and A1-13). These cross sections were correlated with the lithologic column available for Well E33-19 and the regional mapping of Lindsey et al. (1992). The correlation between the lithology and features on the scintillation probe profiles was poor due to low contrast in the natural gamma radiation signatures of the lithologies present. This reflects the uniform character of the lithologic facies in the Hanford formation.

Elevated levels of gamma radiation is detected in the unsaturated zone beneath the 216-B-8 Crib and Tile Field and beneath the 216-B-7A and -7B Cribs and the 216-B-11A and -11B Reverse Wells. The thickness the interval of elevated activity in these two areas was mapped and the extent of the gamma emitters estimated (Figure A1-14). The interval of elevated gamma activity under the 216-B-8 Crib is between 3 and 40 m (10 and 130 ft) below the surface. Elevated activity is detected between 3 and 15 m (10 and 50 ft) beneath the 216-B-8 Tile Field (Figure A1-12). The interval of elevated radiation under the 216-B-7A and -7B Cribs and the 216-B-11A and -11B Reverse Wells is between 5 and 30 m (15 and 100 ft) below the surface (Figures A1-12 and A1-13).

A "leaky" geologic barrier of some sort is postulated to exist in the subsurface beneath the 216-B-8 Crib and Tile Field. Scintillation probe profiles from wells located next to the 216-B-8 Crib have a blocky character while those removed a short distance from the crib have a distinctly digitate character (Figure A1-12). This suggests that a "leaky" geologic barrier is present within the Hanford sand, between 15 and 20 m (50 and 70 ft) below the surface. While the 216-B-8 Crib was active, this barrier impeded the downward movement of gamma emitters, causing them to move laterally. The available lithologic information is inadequate to verify this hypothesis.

Elevated gamma activity is only detected under the southwestern end of the tile field, closest to the 216-B-8 Crib. This activity is only found to a depth of 15 m (50 ft), corresponding to the uppermost "digit" found in the profiles from wells offset from the 216-B-08 Crib itself (Figure A1-12). This supports the existence of the postulated "leaky" geologic barrier within the Hanford sand.

Although the scintillation probe profiles from the wells monitoring the 216-B-7 and -11 waste management units do not have digitate character (Figures A1-12 and A1-13), the relationships between the profiles suggests that the distribution gamma emitters from these waste management units was controlled by similar subsurface conditions as those found under the 216-B-8 Crib and Tile Field. Elevated gamma radiation is found between 6 and 15 m (20 and 50 ft) on the western side of the B-7 Cribs, in Wells E33-59 and -75 (Figure A1-13). This corresponds to the upper "digit" found in scintillation probe profiles from wells removed from the 216-B-8 Crib. Under the 216-B-11A and -11B Reverse Wells, elevated radiation is found on a thin interval between 23 and 30 m (75 and 100 ft) below the surface. This correlates with an interval of silty material found in Well E33-19 (Lindsey et al. 1992). The disposal depth of these wells was 12 m (40 ft), which may have penetrated the postulated geological barrier and allowed gamma emitters to reach this deeper silty layer.

It appears that gamma emitters from the B-7 Cribs have moved laterally under the 216-B-11 Reverse Wells and commingled with any radionuclides from those waste management units. Evidence for this includes the correlation between the depth to which radionuclides reached in the vicinity of Well E33-58 and the depth of the radionuclides detected under the 216-B-11 Reverse Wells. The apparent dip of the base of the elevated radiation in this area also supports the proposed lateral migration of gamma emitters from the 216-B-7 Cribs.

There is no evidence that the radionuclides residing in the unsaturated zone beneath the 216-B-7, -8 and -11 waste management units are migrating vertically or laterally. However, there are very few current scintillation probe profiles available from the wells monitoring these structures. Without adequate temporal control, the potential for migration of gamma emitters in the subsurface cannot be properly evaluated.

Although elevated gamma radiation is detected below the water table in the area of the 216-B-7, -8, -11 and -51 waste management units, there is no evidence that radionuclides placed in these structures ever reached the water table. The top of the elevated gamma activity below the water table is flat in this area and lends no clue of the source of gamma emitters or the direction of groundwater flow. The elevation of the top of the elevated radiation is about 123 m (410 ft), which is above the elevation of the current water table (Last et al. 1989). The scintillation probe profile from Well E33-39, which was emplaced in 1991, indicates that only background levels of gamma radiation are found in the groundwater. Without current logs from the other wells in the area, it is not possible to determine if the elevated gamma activity detected in 1976 was due to gamma emitters in the groundwater or to gamma emitters adhering to rust in the well screen (Smith 1980).

A-1.4.6 216-B-5 and 241-B-361 Waste Management Units

Description of Waste: Low salt, alkaline mixed waste from Cell 5-6W in the 221-B Building and other unspecified wastes from the 221-B Building.

Service Dates: April 1945 to October 1947.

Waste Volume: 30,600,000 L (8,100,000 gal).

Evaluation of Scintillation Probe Profiles:

The 216-B-5 Reverse Well and the 241-B-361 Settling Tank are located in Operable Unit 200-BP-5, northwest of the 221-B Building. The monitoring wells located within the area of these waste management units are E28-1, 28-7, E28-23, E28-24, E28-25, E28-73 and E28-74. Wells E28-1, E28-7, E28-24, E28-73 and E28-74 have been logged by PNL. Wells E28-23 and E28-25 have not been logged. Details of the monitoring well in this area are given in Table A1-7.

Waste management units 216-B-5 and 241-B-361 have been studied by Smith (1980) and Fecht et al. (1977). Significant levels of gamma activity above and below the water table were reported in both studies. Based on scintillation probe profiles and radionuclide analyses of soil and water samples, Smith (1980) reported elevated levels of radionuclides on an interval consistent with the perforated interval of the 216-B-5 Reverse Well. Elevated radionuclide content in the groundwater was found to extend 600 m (2,000 ft) laterally from the 216-B-5 Reverse Well. The source of radionuclides in the ground water was attributed to the 216-B-5 Reverse Wells and to the BY Cribs (waste management units 216-B-43 through -50), which are northeast of this area. No evidence of leakage of radionuclides from the 241-B-361 Settling Tank was found. Based upon the scintillation probe profiles from Well E28-1, Fecht et al. (1977) also determined that elevated gamma radiation below the water table extended 600 m (2,000 ft) from the 216-B-5 Reverse Well. The results of this evaluation do not conflict with the findings of these previous studies.

Scintillation probe profiles from wells located near the 216-B-5 and 241-B-361 waste management units were compiled into two cross sections and correlated with the lithologic section presented by Smith (1980) and the regional mapping of Lindsey et al. (1992) (Figure A1-15). The lithologic section from Smith (1980) was modified to include the lithologic units mapped by Lindsey et al. (1992). The features on the scintillation probe profiles correlated well with the stratigraphy of Smith (1980) and Lindsey et al. (1992).

Elevated levels of gamma radiation is detected above and below the water table, within the Hanford lower coarse and the Ringold A (Figure A1-15). The source of the gamma emitters detected in the unsaturated Hanford lower coarse is attributed to waste disposal activities in the 216-B-5 Reverse Well (Smith 1980). The lateral extent of the gamma emitters detected above the water table cannot be adequately characterized with the available scintillation probe profiles. Elevated gamma radiation levels within the unsaturated Hanford lower coarse are only detected in Well E25-24, located 6 m (20 ft) southeast of the 216-B-5 Reverse Well. Based on soil samples from Wells E25-23 and 25, radionuclides in the Hanford lower coarse are at found least 6 m (20 ft) to the northwest of the 216-B-5 Reverse Well (Smith 1980). The distribution of the radionuclides above the water table are likely to be controlled by the dip of the layering in the Hanford lower coarse. The top of this unit dips to the south-southwest and the top of the Ringold A dips to the south beneath the 216-B-5 and 241-B-361 waste management units (Lindsey et al. 1992). Wells E25-73 and 74 are located down dip, 23 and 31 m (77 and 101 ft) south-southwest respectively, of the 216-B-5 Reverse Well. However, they are not logged to this depth and cannot lend any clues as to the lateral distribution of radionuclides in the unsaturated lower coarse from the reverse well.

Elevated gamma activity is detected below the water table, near the top of the basalt in Wells E25-1, 7 and 24 in the area of the 216-B-5 and B-361 waste management units. There have been no significant changes in the character of the scintillation probe profiles from these wells over time. The radionuclides detected in the groundwater has been attributed to waste disposal activities in the B-5 Reverse Wells. Since the 216-B-5 Reverse Well reaches the water table, it is certain that radionuclides were discharged into the groundwater. Smith (1980) proposed that the BY cribs, located about 900 m (3,000 ft) northwest of this area, were also a source of gamma emitters in the groundwater. This hypothesis was based upon water chemistry data (Smith 1980) and cannot be verified using gross gamma radiation measurements alone.

There is some evidence that gamma emitters may reside near the top of the Hanford sand in the area of the 216-B-5 and 216-B-361 waste management units. Slightly elevated readings are found on this interval in Well E25-24 (Figure A1-15). In Wells E25-73 and

-74, near the 241-B-361 Settling Tank, slightly elevated levels may also be present near the top of the Hanford sand (Figure A1-15). Given the proximity of these wells to the tank itself, it is unclear if the elevated levels are due to the contents of the tank, to gamma emitters in the soil or to the attenuation of the natural gamma radiation by the near surface construction of the wells.

A-1.4.7 216-B-9, 241-BX-155 and -302C Waste Management Units

Waste Description:

216-B-9 Crib and Tile Field: Cell drainage and Tank 5-6 liquid waste from the 221-B Building.

241-BX-155 Diversion Box and 241-BX-302C Catch Tank: Transferred various types of waste solutions from processing and decontamination operations.

Services Dates:

216-B-9 Crib and Tile Field: August 1948 to July 1951.
241-BX-155 Diversion Box: 1948 to 1984.
241-BX-302C Catch Tank: 1948 to 1985.

Waste Volume:

216-B-8 Crib and Tile Field: 36,000,000 L (9,500,000 gal).
241-BX-302C Catch Tank: 0 L (0 gal).

Evaluation of Scintillation Probe Profiles:

The 216-B-9 Crib and Tile Field is located in the northwest area of Operable Unit 200-BP-5. The 241-BX-155 Diversion Box and the 241-BX-302C Catch Tank are located in the northeast corner of the 200-BP-6 Operable Unit about 260 m (750 ft) northwest of the 216-B-9 Crib and Tile Field. The 216-B-9 Crib and Tile Field is monitored by Wells E28-53, E28-54, E28-55, E28-56, E28-57, E28-58, E28-59, E28-60 and E28-61. Well E28-5 is located 200 m (600 ft) east of 216-B-9, and Well E28-2 is located about 120 m (350 ft) northwest of 216-B-9 and 120 m (350 ft) southeast of 241-BX-155 and 241-BX-302C. Details of these wells are given in Table A1-8.

The 216-B-9 Crib and Tile Field has previously been evaluated by Fecht et al. (1977). They concluded that measurable migration of radionuclides beneath the 216-B-9 Crib and Tile Field had not occurred since 1963 and that breakthrough to the groundwater was not indicated. This present evaluation is consistent with Fecht et al. (1977). It should be noted that no newer well logs are available for the wells in the zone of elevated gamma activity.

Scintillation probe profiles from Wells E28-53, E28-54, E28-57 and E28-59 were compiled into a cross section and correlated with the regional mapping of Lindsey et al. (1992) (Figure A1-16). Elevated gamma radiation is present in the 1976 well logs for Wells E28-53, E28-54, E28-55, E28-57 and E28-61. These well logs indicate that radionuclides are present from a depth of 4 to 13 m (12 to 42 ft) beneath the crib area and beneath the secondary tile field lateral immediately south of the E28-57 Well in the tile field. The thickness and lateral extent of the elevated gamma readings is illustrated in Figure A1-16. Lateral migration of radionuclides is not indicated as Wells E28-59, E28-56, E28-58 and E28-60 do not have elevated gamma readings. Vertical migration of gamma emitters has not occurred since 1963 and breakthrough to groundwater is not indicated.

The presence of elevated gamma radiation in the vadose zone around 241-BX-155 and 241-BX-302C cannot be evaluated because the closest monitoring well, E28-2, is 120 m (350 ft) away to the southeast. Well E28-2 does not have elevated gamma readings within the vadose zone. Elevated gamma radiation occurs in the groundwater, in Wells E28-2 and E28-5. The source of groundwater contamination may be from the 216-B-5 Reverse Well, located 200 m (600 ft) south of Well E28-2 and 300 m (900 ft) southwest of Well E28-5.

A-1.4.8 216-B-56, -59, 241-B-154, and -302B Waste Management Units

Waste Descriptions:

216-B-56 and -59 Cribs: These cribs have never been used.
241-B-154 Diversion Box and -302B Catch Tank: Various types of waste solutions from processing and decontamination operations to disposal sites.

Service Dates:

216-B-56 and 59 Cribs: Never used.
216-B-154 Diversion Box: 1945 to 1984.
241-B-302B Catch Tank: 1945 to 1985.

Waste Volume: N/A

Evaluation of Scintillation Probe Profiles:

The 216-B-56 and 59 Cribs, the 241-B-154 Diversion Box and the 241-B-302B Catch Tank are located along the western side of the 200-BP-5 Operable Unit. Well E28-14 monitors 216-B-56. Wells E28-6, E28-4, and E28-3 are located in the vicinity of these waste management units. Details of the wells are given in Table A1-9.

The 216-B-56 Crib has previously been evaluated by Fecht et al. (1977). They detected only background radiation around the crib and noted that the crib had never been used. The findings of this present evaluation do not conflict with this previous study.

The 1979 and 1987 logs for Well E28-14 are correlated with a lithologic column constructed from the geology of Lindsey et al. (1992) in Figure A1-18. All the wells used in this evaluation have gamma activity at background levels in the vadose zone. Well E28-14, which reaches the groundwater, has elevated gamma activity approximately 10 m (30 ft) below the water table. This elevated activity first appeared in the 1976 log. The source of these elevated gamma readings may be the 216-B-5 Reverse Well, which is located 220 m (600 ft) northwest of Well E28-14.

The data available for this evaluation indicates that breakthrough to the groundwater has not occurred from these waste management units.

A-1.4.9 216-B-6, -10A, and -10B Waste Management Units

Waste Description:
216-B-6 Reverse Well: Acidic liquid mixed waste including decontamination sink waste and sample waste from building 222-B.
216-B-10A and -10B Cribs: Acidic liquid mixed wastes including decontamination sink and shower waste, and sample slurper waste from building 222-B, floor drainage from building 292-B.

Service Dates:
216-B-6 Reverse Well: April 1945 to December 1945.
216-B-10A Crib: December 1949 to January 1952.
216-B-10B Crib: June 1969 to October 1973.

Waste Volume:
216-B-6 Reverse Well: 6,000,000 L (1,600,000 gal).
216-B-10A Crib: 9,990,000 L (2,600,000 gal).
216-B-10B Crib: 28,000 L (7,400 gal).

Evaluation of Scintillation Probe Profiles:

The 216-B-6, -10A and -10B waste management units are located south of building 222-B, within the 200-BP-6 Operable Unit. These waste management units are monitored by Well E28-17, which is occasionally logged by PNL. The location of this Well relative to the B-6 and -10 waste management units is shown in Figure A1-19. No scintillation probe profiles were available from any other wells in the area.

Fecht et al. (1977) reviewed the scintillation probe profiles from Well E28-17 and concluded that gamma emitters from the 216-B-10A and -10B Cribs and concluded that radionuclides had not reached the groundwater in this area. Fecht et al. based their conclusions on the volume and composition of wastes disposed of in the 216-B-10 Cribs since elevated gamma radiation was never detected in the E28-17 Well. The conclusions of this report do not differ from those of Fecht et al. (1977).

The scintillation probe profiles for Well E28-17 were compiled and correlated with the lithologic column for that well (Lindsey et al. 1992). The regional mapping of the tops of the lithologic units present in this area indicates that this well is up dip from the 216-B-6 and -10 waste management units. This suggests that the well is not optimally placed to detect gamma emitters from these units.

Since no elevated gamma activity has ever been detected in Well E28-17, there is no evidence that radionuclides from the 216-B-6 and -10 waste management units are migrating in the vadose zone or have reached the water table. However, this is inconclusive because the well is probably not optimally placed to detect gamma emitters from the 216-B-6 and -10 waste management units.

A-1.4.10 216-B-2-1, -2-2, -2-3, and -63 Waste Management Units

Waste Description: Mixed waste. A complete waste description is in Section 2.3.5.

Service Dates:

216-B-2-1 Ditch: April 1945 to November 1963.
216-B-2-2 Ditch: November 1963 to May 1970.
216-B-2-2 Ditch: 1970 to 1987.
216-B-63 Ditch: 1970 to present; active.

Waste Volume:

216-B-2-1 Ditch: 149,000,000,000 L (39,300,000,000 gal).
216-B-2-2 Ditch: 49,700 L (13,100 gal).
216-B-2-3 Ditch: Not reported.
216-B-63 Ditch: 7,220,000,000 L (1,910,000,000 gal).

Evaluation of Scintillation Probe Profiles:

The 216-B-2-1, -2-2, -2-3 and -63 Ditches are located in the 200-BP-8 Operable Unit. Gross gamma logs are available from eight wells located in the vicinity of the ditches. Details of Monitoring Wells E33-33, E33-36, E33-37, E27-16, E27-11, E27-8, E27-9 and E34-8 are provided in Table A1-10.

No elevated gamma readings were recorded in any of the wells monitoring the ditches. Scintillation probe profiles from Wells E33-37, E27-11 and E27-9 were compiled into a cross section and correlated with the regional mapping of Lindsey et al. (1992). (Figure A1-20). The wells appear to be well located for monitoring the ditches, but no elevated gamma activity has been recorded in the well logs despite unplanned releases into the ditches. The data available indicate that breakthrough to the groundwater has not occurred at this site.

A-1.4.11 216-B-12, -55, and -64 Waste Management Units

Waste Description:
216-B-12 Crib: Low-salt, neutral/basic mixed waste consisting of process condensate from evaporators in buildings 221-U, 224-U and 221-B, and construction wastes from building 221-B.
216-B-55 Crib: Low level liquid wastes (steam condensate) from building 221-B.
216-B-64 Retention Basin: Never used.

Service Dates:
216-B-12 Crib: November 1952 to December 1957; May 1967 to November 1973.
216-B-55 Crib: September 1967 to Present.
216-B-64 Retention Basin: Never Used.

Waste Volume:
216-B-12 Crib: 520,000,000 L (137,000,000 gal).
216-B-55 Crib: 1,230,000,000 L (325,000,000 gal).
216-B-64 Retention Basin: 0 L.

Evaluation of Scintillation Probe Profiles:

The 216-B-12, -55 and -64 waste management units are all located on the eastern side of the 200-BP-9 Operable Unit, between 300 and 600 m (1,000 and 2,000 ft) west of Building 221-B. The 216-B-55 Crib is currently active and the 216-B-64 Retention Basin has never been used. Wells E28-9, -16, -64, -65, -66 and -76 monitor the inactive 216-B-12 Crib. Wells E28-12 and -13 monitor the 216-B-55 Crib. No wells are in place to monitor the 216-B-64 Retention Basin. All of the monitoring wells in the area have been occasionally logged by PNL. Well E28-12 (02-55-04) is also logged semi-annually by TFSA&S. Details of these monitoring wells and the scintillation probe profiles used in this evaluation are given in Table A1-11.

The scintillation probe profiles from the wells monitoring the 216-B-12 and -55 Cribs were reviewed by Fecht et al. (1977). Elevated levels of activity were detected from the base of the 216-B-12 Crib to an unknown depth. Only background levels of radiation were detected beneath the 216-B-55 Crib. No evidence of radionuclides reaching the groundwater was found in the area. The conclusions of this evaluation do not differ substantially from those of Fecht et al. (1977).

Scintillation probe profiles from most of the wells in the area of the 216-B-12, -55 and -64 waste management units were compiled into two cross sections and correlated with the lithologic column from Well E28-17 (Figure A1-21) (Lindsey et al. 1992). Well E28-17 is located about 300 m (1,000 ft) southeast of this area. Although the features on the scintillation probe profiles due to changes in lithology are very subtle in this area, the consistent character of the profiles and the background conditions detected in most of the wells make the correlation between the logs and the lithology fair to good.

Elevated gamma radiation is detected beneath the 216-B-12 Crib from the bottom of the crib to an unknown depth. The four wells in the immediate vicinity of this crib (E28-64, -65, -66 and -76) do not penetrate the interval of elevated radiation (Figure A1-21). The top of the elevated gamma radiation correlates closely with the top of the Hanford sand, suggesting that this lithologic boundary may control the distribution of radionuclides in the subsurface. The elevated radiation is shallowest near the southern end of the crib, and is deeper to the north. This is consistent with the northerly dip of the top of the Hanford sand (Lindsey et al. 1992). Scintillation probe profiles from Well E28-16 suggest that gamma emitters placed in the B-12 Crib may reach a depth of about 37 m (120 ft). An interval of elevated gamma radiation was detected between 28 and 37 m (90 and 120 ft) in 1976 (Fecht et al. 1977). This well is located about 24 m (80 ft) south of the B-12 Crib, up the regional dip of the top of the Hanford sand.

Background levels of gamma radiation are detected in the two wells which monitor the active 216-B-55 Crib. This is inconsistent with the history of waste disposal for this crib.

Wells E28-12 and -13 are both located up dip from the 216-B-55 Crib (Lindsey et al. 1992). These wells are probably not optimally located to detect radionuclides from the crib in the vadose zone.

It is possible that the interval of elevated gamma activity detected in Well E28-16, attributed to radionuclides from the 216-B-12 Crib, is due to lateral migration of radionuclides from the 216-B-55 Crib. Evidence in favor of this hypothesis includes the down dip location of the E28-16 Well from the 216-B-55 Crib and the absence of elevated radiation in the E28-9 Well, located 30 m (100 ft) west of the 216-B-12 Crib, suggests that there may be another source of radionuclides in the area of the E28-16 Well. Evidence against this hypothesis includes the apparent lack of a lithologic boundary within the Hanford sand which would facilitate the lateral migration of radionuclides over the 70 m (225 ft) between the B-55 Crib and the E28-16 Well.

There is no evidence that gamma emitters from the 216-B-12 and -55 Cribs have reached the groundwater. Background levels of gamma radiation are detected in all of the wells reaching the groundwater in this area. These wells are well placed to detect any changes in the conditions within the groundwater due to disposal activities in the 216-B-12 and B-55 Cribs.

A-1.4.12 216-B-62 Waste Management Unit

Waste Description: Low level process condensate from B-221 Building.

Service Dates: 11/73 to Present.

Waste Volume: 282,000,000 L (74,500,000 gal).

Evaluation of Scintillation Probe Profiles:

The active 216-B-62 Crib is located within the 200-BP-9 Operable Unit, 460 m (1,500 ft) northwest of Building 221-B. This crib is monitored by Wells E28-18, -20, -21 and -75. All of these wells are logged occasionally by PNL. Wells E28-20 and -75 are also logged semi-annually by TFSA&S. Details of the wells monitoring the B-62 Crib and the logs used in this evaluation are given in Table A1-12.

The subsurface distribution of radionuclides from the 216-B-62 Crib and their potential for migration were evaluated by Fecht et al. (1977). They found that radionuclides from the crib were confined to an interval in the near surface and had not reached the water table. This current evaluation does not differ from the findings of Fecht et al. (1977).

Scintillation probe profiles from the four wells which monitor the 216-B-62 waste management unit were compiled into a cross section and correlated with the lithologic column available for Well E28-18 (Lindsey et al. 1992) (Figure A1-22). The correlation between features on the scintillation profiles and lithologic boundaries can be considered fair to poor since the expression of lithologic changes is very subtle on profiles from wells in this area.

The gamma emitting radionuclides disposed of in the 216-B-62 Crib appear to reside near its southeastern end. The top of the interval where elevated levels of gamma radiation are detected is found at a depth of about 10 m (34 ft). This corresponds to the top of the Hanford sand in the area of the B-62 Crib. The interval of elevated radiation is about 24 m (80 ft) thick. There is no evidence of gamma emitters moving downwards over time or of gamma emitters in the groundwater.

The data are inadequate to define the lateral extent and potential for lateral migration of radionuclides from the 216-B-62 Crib. It is likely that the lateral distribution of gamma emitters is controlled by the northward dip of the top of the Hanford sand in this area (Lindsey et al. 1992). This is supported by the correlation between the top of the interval of elevated radiation and the Hanford sand. However, the elevated radiation detected in Well E28-18, located south of the crib, conflicts with this hypothesis. One possible explanation is that there may be some local features in the top of the Hanford sand which are not shown by the regional mapping of Lindsey et al. (1992). Another possibility is that the distribution of radionuclides is not controlled by the lithology at all.

A-1.4.13 218-E-2, -2A, -4, -5, -5A, -9, and -10 Waste Management Units

Description of Waste: Solid mixed wastes including failed equipment and industrial waste.

Service Dates:

218-E-2 Burial Ground: 1945 to 1953.
218-E-2A Burial Ground: 1945 to 1955.
218-E-4 Burial Ground: 1955 to 1956.
218-E-5 Burial Ground: 1954 to 1956.
218-E-5A Burial Ground: 1956 to 1959.
218-E-9 Burial Ground: 1953 to 1958.
218-E-10 Burial Ground: 1960 to Present.

Waste Volume:

218-E-2 Burial Ground: 9,033 m^3 (11,833 yd^3).
218-E-2A Burial Ground: 0 m^3.
218-E-4 Burial Ground: 1,586 m^3 (2,078 yd^3).
218-E-5 Burial Ground: 3,172 m^3 (4,155 yd^3).
218-E-5A Burial Ground: 6,173 m^3 (8,087 yd^3).
218-E-9 Burial Ground: 0 m^3.
218-E-10 Burial Ground: 19,100 m3 (25,000 yd3) as of 1/88.

Evaluation of Scintillation Probe Profiles:

The 218-E-2, -2A, -4, -5, -5A, -9 and -10 Burial Grounds are located within Operable Unit 200-BP-10, immediately south and west of the 241-BX and 241-BY Tank Farms. Monitoring Wells E28-2, -8, -26, -27, -28, E32-1, -2, -3, -4, -5, E33-28, -29, -30, -34 and -35 are located on the edges of these waste management units. Few vintages of logs were available from most of these wells either because they were drilled recently or because logs could not be located. Details of the monitoring wells in the area and the available scintillation probe profiles are given in Table A1-13.

The 218-E-10 Burial Ground was studied in an interim hydrogeologic report by Last et al. (1989). The history of waste disposal activities in this waste management unit and the hydrogeology of the area were discussed in that report. Data used in the report by Last et al. included boring logs, scintillation probe profiles and other geophysical logs. No discussion of radionuclides in the vadose zone was given.

Scintillation probe profiles from most of the wells in this area were compiled into three cross sections and correlated with the stratigraphic information from Last et al. (1989) and Lindsey et al. (1992) (Figure A1-23). The correlation between the lithology and features on the gamma logs was poor because there is very little difference in the gamma response of the lithologic units encountered. The most pronounced features on the scintillation profiles are due to the telescoping casing strings used in many of the wells in this area.

There is no evidence of elevated gamma activity beneath the 218-E-2, -2A, -4, -5, -5A, -9 and -10 Burial Grounds. This is consistent with the solid nature of the wastes disposed of in these waste management units. However, the current monitoring program in place in this area is mainly concerned with radionuclides in the groundwater (Last et al. 1989). No monitoring wells have been located within the individual burial grounds, where gamma emitters residing within the vadose zone might be more easily detected. Also, the telescoping casing used in many of the wells monitoring these waste management units (Figure A1-23) may attenuate the gamma activity in the near surface by as much as 99% where the greatest number casing strings are used (4 casing strings attenuating the signal by

33% each). Two casing strings are typically used to a depth of about 60 m (200 ft) in these wells. This will attenuate the gamma activity by about 90%. The attenuation of the measured gamma activity by the multiple strings of well casing may make it impossible to detect low concentrations of radionuclides within the vadose zone with the parameters currently used in the logging program.

A-1.4.14 216-B-3, -3A, -3B, -3C, -3-1, -3-2, -3-3, and 216-E-28 Waste Management Units

Waste Description: Mixed waste. A complete waste description is in Section 2.3.5.

Service Dates:

216-B-3 Pond: 1945 to Present; Active.
216-B-3A Pond: 1983 to Present; Active.
216-B-3B Pond: 1984 to Present; Active.
216-B-3C Pond: 1985 to Present; Active.
216-B-3-1 Ditch: 1945 to 1964.
216-B-3-2 Ditch: 1963 to 1970.
216-B-3-3- Ditch: 1963 to 1970.
216-E-28 Pond: Unknown.

Waste Volume:

216-B-3 Pond: 240,000,000,000 : (63,000,000,000 gal).
216-B-3A through -3C Ponds: Not reported.
216-B-3-1 Ditch: 149,000,000,000 L (39,300,000,000 gal).
216-B-3-2 Ditch: 149,000,000,000 L (39,300,000,000 gal).
216-B-3-3 Ditch: Not reported.
216-E-28 Pond: Unknown.

Evaluation of Scintillation Probe Profiles:

The 216-B-3 Ponds, 216-B-3-1 through -3 Ditches and the 216-E-25 Pond are located in Operable Unit 200-BP-11. Scintillation probe profiles were obtained for 30 wells located in and around the area of these waste management units. Details of these wells are given in Table A1-14.

With the exception of moderately elevated gamma activity at a depth of 122 m (400 ft) in Well 699-42-42A (DB-8) and 101 m (330 ft) in Well 699-42-40C, no elevated gamma activity is recorded in any of the wells. The monitoring wells are located in such a way as to monitor for lateral migration of radionuclides (Luttrell et al. 1989). The lack of elevated gamma readings indicates that lateral migration of gamma emitters through the vadose zone has not occurred. Scintillation probe profiles from E26-8, 699-43-42J and 699-41-40 were compiled into a cross section and correlated with a composite lithologic column constructed from wells logs from Wells 699-43-42J and 699-41-40 (BP-6) and the geology of Lindsey et al. (1992) (Figure A1-24).

The moderately elevated gamma activity at a depth of 122 m (400 ft) in Well 699-42-42A (DB-8) and at 330 feet in Well 699-42-40C corresponds with the Rattlesnake Ridge interbed between the Elephant Mountain and Pomona Members of the Columbia River Basalt Group. These moderate peaks may represent naturally higher gamma radiation associated with the interbed. Alternatively these elevated readings may represent contamination of the Rattlesnake Ridge confined aquifer.

A-1.4.15 218-E-3 Waste Management Unit

Waste Description: Construction scrap from 202-A Building construction work. In 1971 the burial ground was exhumed and removed from radiation status.

Service Dates:

218-E-3 Burial Ground: 1954.

Waste Volume: N/A.

Evaluation of Scintillation Probe Profiles:

The 216-E-3 Burial Ground is located in the southwest corner of the 200-SS-1 Operable Unit. The scintillation probe profile of Well E19-1, located about 200 m (600 ft) northeast of 216-E-3, was examined. No elevated gamma readings are present in this log.

The E19-1 Well is probably located too far away from the E-3 Burial Ground to monitor the vadose zone beneath burial ground. In addition Well E19-1 is located up dip from the burial ground. However, the E-3 Burial Ground was exhumed and removed from radiation status in 1971.

A-1.4.16 216-A-25 and 216-N-8 Waste Management Units

Waste Description: A complete waste description is in Section 2.3.5.

Service Dates:

216-A-25 Pond: 1957 to 1987.
216-N-8 Pond: 1958 to 1987.

Waste Volume:

216-A-25 Pond: 307,000,000,000 L (81,100,000,000 gal).
216-N-8 Pond: Unknown.

Evaluation of Scintillation Probe Profiles:

The 216-A-25 and 216-N-8 ponds (Gable Mountain and West Ponds) are located in Operable Unit 200-UI-6. Scintillation probe profiles were obtained for Wells 699-50-45, 699-50-48, 52-46A, 52-48, 54-45B, 54-42, 55-44, 56-53, 55-55, and 60-57. Details of the monitoring wells are given in Table A1-15.

No elevated gamma activity is recorded within the vadose zone in these wells. Moderately elevated gamma radiation is recorded in the logs from the southeastern part of Operable Unit 200-UI-6 (Wells 699-50-48, 699-50-45, 699-52-48 and 699-52-46A). The elevated activity is at depths well below the water table and within the Columbia River Basalt Group. The scintillation probe profile of Well 699-50-45B, located 1,050 m (3,500 ft) southeast of the Gable Mountain Pond, is shown in Figure A1-25.

The elevated gamma activity may represent naturally higher gamma radiation associated with an interbed of sediment or paleosoil between basalt layers. Well 600-42-42A (DB-8) in the B Pond area has a similar sized and shaped peak at a depth of 122 m (400 ft) within the Columbia River Basalt Group. Alternatively the elevated activity may represent contamination of one of the upper unconfined aquifers.

A-1.4.17 241-B Tank Farm

The 241-B Tank Farm is located within the 200-BP-7 Operable Unit, east of the 241-BX Tank Farm and south of the 216-B-7 Cribs and 216-B-11 Reverse Wells. The 241-B Tank Farm contains 16 single-shell, carbon steel-lined, concrete reinforced tanks. Twelve of the tanks, 241-B-101 through -112 have individual capacities of 2,017,000 L (533,000 gal). Four tanks, 241-B-201 through 204 have individual capacities of 208,000 L (55,000 gal).

The B-Tanks were constructed in an excavation, about 12 m (39 ft) deep and backfilled with the excavated material. The backfill material consists of poorly sorted cobbles, pebbles, very coarse to medium sands and silt. All of tanks contain wastes in the form of salt cake, or sludge with drainable interstitial liquid (Hanlon 1991). All of the tanks have been interim isolated. Tanks 241-B-110 and -201 are confirmed leakers, and tanks 241-B-101, -103, -107, -108, -111, -112, -203, -204 are assumed leakers (Hanlon 1991).

Scintillation probe profiles from selected drywells used to monitor the B Tanks were reviewed and general conclusions reached about the distribution of radionuclides in the subsurface in the B Tank Farm area. All of the scintillation probe profits used were collected by TFSA&S, which logs the monitoring wells in the 241-B Tank Farm on a periodic basis.

Elevated levels of gamma activity are detected within the backfill material around the tanks and near the surface, and within the Hanford sand beneath the bottom of the tanks. The near surface elevated gamma activity is not necessarily directly related to tank leakage; it may be partly due to gamma emitters contained within near surface utilities. Elevated gamma activity at the base of the backfill and extending into the upper reaches of the Hanford sand occurs near tanks 241-B-101, -105, -106, -107, and -110.

Downward migration of gamma emitters is indicated beneath the 241-B-101, -106, and -108 Tanks. The criteria used to deduce whether or not migration is occurring include instances where increasing levels of radioactivity are found, gross changes in the character of the scintillation probe profiles or the consistent displacement and broadening of peaks over time on the scintillation probe profiles.

Because of the limited depth of the wells, the possibility that gamma emitters may have reached the groundwater cannot be ruled out.

A-1.4.18 241-BX Tank Farm

The 241-BX Tank Farm is located within the 200-BP-7 Operable Unit, south of the 241-BX Tank Farm and west of the 241-B Tank Farm. The 241-BX Tank Farm contains 12 buried single-shell, carbon steel-lined, concrete reinforced tanks. The tanks have individual capacities of 2,017,000 L (53,000 gal). The BX Tanks were constructed in an excavation, about 13 m (42 ft) deep and backfilled with the excavated material. The backfill material consists of poorly sorted cobbles, pebbles, course to medium sand and silt. All the tanks contain mixed waste in the form of salt cake and sludge with interstitial liquid (Hanlon 1991). All of the tanks have been interim isolated and undergone initial stabilization. Tank 241-BX-102 is a confirmed leaker. Tanks 241-BX-101, -108, -110, and -111 are assumed leakers. Unplanned releases have occurred at Tanks 241-BX-102, -103, and -104. Tanks

241-BX-102, -107, -108, -110 and -111 are included in the Watch List Tanks because they contain ferrocyanide.

Scintillation probe profiles from selected drywells used to monitor the BX Tanks were reviewed and general conclusions reached about the distribution of radionuclides in the subsurface in the 241-BX Tank Farm area. All of the scintillation probe profiles used were collected by TFSA&S, which logs the monitoring wells in the 241-BX Tank Farm on a periodic basis.

Elevated gamma activity is present within the backfill material around the tanks and near the surface. In addition elevated gamma activity is indicated beneath the BX-107 and -111 tanks within the Hanford sand. Some of the elevated gamma activity within the backfill and near the surface may be due to gamma emitters contained within near surface utilities.

No definite downward migration is in evidence for the scintillation probe profiles available. Because of the limited depth of the wells, the possibility that gamma emitters may have reached the groundwater cannot be ruled out.

A-1.4.19 241-BY Tank Farm

The 241-BY Tank Farm is located within the 200-BP-7 Operable Unit, north of the 241-BX Tank Farm and south of the BY Cribs. The 241-BY Tank Farm contains 12 single-shell tanks with a capacity of 2,870,000 L (758,000 gal). The BY Tanks were constructed in an excavation, about 14 m (46 ft) below grade, and buried using native soil (Welty 1988). All of these tanks contain noncomplexed wastes in the form of salt cake, sludge or drainable interstitial liquid (Hanlon 1991). Except for tanks 241-102-BY and 109-BY, the remaining BY Tanks contain ferrocyanide and are monitored closely for changes in temperature and waste volume (Hanlon 1991). All of the BY Tanks have been partially or interim isolated. Tanks 241-103-BY, 105-BY, 106-BY, 107-BY and 108-BY are classified as assumed leakers. Of these assumed leaking tanks, only 241-106-BY has not been stabilized (Hanlon 1991).

Scintillation probe profiles from selected drywells used to monitor the BY Tanks were reviewed and general conclusions reached about the distribution of radionuclides in the subsurface in the 241-BY Tank Farm area. All of the scintillation probe profiles used were collected by TFSA&S, which periodically logs the monitoring wells in the 241-BY Tank Farm. In general, levels of gamma activity appear to be declining over time. There is also evidence of migration of radionucludes in the subsurface. The criteria used to deduce whether or not migration is occurring include instances where increasing levels of radioactivity are found, gross changes in the character of the scintillation probe profiles or the consistent displacement and broadening of peaks over time on the scintillation probe profiles.

Elevated levels of gamma activity are detected within the backfill material around the tanks and near the surface, and within the Hanford sand beneath the bottom of the tanks. Elevated gamma activity at or near the surface is evident on profiles from wells near all of the tanks in the BY Farm except for 241-105-BY and 241-106-BY. This near surface activity is not directly related to any leakage from the tanks themselves, and may be partly due to gamma emitters contained within near surface utilities. Elevated gamma radiation unrelated to surface activity is detected within the backfill materials near all of the BY Tanks but 241-102-BY and 241-105-BY. These elevated levels extend into the upper reaches of the Hanford sand near tanks 241-101-BY, 241-103-BY, 241-106-BY, 241-108-BY, 241-109-BY, 241-111-BY and 241-112-BY. The gamma emitters responsible for this intra-fill activity are mobile in the vicinity of tanks 241-102-BY, 241-103-BY, 241-106-BY, 241-111-BY and 241-112-BY. Radionuclides are detected within the Hanford sand in the vicinity most of the tanks in the 241-BY Tank Farm except for tanks 241-101-BY, 241-102-BY, 241-111-BY and 241-112-BY. Evidence of migrating gamma emitters is evident on profiles from wells located near tanks 241-103-BY, 241-104-BY, 241-105-BY, 241-106-BY, 241-107-BY and 241-108-BY. Elevated gamma radiation is detected to the total depth of wells located near tanks 241-102-BY, 241-103-BY, 241-104-BY, 241-105-BY, 241-107-BY and 241-108-BY. The possibility that gamma emitters in these areas may have reached the groundwater cannot be ruled out.

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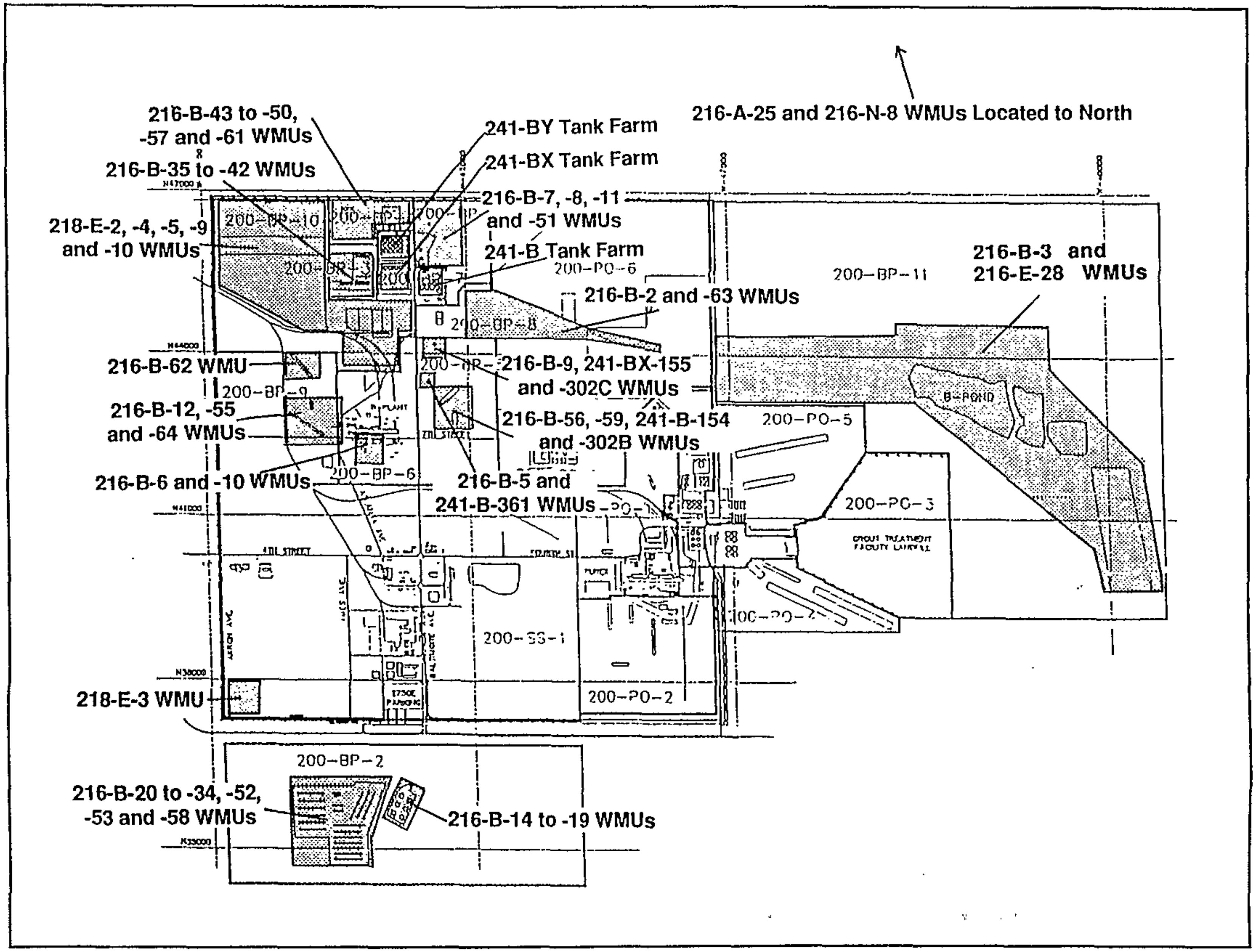

Figure A1-1. B Plant Aggregate Area: Waste Management Unit Areas Evaluated.

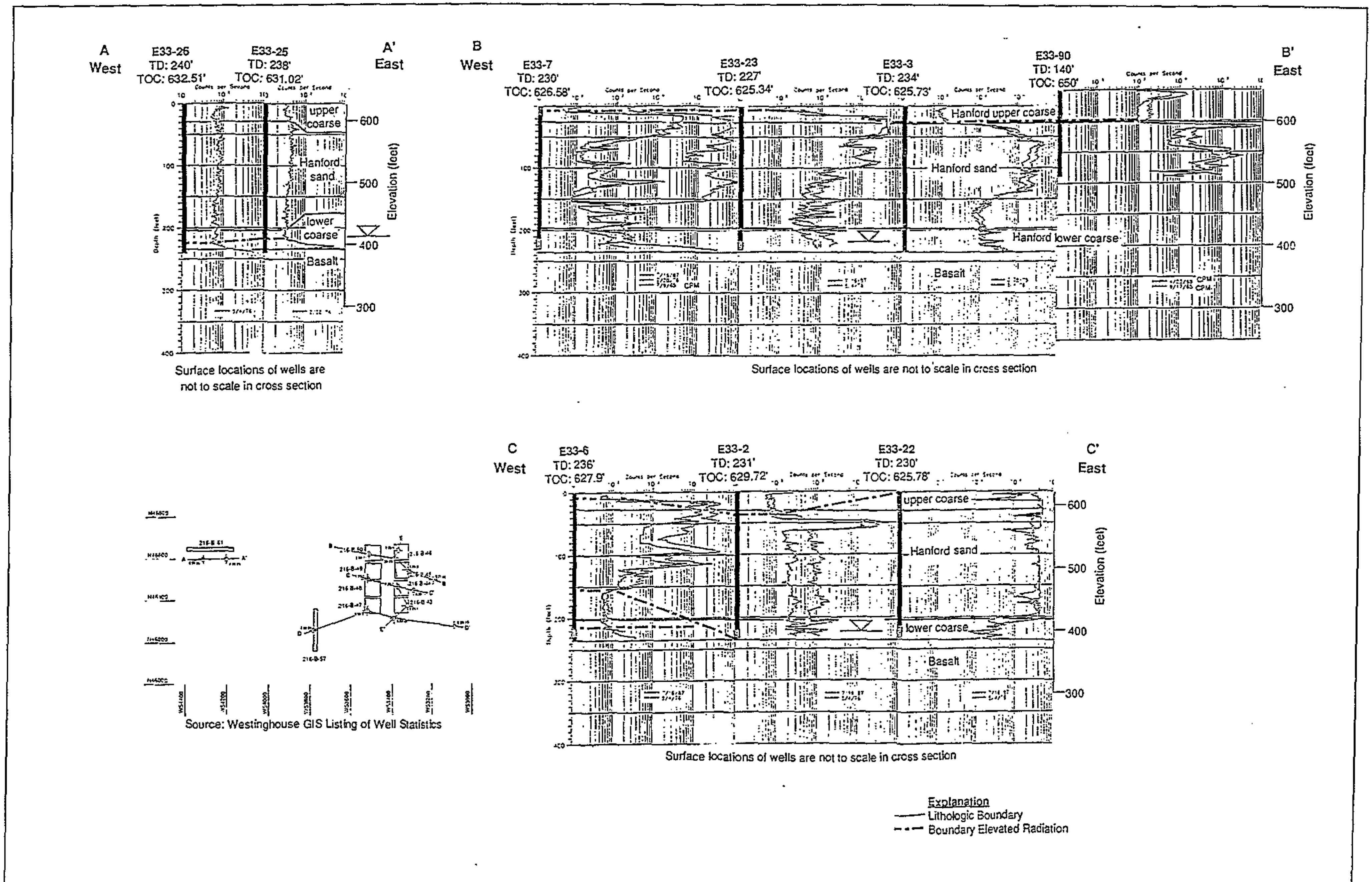

Figure A1-2. 216-B-43 through -50, -57, and -61 Waste Management Units: Scintillation Probe Profile Cross Sections A-A', B-B', and C-C'.

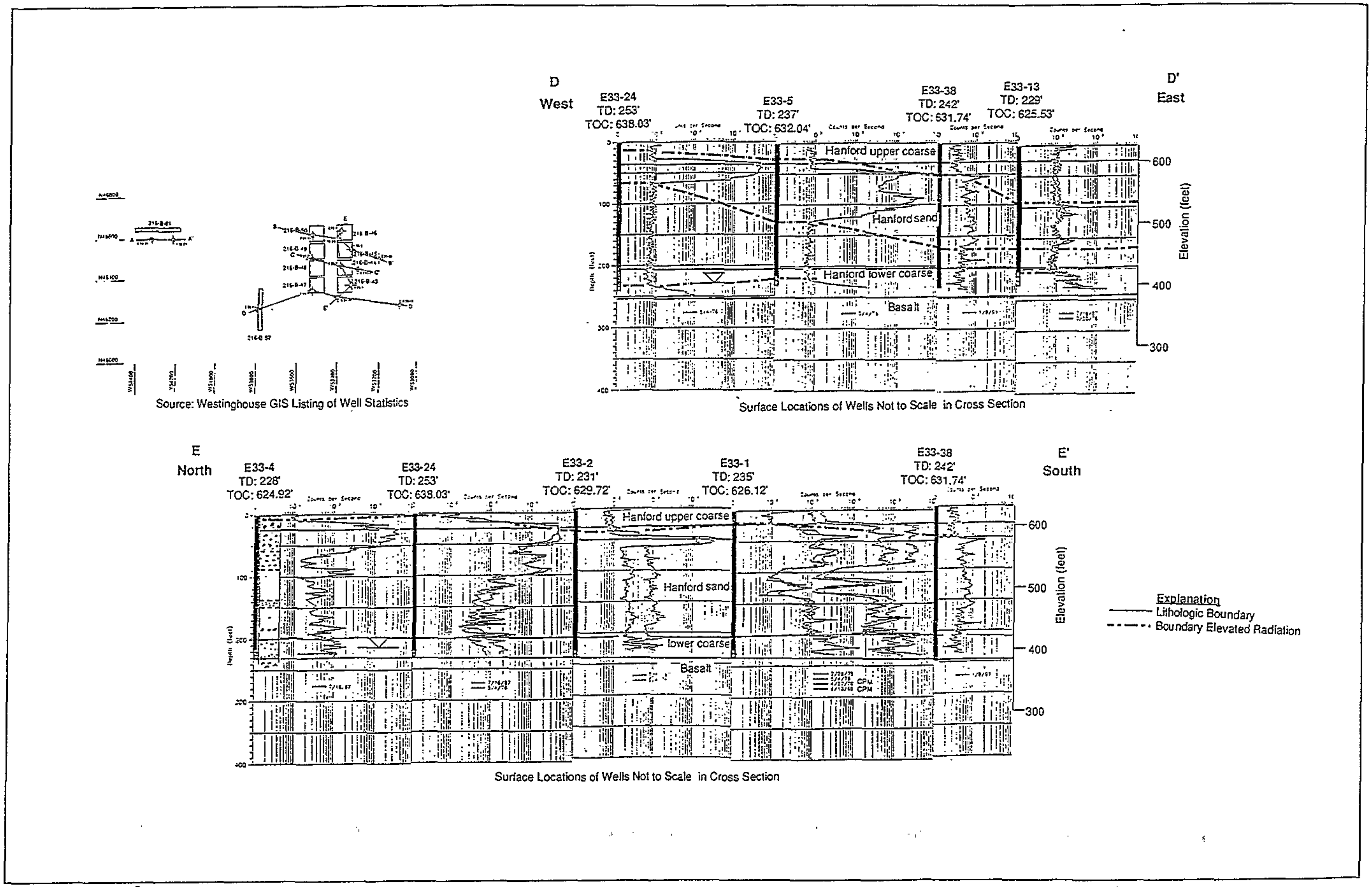

Figure A1-3. 216-B-43 through --50, -57, and -61 Waste Management Units: Scintillation Probe Profile Cross Sections D-D' and E-E'.

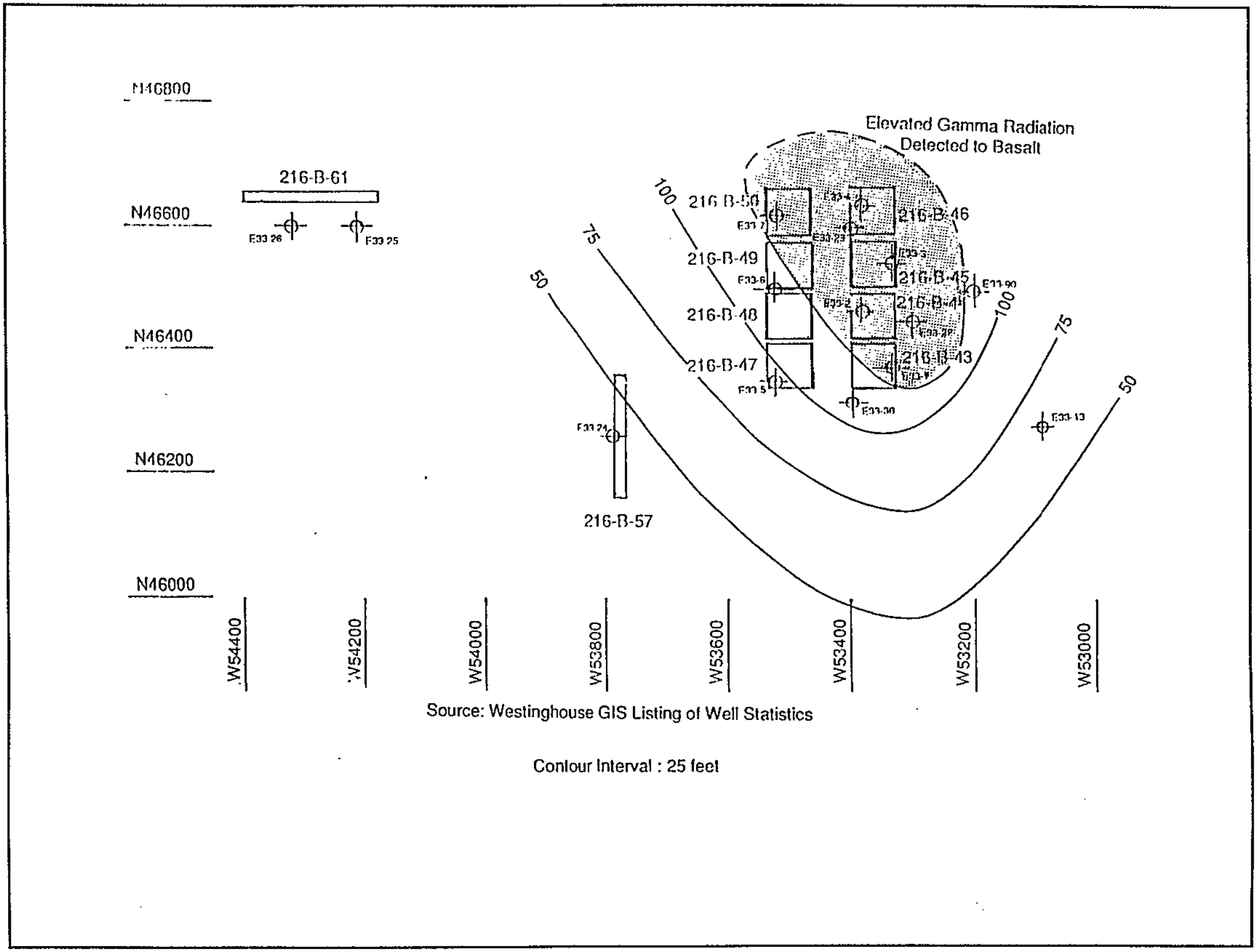

Figure A1-4. 216-B-43 through -50, -57, and -61 Waste Management Units: Elevated Gamma Radiation Isopach Map.

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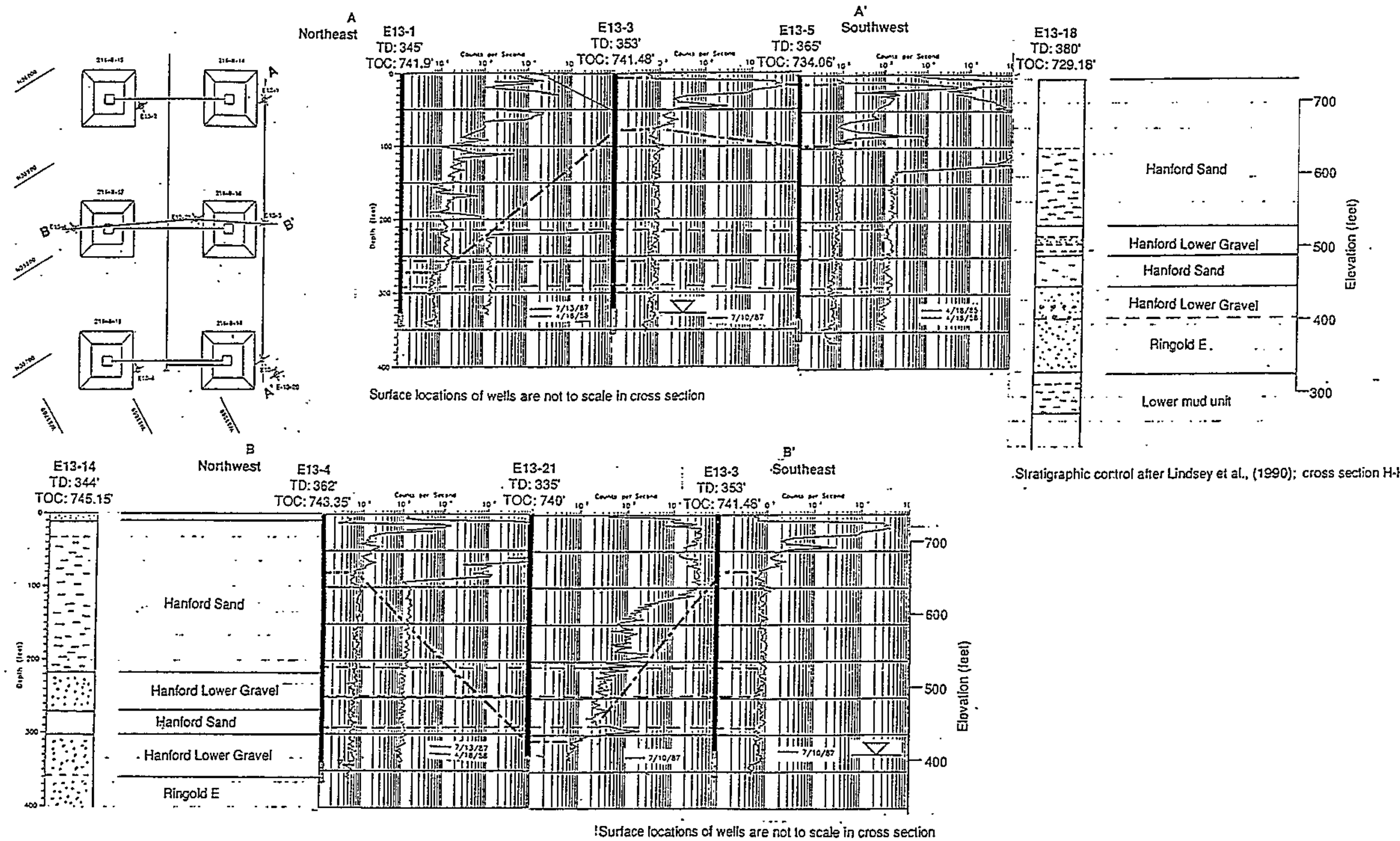

Figure A1-5. 216-B-14 through -19 Waste Management Units: Scintillation Probe Profile Cross Sections A-A' and B-B'.

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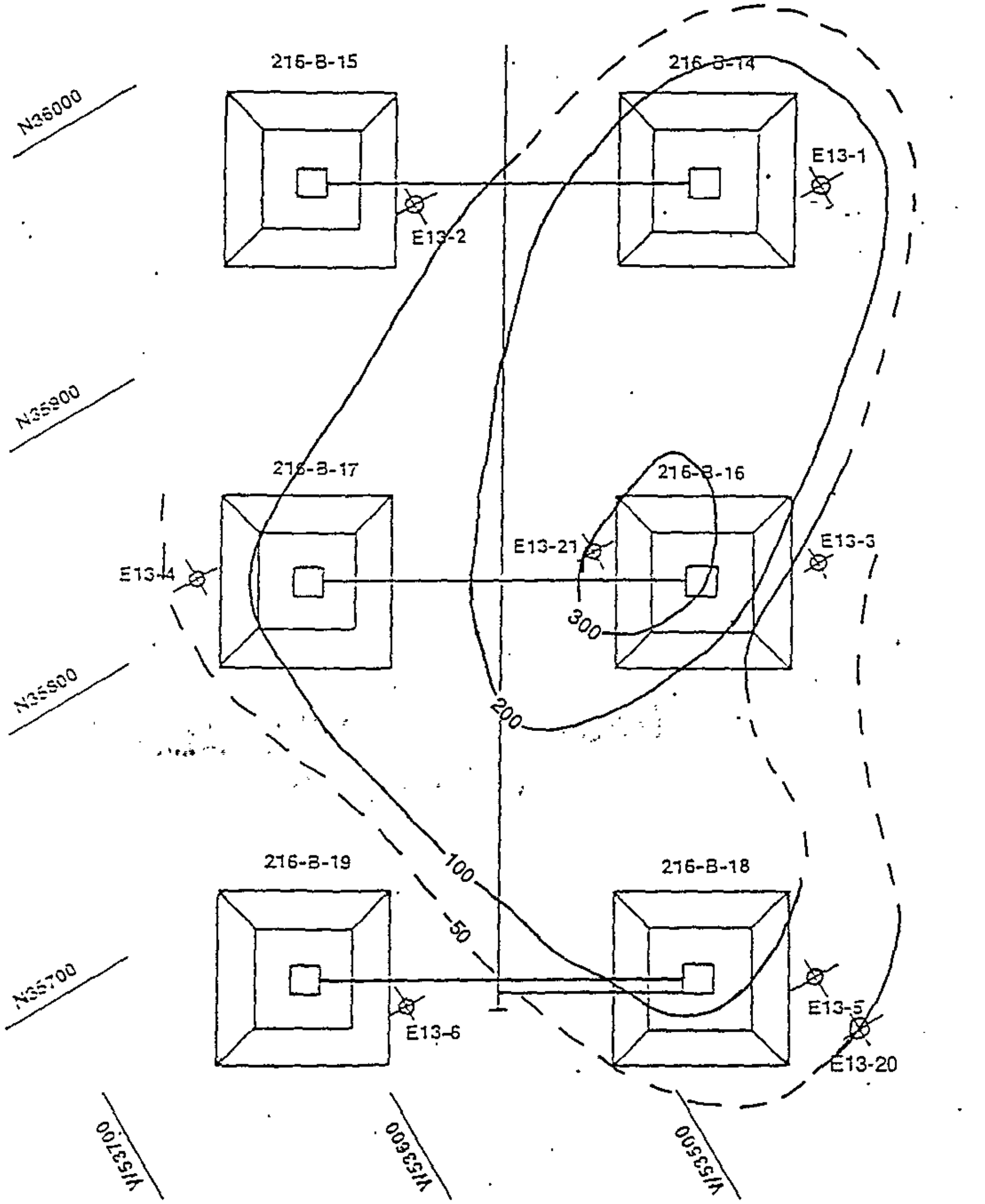

Figure A1-6. 216-B-14 through -19 Waste Management Units: Elevated Gamma Radiation Isopach Map.

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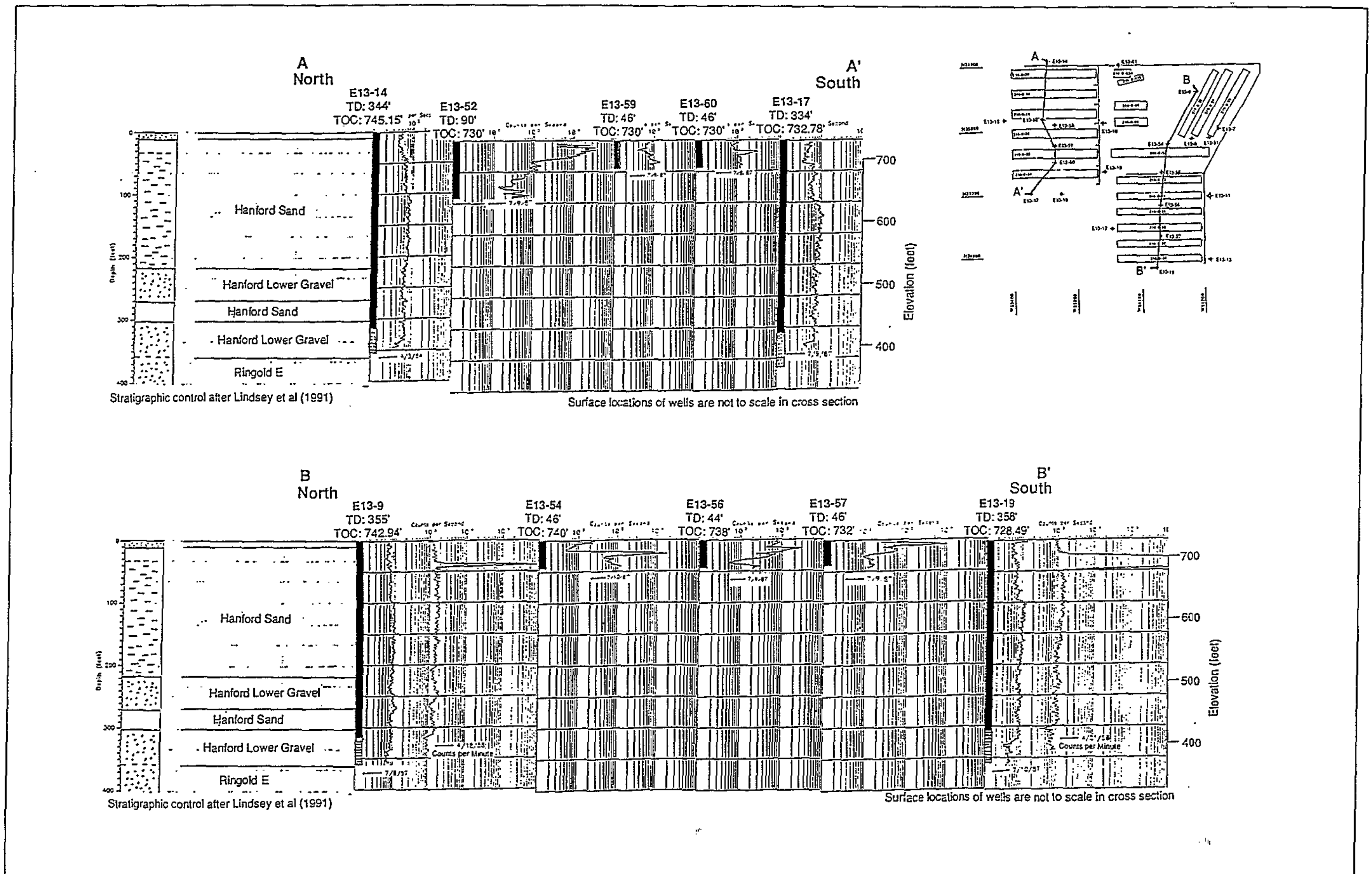

Figure A1-7. 216-B-20 through -34, -52 through -54, and -58 Waste Management Units: Scintillation Probe Profile Cross Sections A-A' and B-B'.

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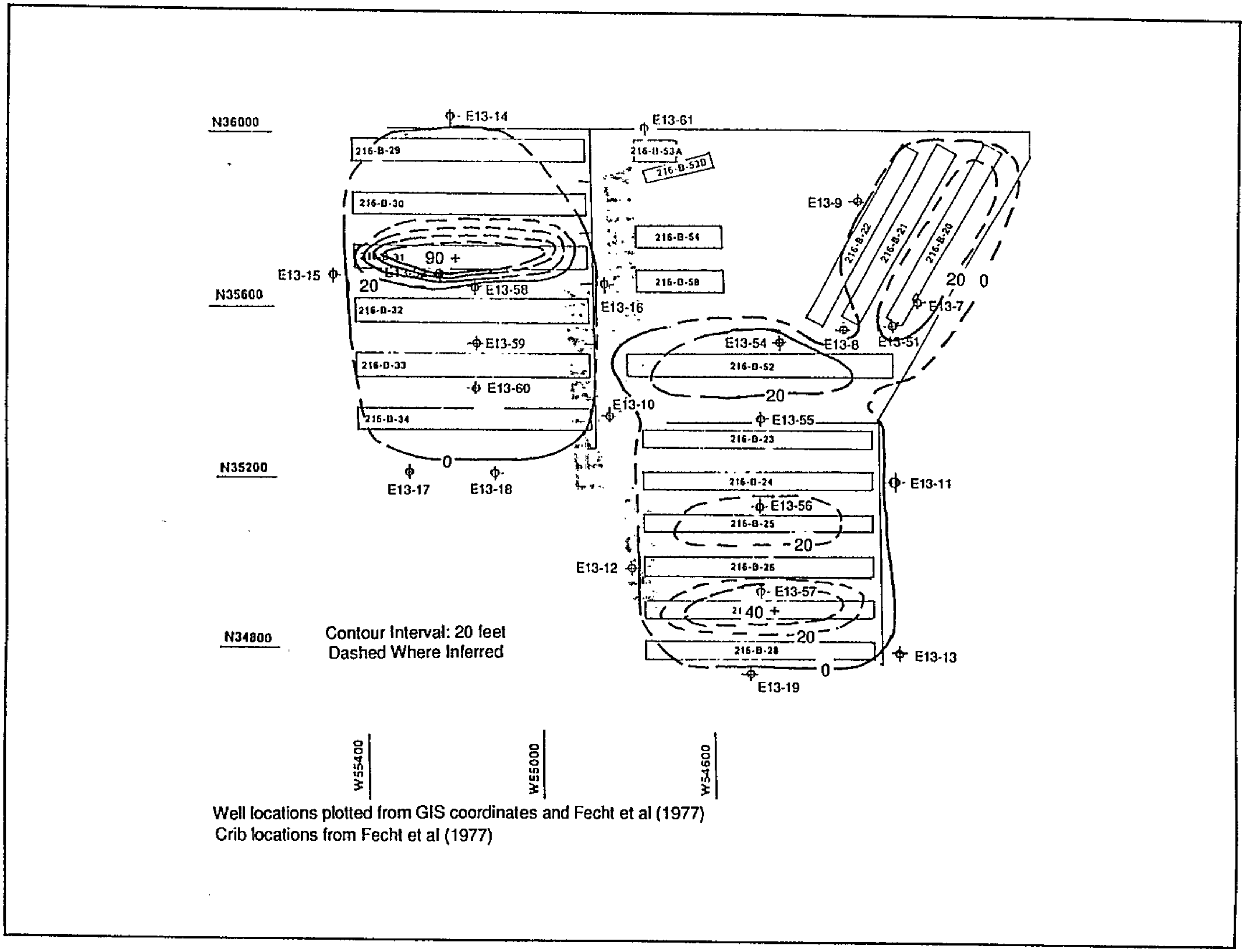

Figure A1-8. 216-B-20 through -34, -52 through -54, and -58 Waste Management Units: Elevated Gamma Radiation Isopach Map.

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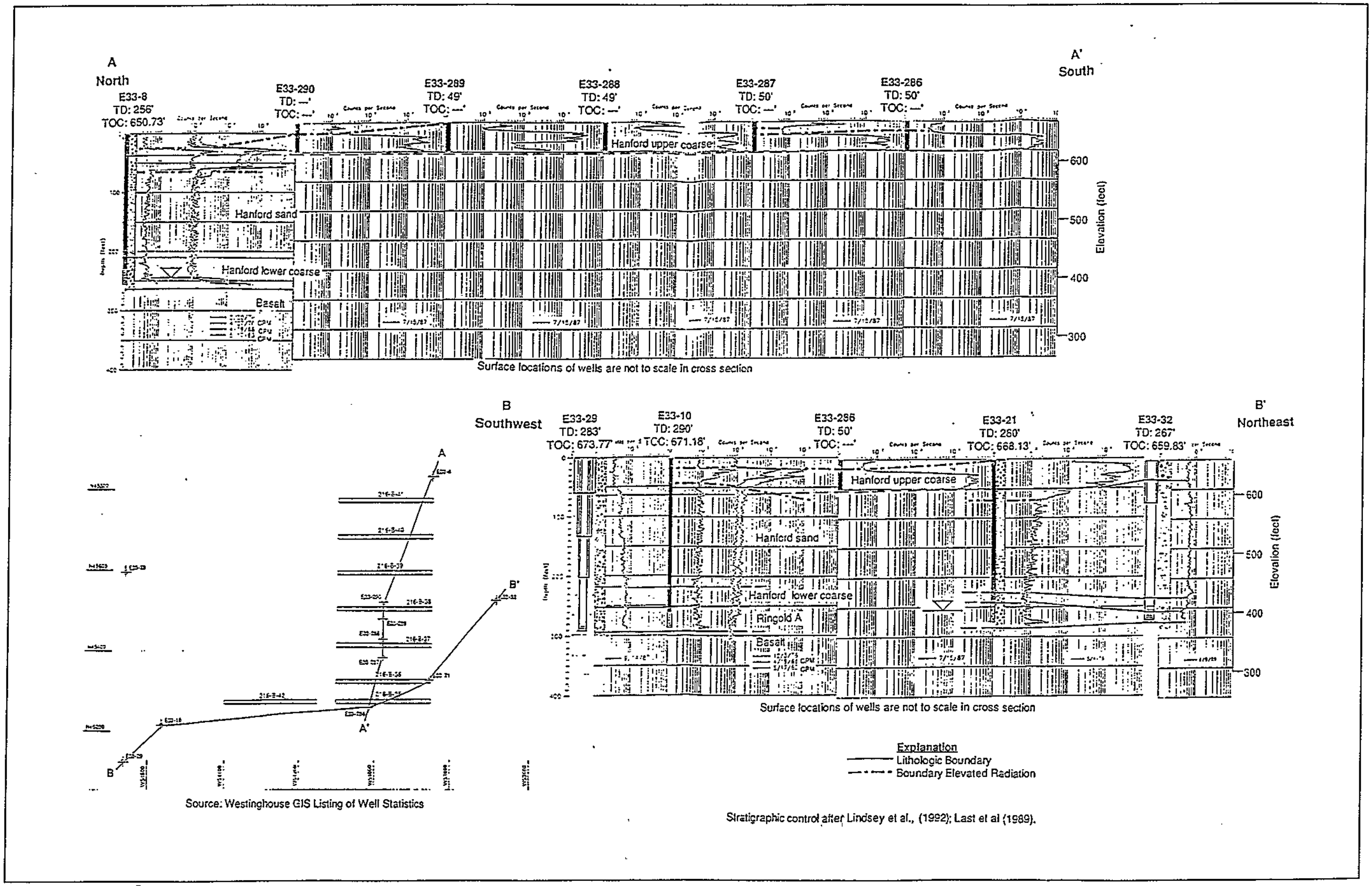

Figure A1-9. 216-B-35 through -42 Waste Management Units: Scintillation Probe Profile Cross Sections A-A' and B-B'.

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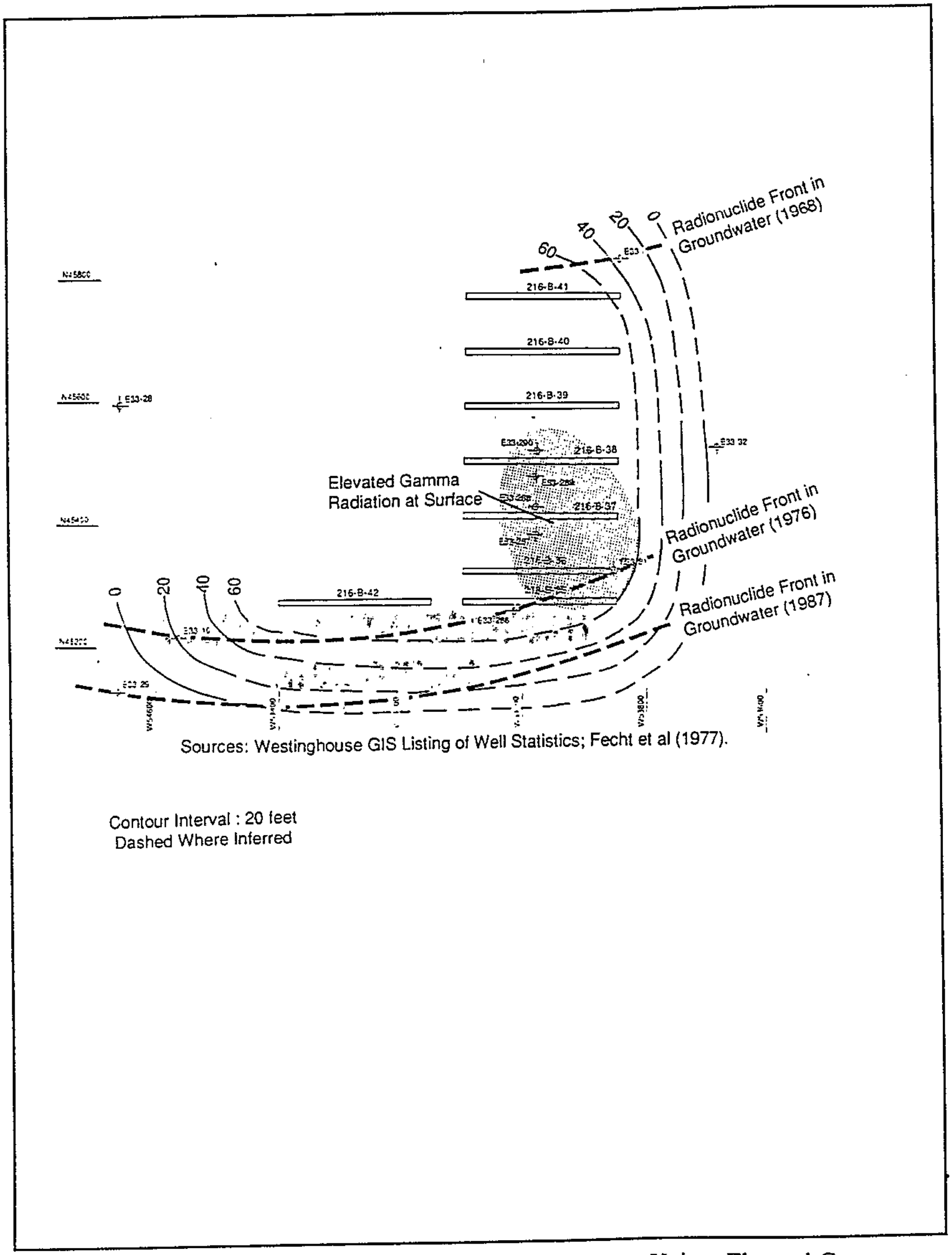

Figure A1-10. 216-B-35 through -42 Waste Management Units: Elevated Gamma Radiation Isopach Map.

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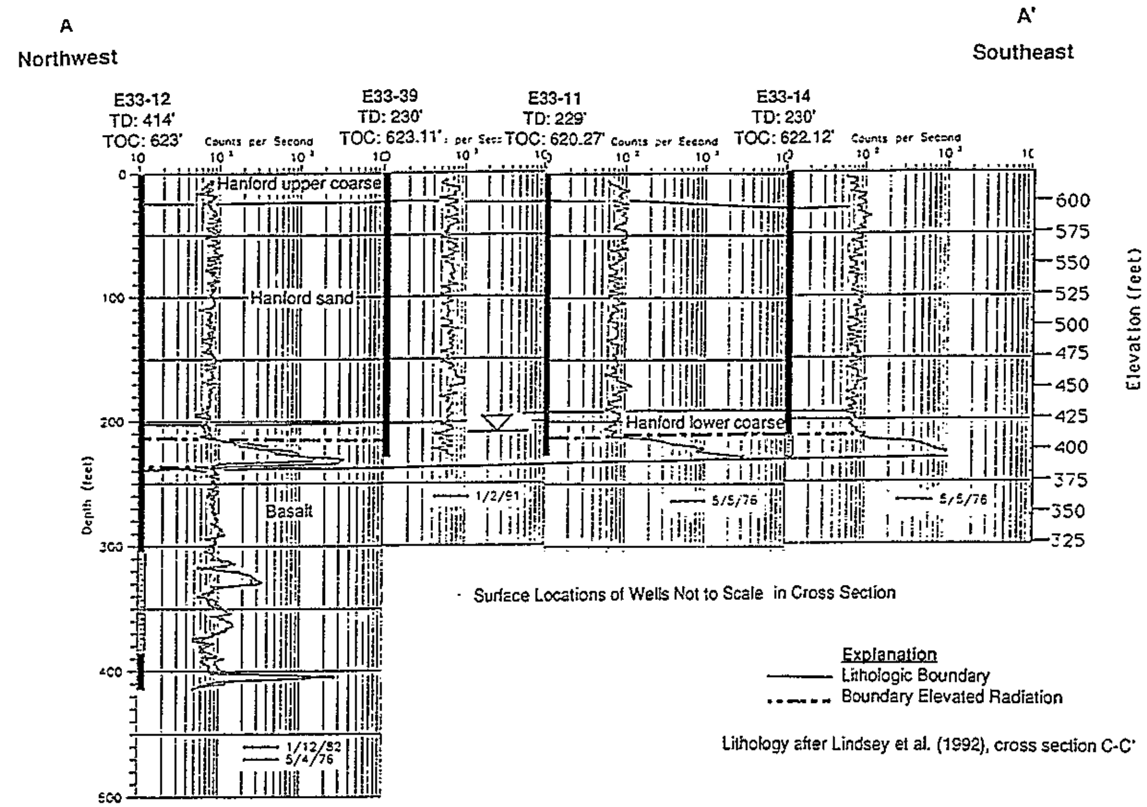

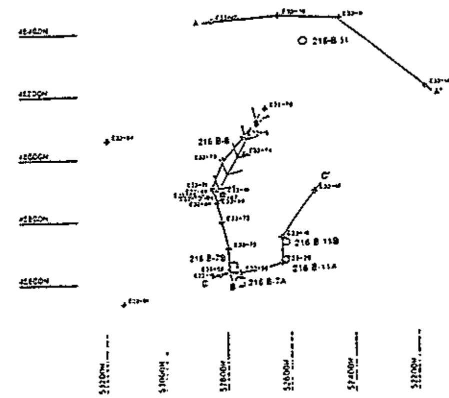

Figure A1-11. 216-B-7, -8, -11, and -51 Waste Management Units: Scintillation Probe Profile Cross Section A-A'.

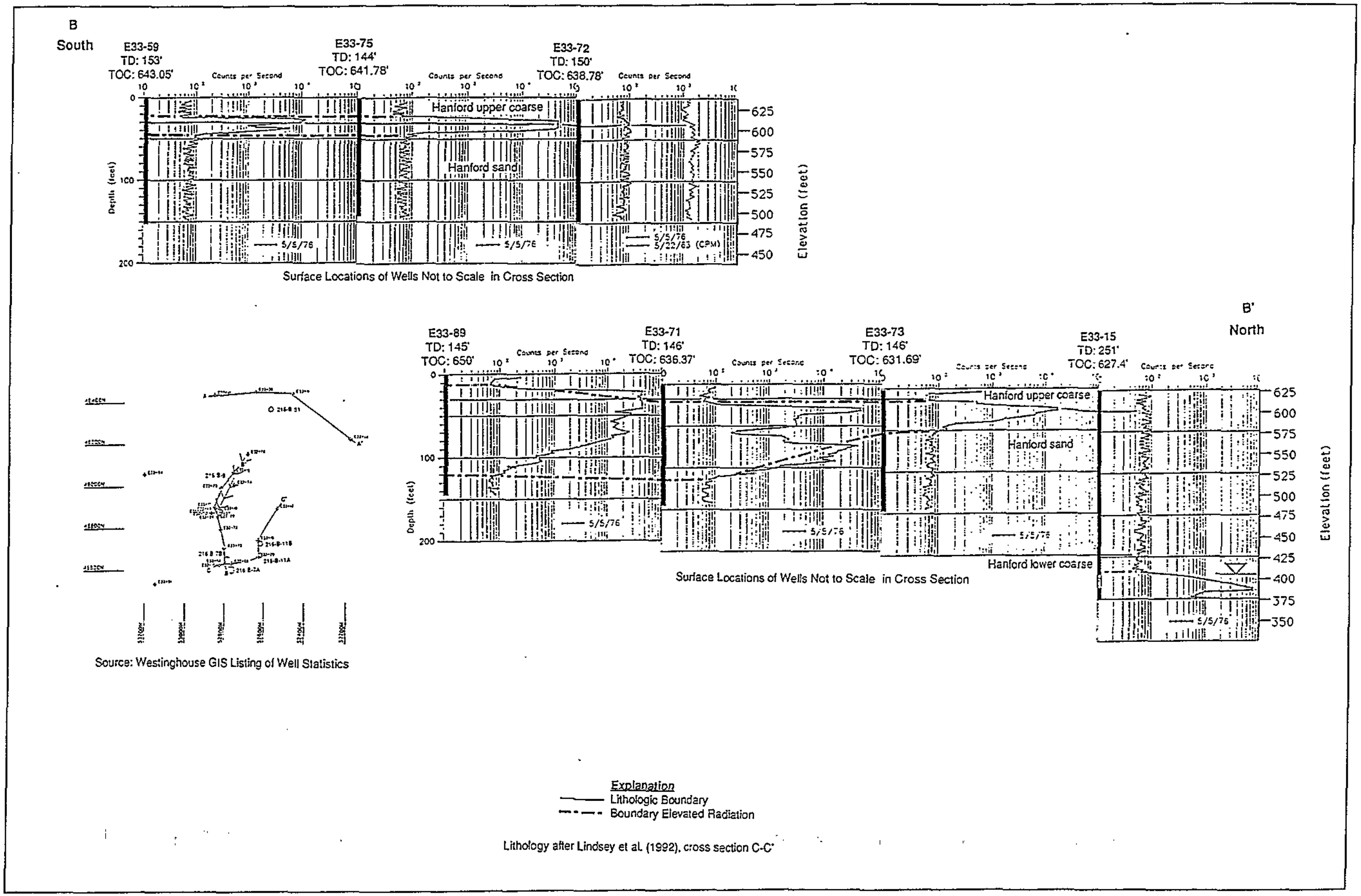

Figure A1-12. 216-B-7, -8, -11, -51 Waste Management Units: Scintillation Probe Profile Cross Section B-B'.

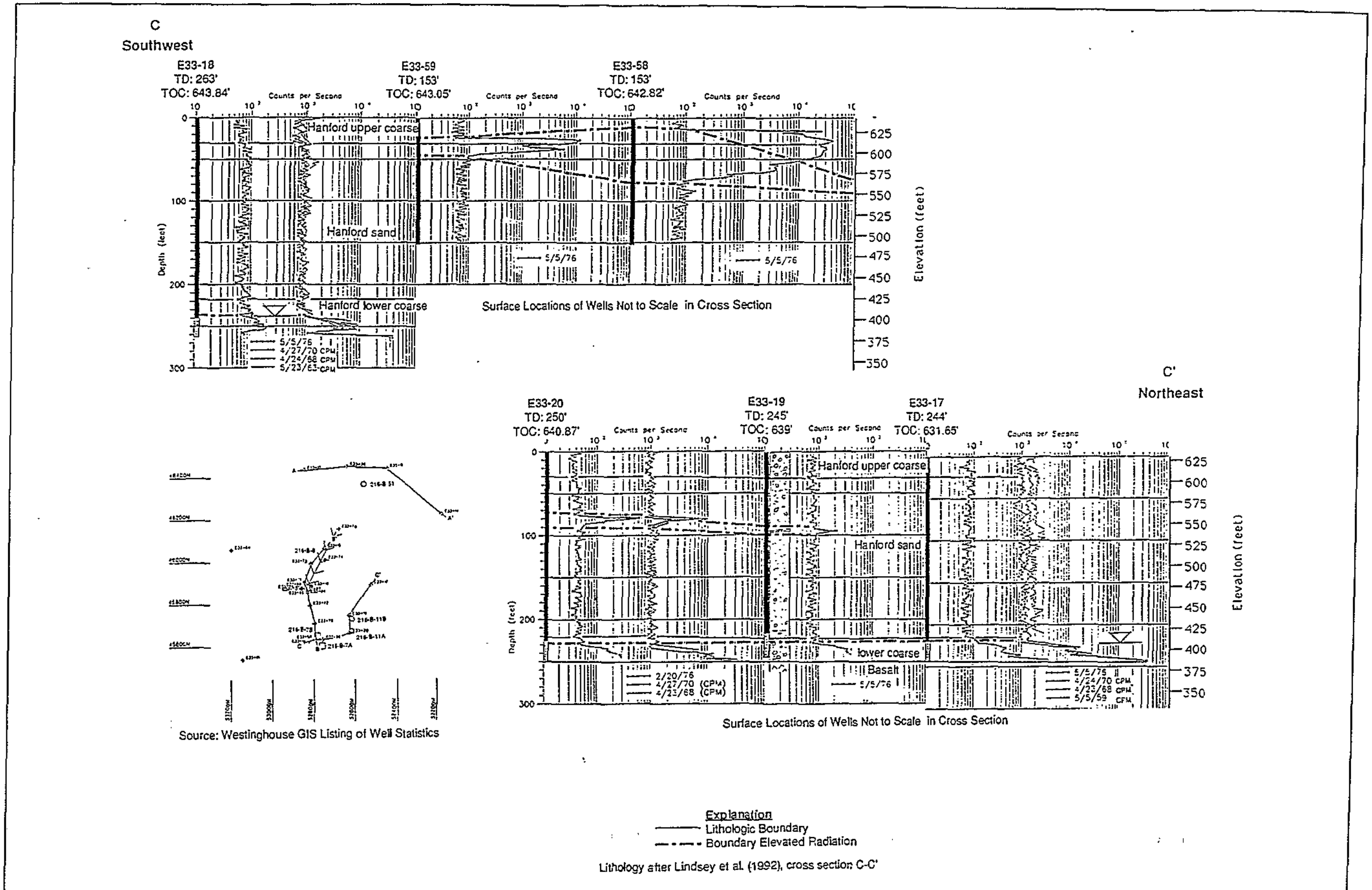

Figure A1-13. 216-B-7, -8, -11, and -51 Waste Management Units: Scintillation Probe Profile Cross Section C-C'.

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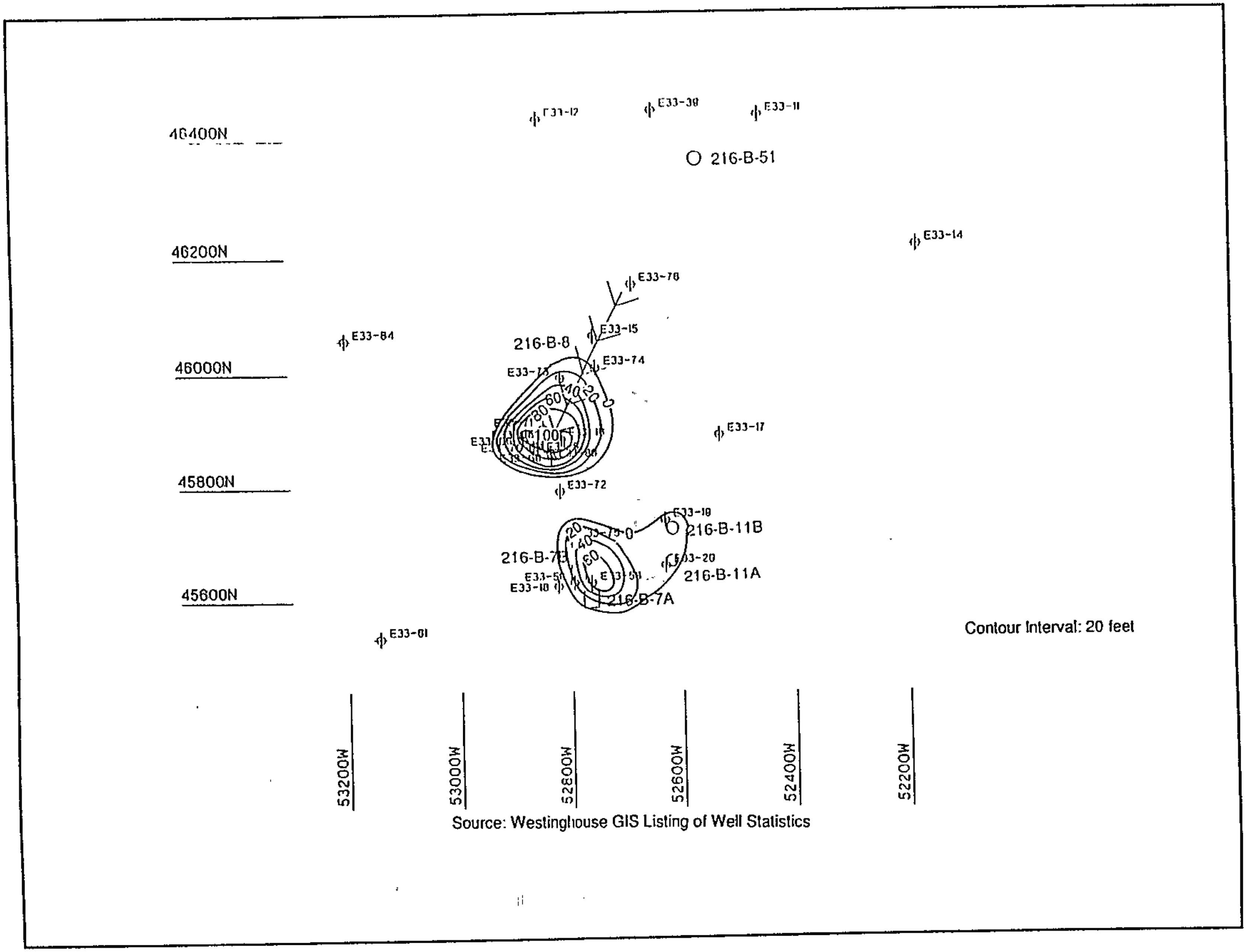

Figure A1-14. 216-B-7, -8, -11, and -51 Waste Management Units: Elevated Gamma Radiation Isopach Map.

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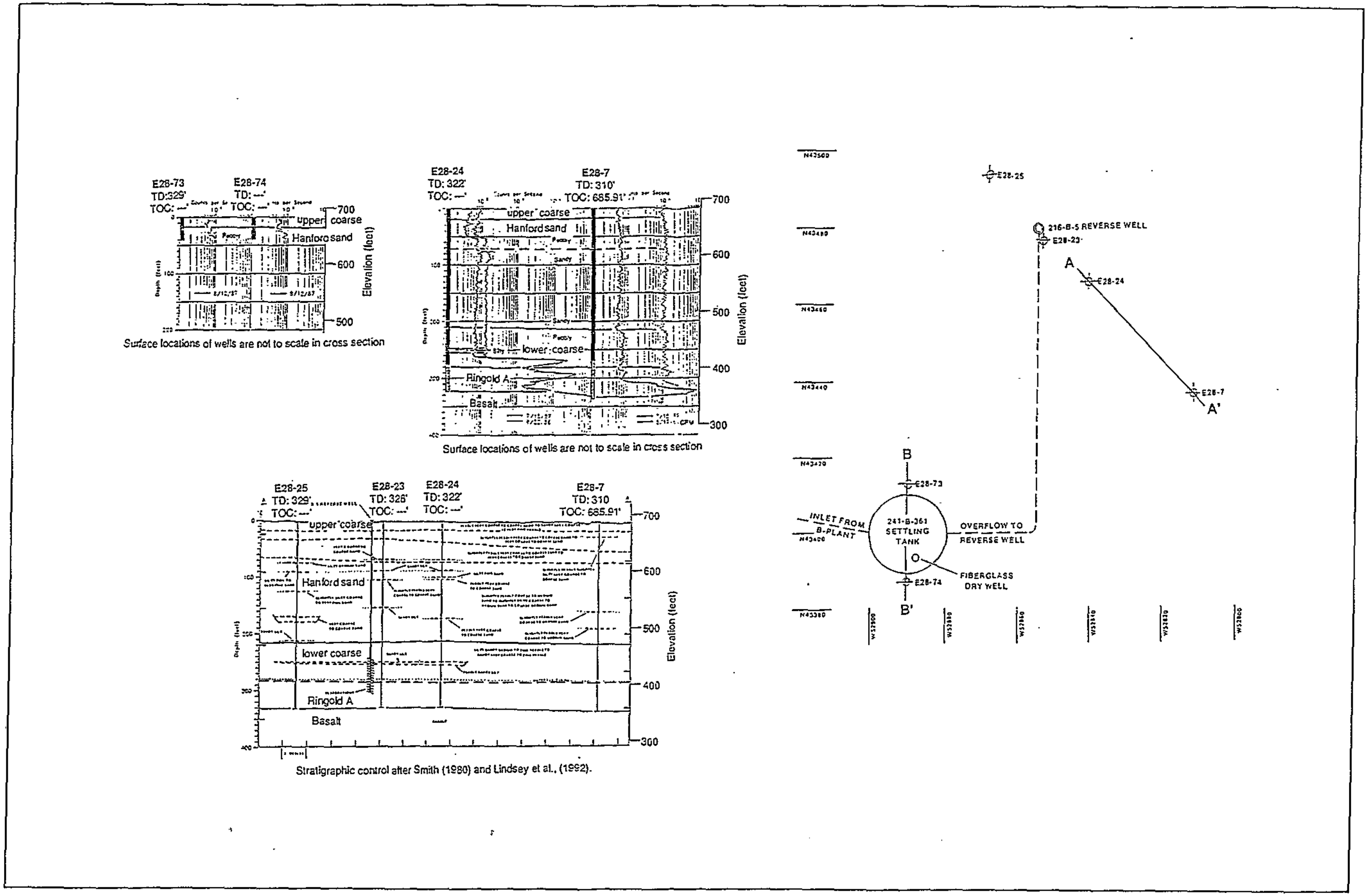

Figure A1-15. 216-B-5, and 241-B-361 Waste Management Units: Scintillation Probe Profile Cross Sections A-A' and B-B'.

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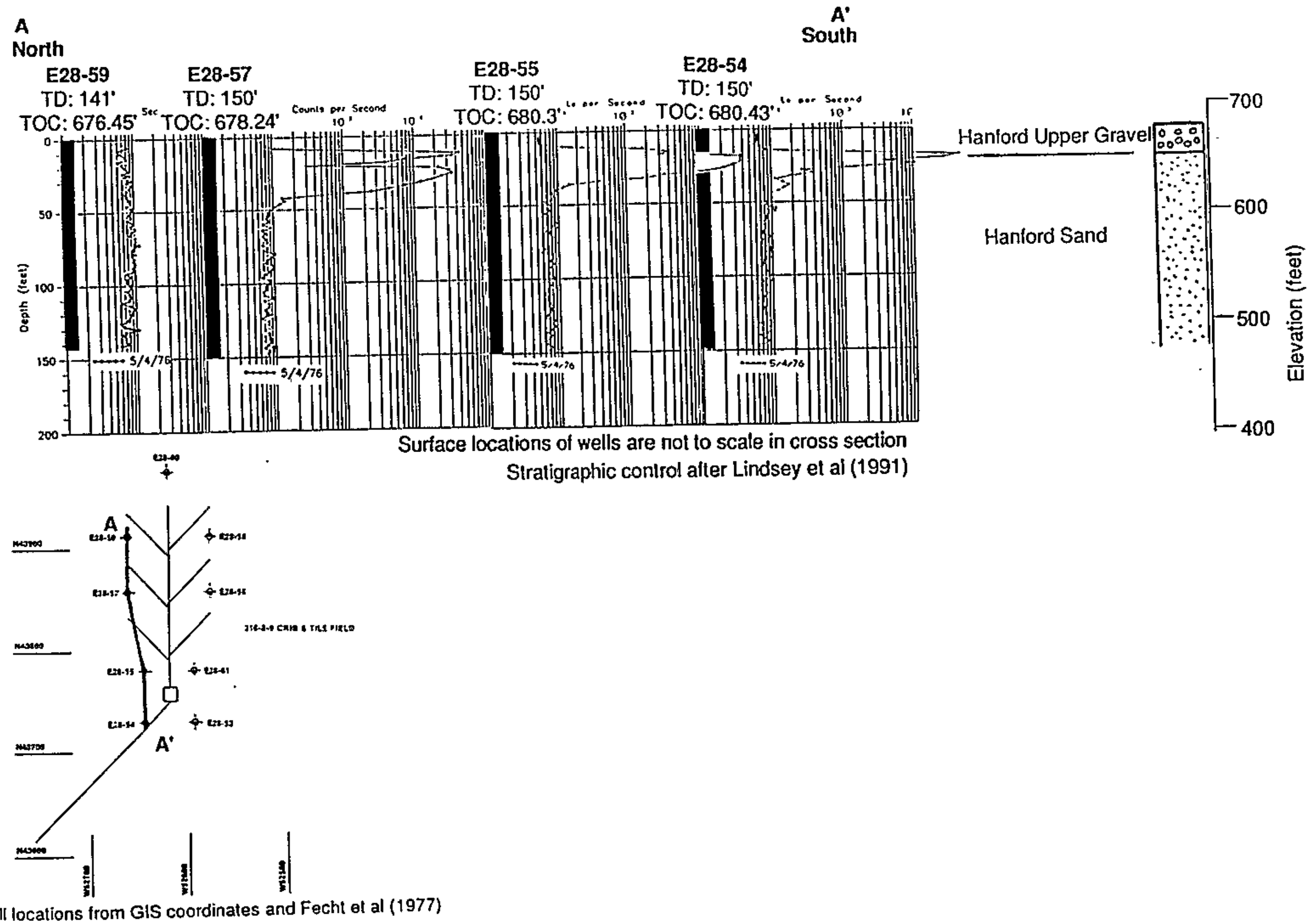


Figure A1-16. 216-B-9 Waste Management Unit: Scintillation Probe Profile Cross Section A-A'.

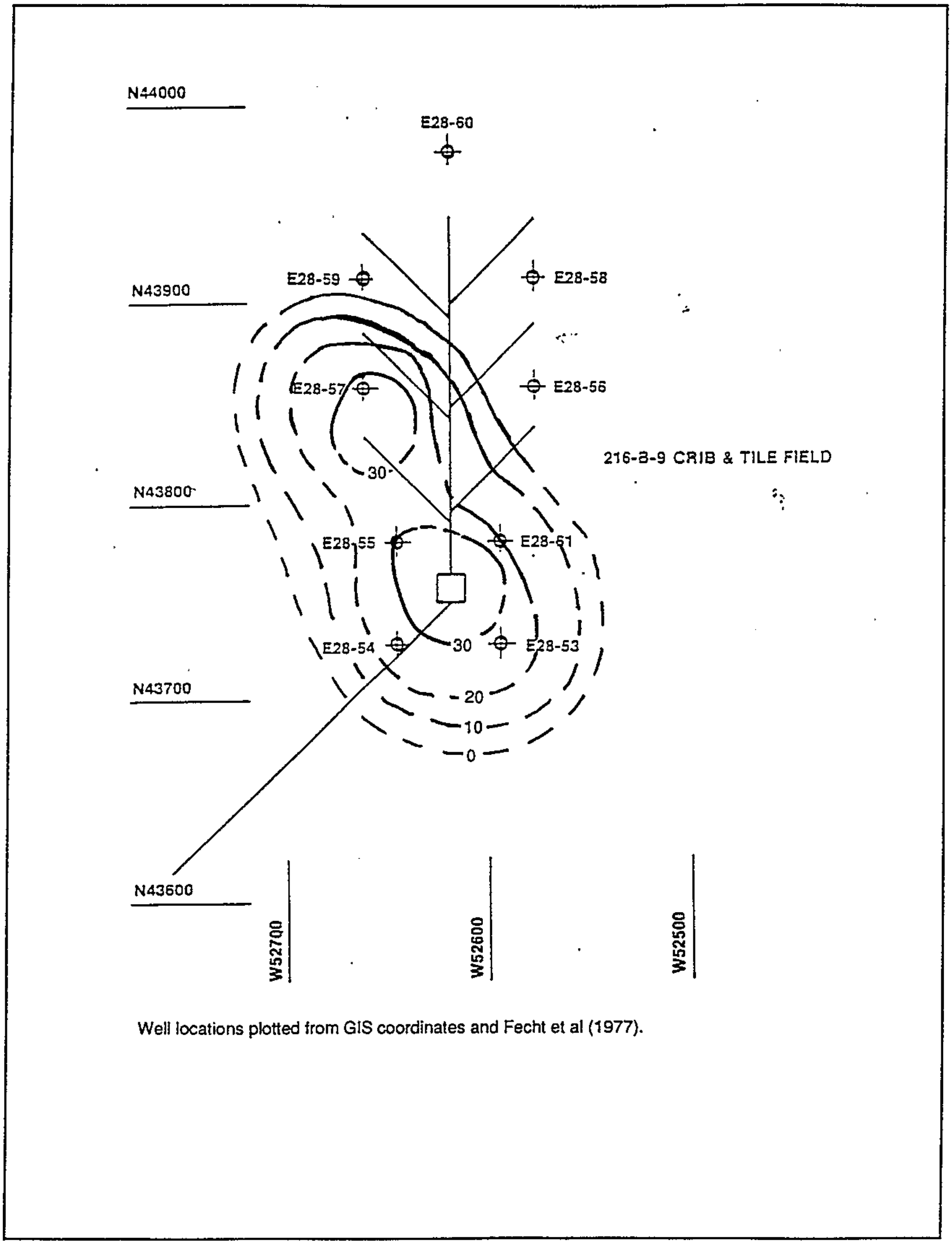
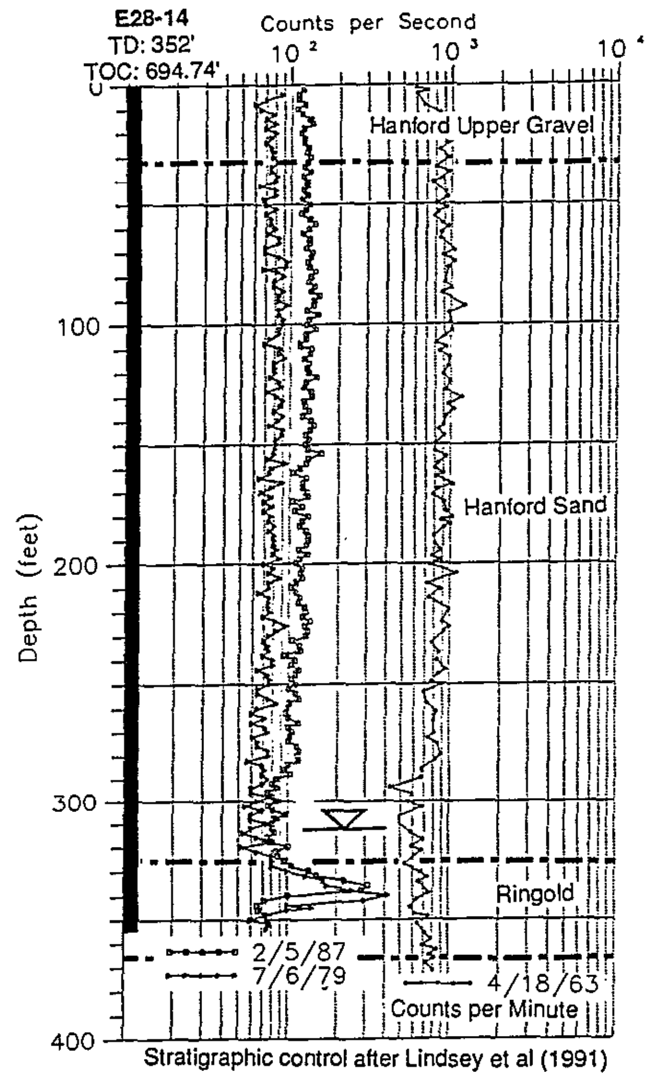


Figure A1-17. 216-B-9 Waste Management Unit: Elevated Gamma Isoradiation Isopach Map.



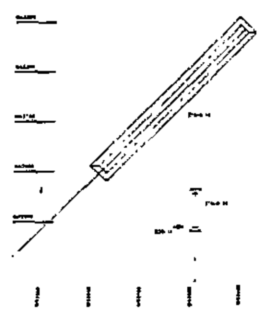


Figure A1-18. 216-B-56 and 216-B-59 Waste Management Units: Scintillation Probe Profile of Well 299-E28-14.

9 2 1 2 6 5 3 3 4 2

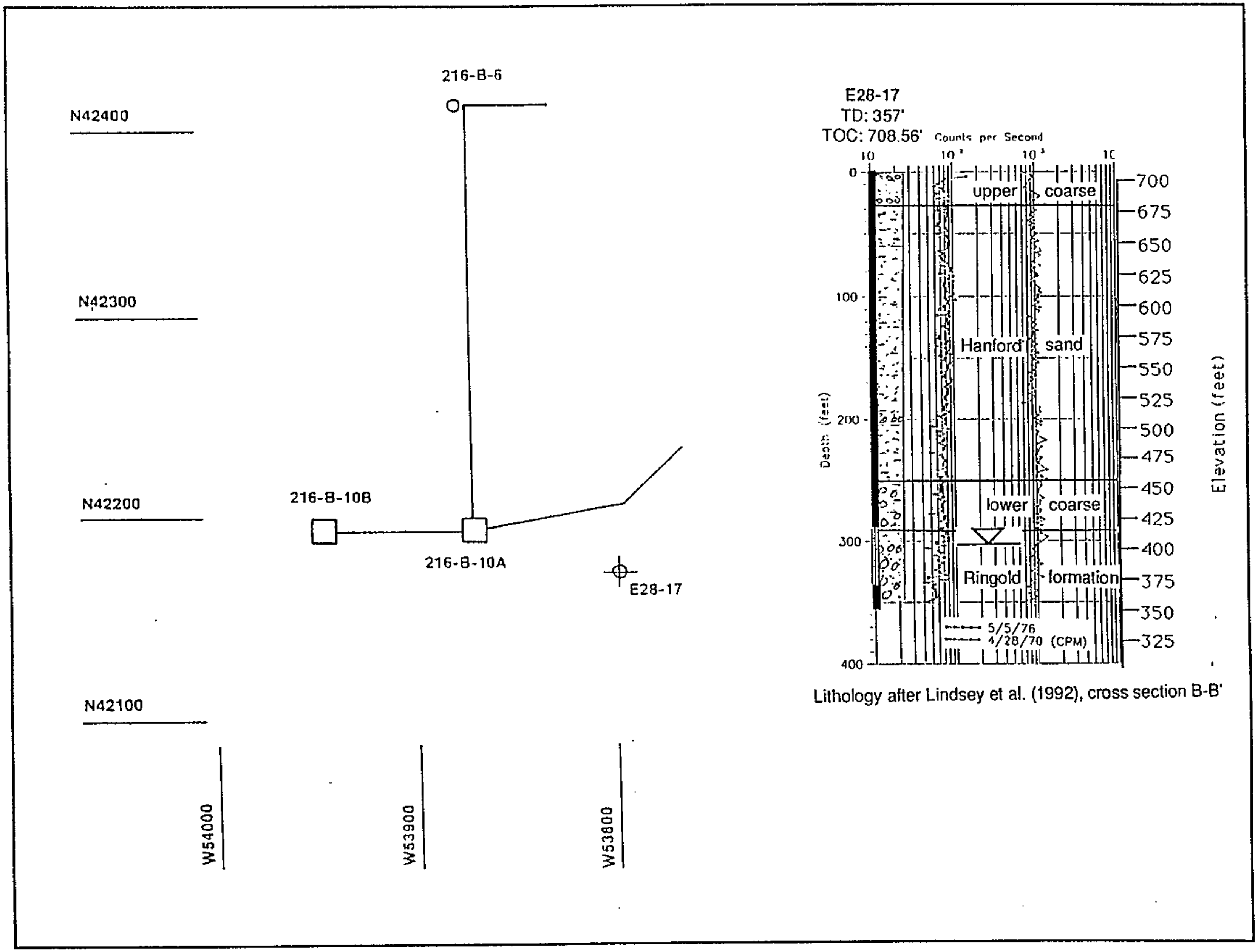


Figure A1-19. 216-B-6, -10A, and -10B Waste Management Units: Scintillation Probe Profile of Well 299-E28-17.

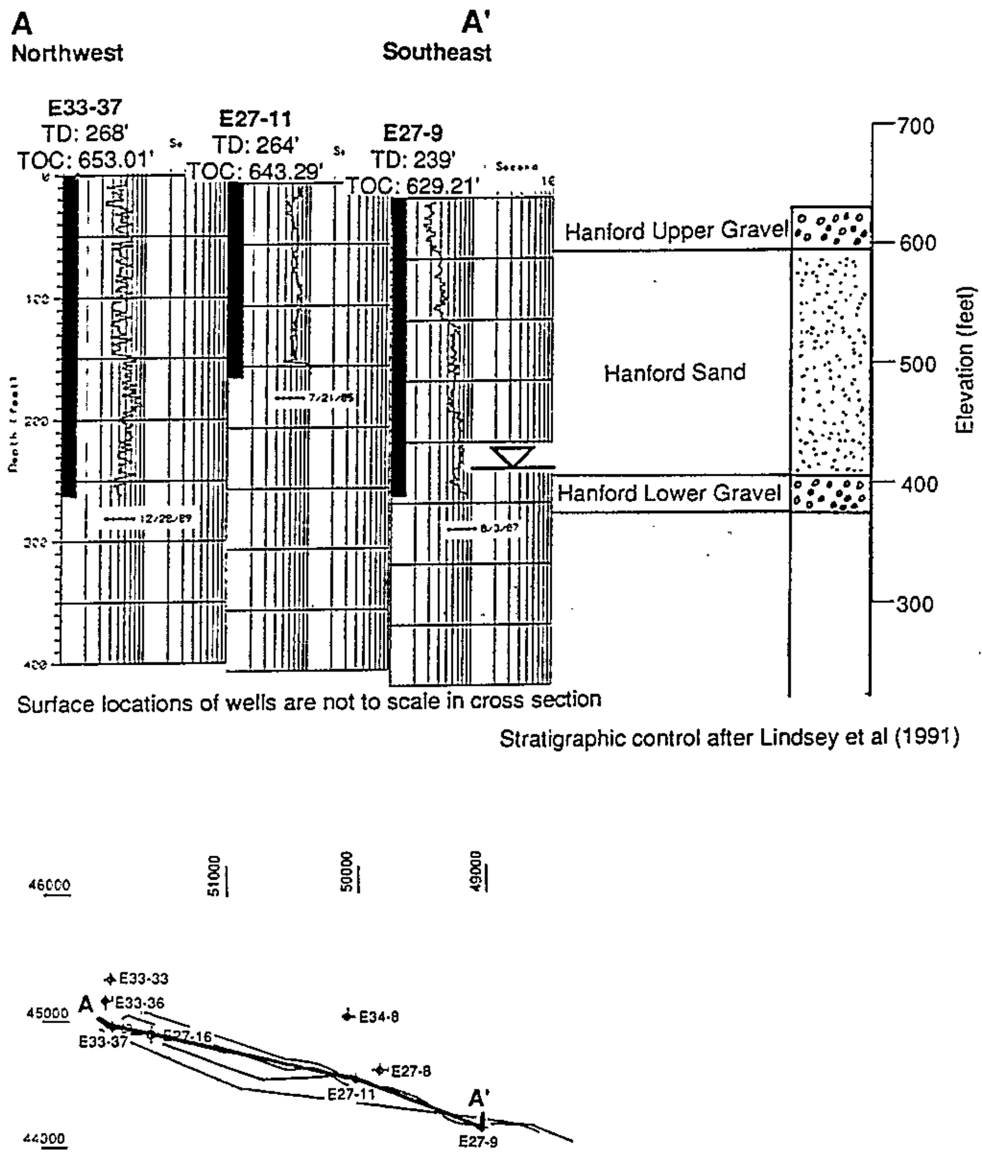


Figure A1-20. 216-B-2 and 216-B-63 Waste Management Units: Scintillation Probe Profile Cross Section A-A'.

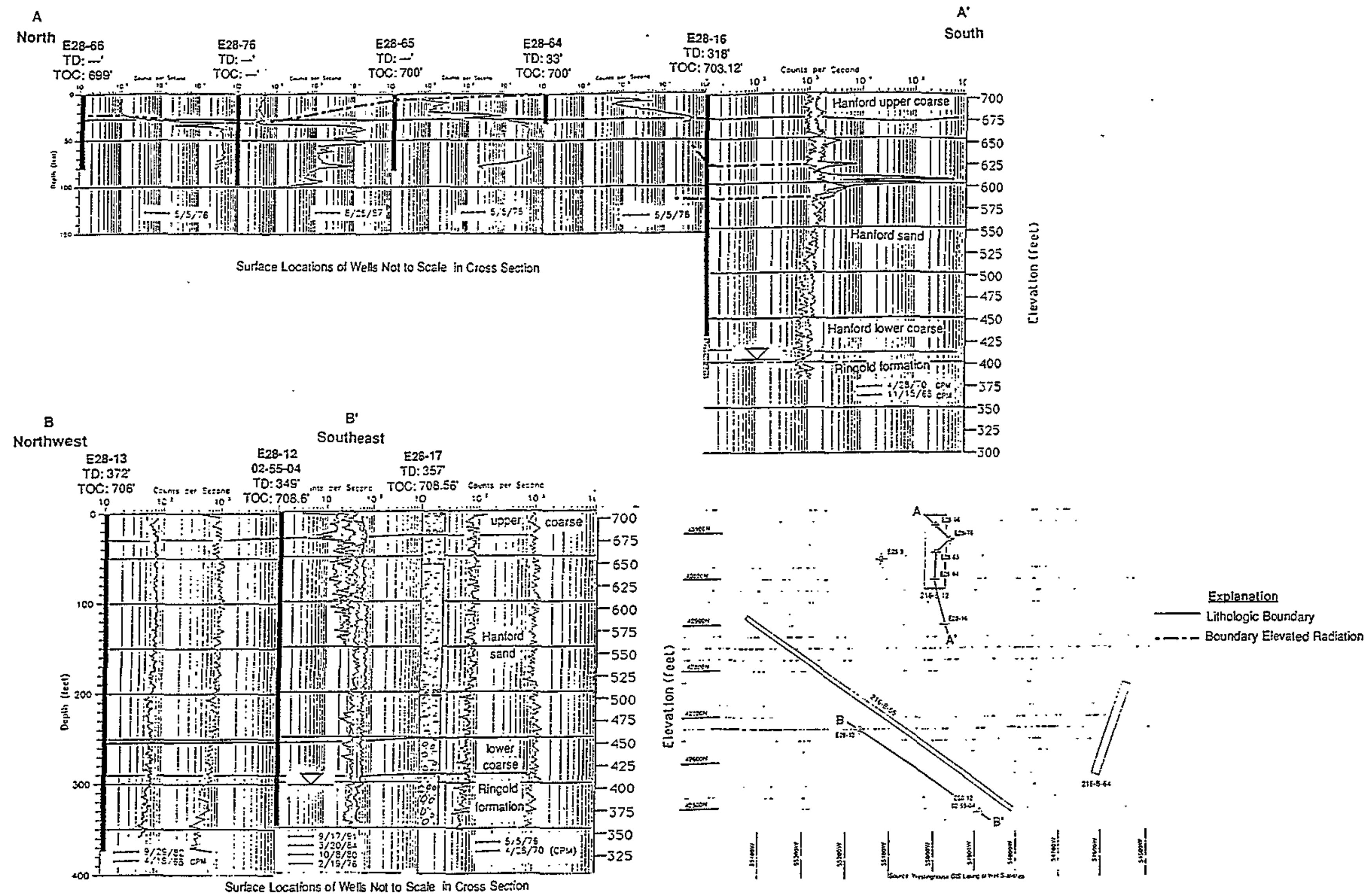


Figure A1-21. 216-B-12, -55, and -64 Waste Management Units: Scintillation Probe Profile Cross Sections A-A' and B-B'.

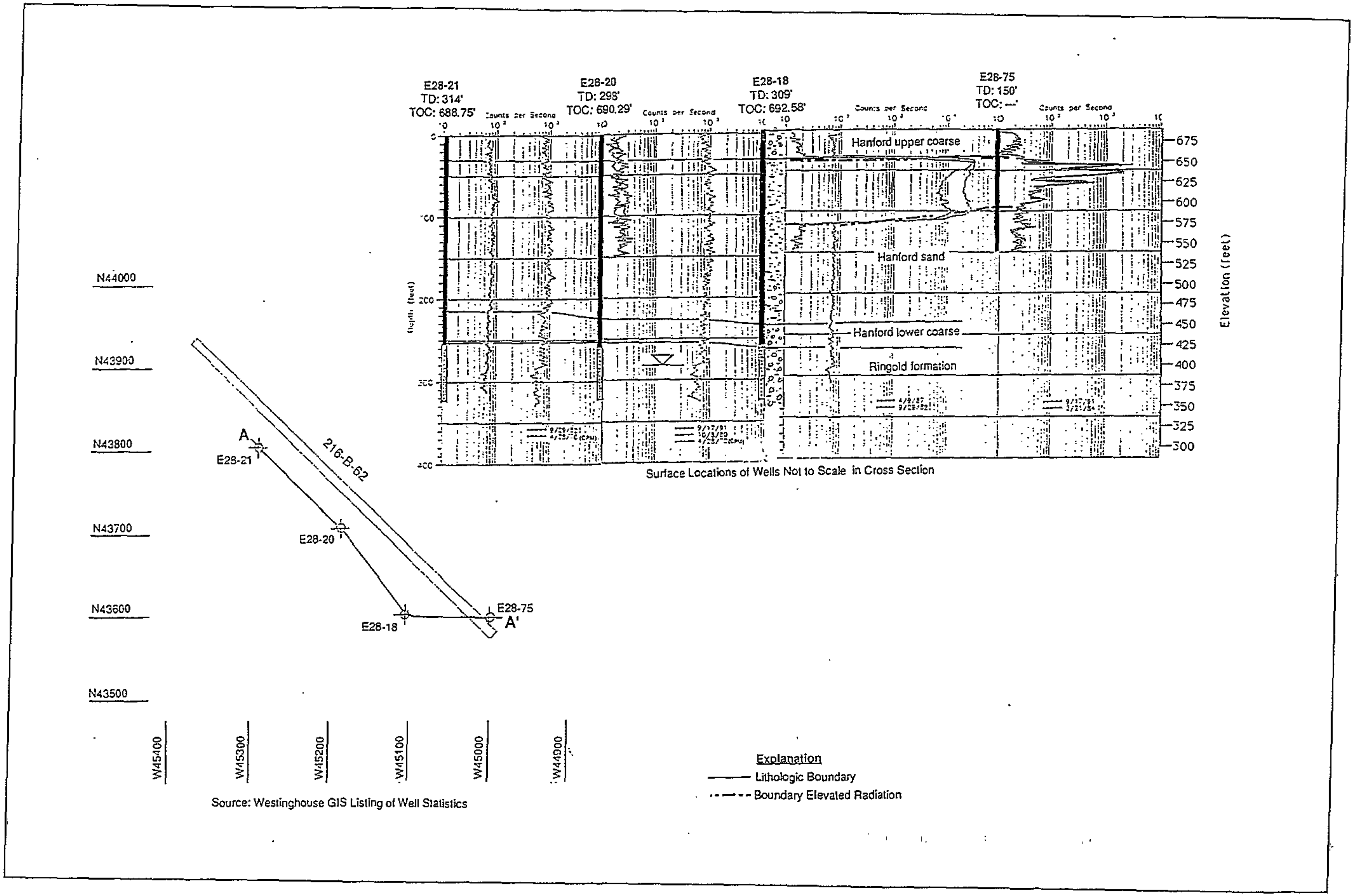


Figure A1-22. 216-B-62 Waste Management Unit: Scintillation Probe Profile Cross Section A-A'.

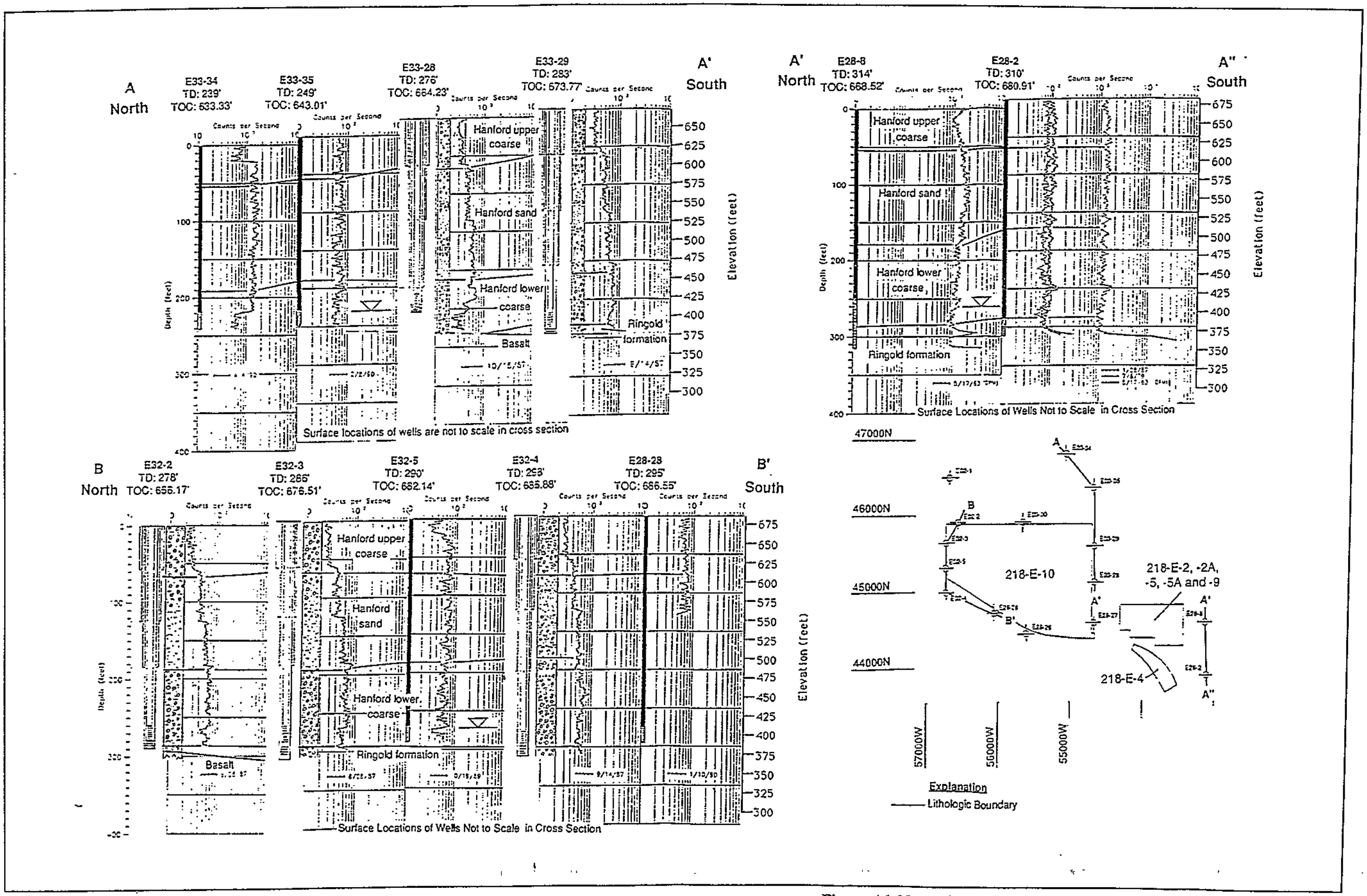


Figure A1-23. 216-E-2, -2, -2A, -4, -5, -5A, -9, and -10 Waste Management Units: Scintillation Probe Profile Cross Sections A-A', A'-A'', and B-B'.

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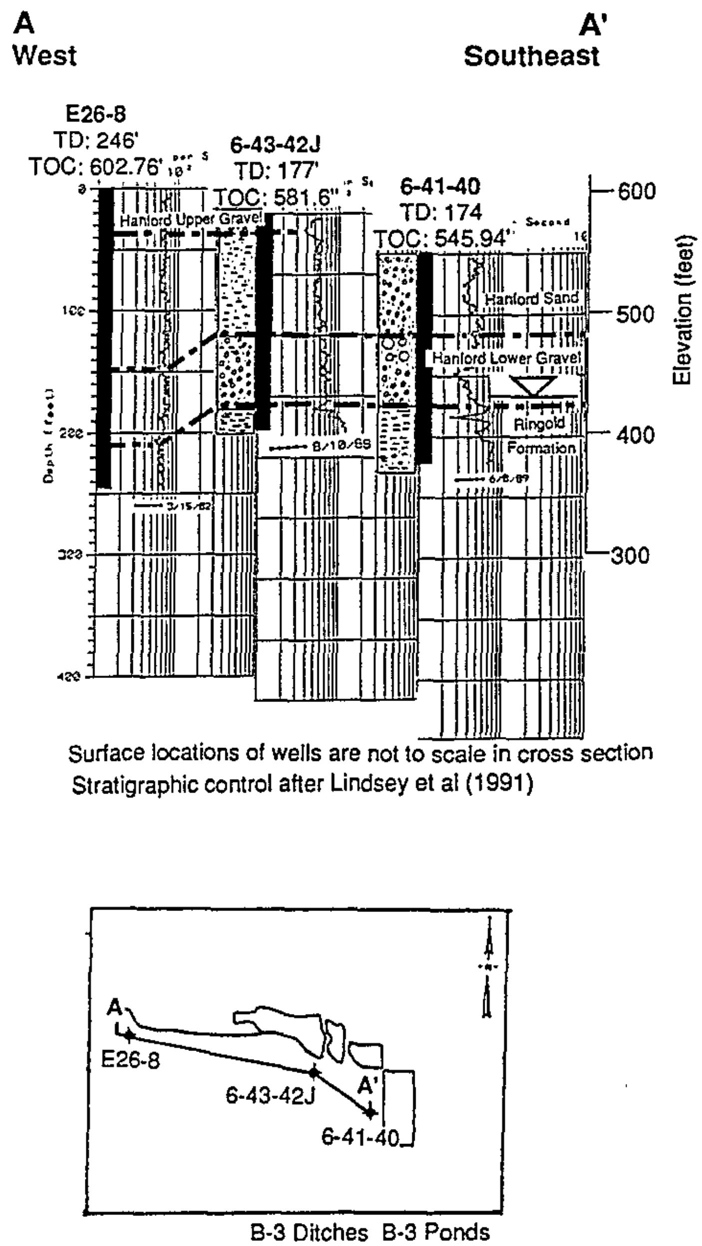

Figure A1-24. 216-B-3 Waste Management Unit: Scintillation Probe Profile Cross Section A-A'.

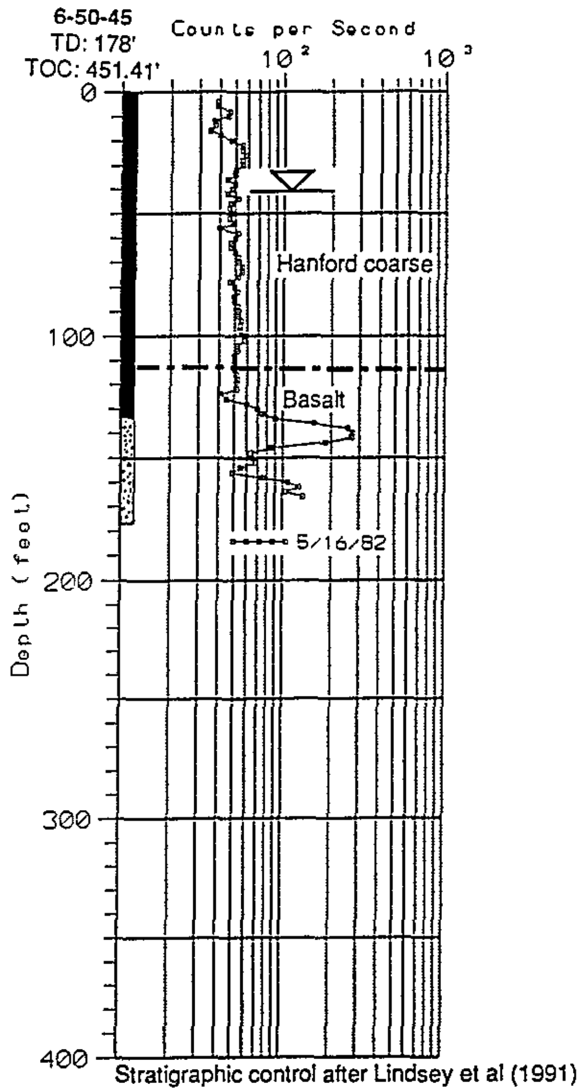

Figure A1-25. 216-A-25 Waste Management Unit: Scintillation Probe Profile of Well 6-50-45.

Table A1-1. Summary of WMU Evaluation Results. Page 1 of 3

WMU	Description	Radiation Detected	Depth Interval (ft)	Evidence of Migration	Detected in Groundwater
216-B-43	Crib	Yes	24-230	No	Yes*
216-B-44	Crib	Yes	39-230	No	Yes*
216-B-45	Crib	Yes	28-230	No	Yes*
216-B-46	Crib	Yes	5-230	No	Yes*
216-B-47	Crib	Yes	40-125	No	Yes*
216-B-48	Crib	Yes	10-153	No	Yes*
216-B-49	Crib	Yes	10-153	No	Yes*
216-B-50	Crib	Yes	10-230	No	Yes*
216-B-57	Crib	Yes	25-68	No	Yes*
216-B-61	Crib	Yes	---	No	Yes*
216-B-14	Crib	Yes	0-268	No	No
216-B-15	Crib	Yes	---	No	No
216-B-16	Crib	Yes	0-306	No	No
216-B-17	Crib	Yes	12-70	No	No
216-B-18	Crib	Yes	12-90	No	No
216-B-19	Crib	Yes	---	No	No
216-B-20	Trench	Yes	15-40	No	No
216-B-21	Trench	No	Unknown	---	No
216-B-22	Trench	No	Unknown	---	No
216-B-24	Trench	No	Unknown	---	---
216-B-25	Trench	Yes	4-??	No	Unknown
216-B-26	Trench	No	Unknown	---	---
216-B-27	Trench	Yes	4-22	No	Unknown
216-B-28	Trench	No	Unknown	---	No
216-B-29	Trench	No	Unknown	---	No
216-B-30	Trench	---	---	---	---
216-B-31	Trench	Yes	4-??	No	Unknown
216-B-32	Trench	Yes	34-36	No	Unknown
216-B-33	Trench	Yes	22-30	No	Unknown
216-B-34	Trench	No	Unknown	---	No
216-B-52	Trench	---	---	---	---

Table A1-1. Summary of WMU Evaluation Results. Page 2 of 3

WMU	Description	Radiation Detected	Depth Interval (ft)	Evidence of Migration	Detected in Groundwater
216-B-53A	Trench	No	Unknown	---	---
216-B-53B	Trench	---	---	---	---
216-B-58	Trench	---	---	---	---
216-B-35	Trench	Yes	20-??	No	Unknown
216-B-36	Trench	Yes	0-70	No	Unknown
216-B-37	Trench	Yes	0-??	No	Unknown
216-B-38	Trench	Yes	0-??	No	Unknown
216-B-39	Trench	---	---	---	Unknown
216-B-40	Trench	---	---	---	Unknown
216-B-41	Trench	Yes	27-63	No	Yes
216-B-42	Trench	Yes	18-37	No	No
216-B-7A&B	Cribs	Yes	12-75	No	Yes*
216-B-8	Crib & Tile Field	Yes	12-120 22-50	No No	Yes* ---
216-B-11A&B	Reverse Wells	Yes	75-98	No	Yes*
216-B-51	French Drain	No	---	---	Yes*
216-B-5	Reverse Well	No	---	---	Yes
241-B-361	Settling Tank	No	---	---	---
216-B-9	Crib & Tile Field	Yes Yes	8-42 8-42	No No	Unknown Unknown
241-BX-155	Diversion Box	No	Unknown	---	Unknown
241-BX-302C	Catch Tank	No	Unknown	---	Unknown
216-B-56	Crib	No	---	---	Yes
216-B-59	Trench	---	---	---	---
216-B-59B	Retention Basin	---	---	---	---
241-B-154	Diversion Box	---	---	---	---
241-B-302B	Catch Tank	---	---	---	---
216-B-6	Reverse Well	---	---	---	---
216-B-10A	Crib	No	---	---	No
216-B-10B	Crib	No	---	---	No
216-B-2-1	Ditch	No	---	---	No
216-B-2-2	Ditch	No	---	---	No

Table A1-1. Summary of WMU Evaluation Results. Page 3 of 3

WMU	Description	Radiation Detected	Depth Interval (ft)	Evidence of Migration	Detected in Groundwater
216-B-2-3	Ditch	No	---	---	No
216-B-63	Ditch	No	---	---	No
216-B-12	Crib	Yes	0-125	No	No
216-B-55	Crib	No	---	---	No
216-B-64	Retention Basin	---	---	---	---
216-B-62	Crib	Yes	32-114	No	No
218-E-2	Burial Ground	No	---	---	Yes*
218-E-2A	Burial Ground	No	---	---	Yes*
218-E-4	Burial Ground	No	---	---	Yes*
218-E-5	Burial Ground	No	---	---	Yes*
218-E-5A	Burial Ground	No	---	---	Yes*
218-E-9	Burial Ground	No	---	---	Yes*
218-E-10	Burial Ground	No	---	---	No
216-B-3	Pond	No	Unknown	---	No
216-B-3A	Pond	No	Unknown	---	No
216-B-3B	Pond	No	Unknown	---	No
216-B-3C	Pond	No	Unknown	---	No
216-B-3-1	Ditch	No	---	---	No
216-B-3-2	Ditch	No	---	---	No
216-B-3-3	Ditch	No	---	---	No
216-E-25	Pond	---	---	---	---
218-E-3	Burial Ground	No	---	---	No
216-A-28	Pond	Yes	125-165	No	Yes
216-N-8	Pond	Yes	125-165	No	Yes
241-B-101to 112	Tank Farm	Yes	B-??	Yes	Unknown
241-BX-101 to 112	Tank Farm	Yes	0-??	No	Unknown
241-BY-101 to 112	Tank Farm	Yes	0-??	Yes	Unknown

* Gamma radiation detected in groundwater possibly spurrious.
° Unit is Currently Active.

Table A1-2. Details of Wells and Logs Used in Evaluation of WMUs 216-B-43 through -50, 57, and -61.

Well #	Northing	Westing	TOC	TD	Perforations	Logs Used
E33-1	46375	53335	626.12	235	215-235	2/28/79*
						5/4/76*
						4/27/70*
						4/19/68
						8/13/65*
						5/23/63
						1/28/58
E33-2	46466°	53384	629.72	231	220-233	7/16/87*
						5/4/76*
						4/27/70
						5/23/63
						5/11/59
E33-3	46547	53331	625.73	234	---	2/28/79*
						5/4/76*
						4/27/70
						5/23/63
						1/28/59
E33-4	46635	53384	624.92	228	215-231	7/16/87*
						5/20/76
						4/27/70
						5/23/63
						1/28/59
E33-5	46352	53523	632.04	237	218-235	5/4/76*
						4/27/70
						5/23/69
						5/4/59
E33-6	46503	53524	627.9	236	214-229	7/16/87*
						5/4/76*
						4/29/70
						5/23/63
						5/11/59
E33-7	46619	53520	626.58	230	215-230	7/16/87*
						2/20/76*
						4/19/68
						7/9/65*
						1/28/59
E33-13	46278	53093	625.53	229	210-235	7/16/87*
						2/20/76*
E33-22	46450°	53300°	625.78	230	212-231	7/16/87*
						5/4/76*
						9/17/65
E33-23	46600°	53350°	625.34	227	218-230	7/16/87*
						5/4/76*
						4/27/70
						9/20/65
E33-24	46260	53790	638.03	253	219-241	5/4/76*
						4/27/70
						4/19/69
E33-25	46600	54210	631.02	238	199-233	2/20/76*
						4/24/70
E33-26	46600	54315	632.51	240	---	5/4/76*
E33-38	46312	53469	631.74	242	---	1/9/91*
E33-90	46500	53200	650	140	---	9/17/65*

*Digitized Logs
°Discrepancy between GIS coordinates and map location in Fecht et al. (1977).
Sources: Westinghouse GIS Listing of Well Statistics; Fecht et al. (1976).

Table A1-3. Details of Wells Used in Evaluation of WMUs 216-B-14 through -19.

Well #	Northing	Easting	TOC	TD	Perforations	Logs Used	
E13-1	35800	53260	741.9	345	329-364	7/13/87	*
						4/18/58	*
						4/30/70	
						4/29/68	
						5/9/63	
						5/14/59	
						3/9/56	
E13-2	35564	53446	743.49	346	335-367	7/13/87	*
						4/18/58	*
						4/30/76	
						4/24/68	
						5/10/63	
						5/14/59	
						3/9/56	
E13-3	35734	53408	741.48	353	327-362	7/10/87	*
						4/30/76	
						4/24/68	
						5/9/63	
						4/14/59	
						3/9/56	
E13-4	35809	53550	743.5	362	337-367	7/13/87	*
						4/18/58	*
						4/30/76	
						4/24/68	
						5/10/63	
						5/14/59	
						3/9/56	
E13-5	35565	53447	734.06	365	330-365	4/18/85	*
						4/18/58	*
						4/30/76	
						4/24/68	
						5/9/63	
						5/14/59	
						3/9/56	
E13-6	35641	53589	742.4	363	341-362	7/10/87	*
						4/18/58	*
						2/20/76	
						4/24/68	
						5/10/63	
						5/14/59	
						3/9/56	
E13-20	35543	53440	742.92	357	334-384	7/10/87	*
E13-21	35730	53420	740	335		7/10/87	*
						4/30/76	
						4/24/68	
						7/5/66	

* Digitized Logs
Source: Westinghouse GIS Listing of Well Statistics

Table A1-4. Details of Wells and Logs Used in Evaluation of WMUs 216-B-20 through -34, -52, -53A, -53B, -54, and -58.

Page 1 of 2

Well #	Northing	Easting	TOC	TD	Perforations	Logs Used	
E13-7	35631	54107	742.94	355	323-365	7/8/87	*
						4/30/76	
						4/24/68	
						5/10/63	
						5/26/59	
E13-8	35508	54323	740.7	356	317-362	7/9/87	*
						2/10/76	
						4/24/68	
						5/10/63	
						5/4/59	
						4/18/58	*
E13-9	35900	54297	744.03	361	319-362	7/8/87	*
						4/30/76	
						4/24/66	
						5/10/63	
						5/26/59	
E13-10	35348	54798	738.84	346	310-342	7/9/87	*
						4/30/76	
						4/24/68	
						5/13/63	
						5/26/59	
						5/2/58	*
E13-11	35199	54170	734.97	350	310-364	3/22/84	*
						4/30/76	
						2/26/59	
E13-12	35001	54820	731.34	342	308-360	7/9/87	
						4/30/76	
						5/26/59	
E13-13	34800	54100	726.06	349	302-356	5/10/63	
						5/26/59	
E13-14	36080	55150	745.15	344	320-353	4/3/84	
						5/3/76	
						4/23/68	
						5/13/63	
						5/27/59	
E13-15	35660	55470	734.55	362	315-365	7/9/87	
						5/3/76	
						4/23/68	
						5/13/63	
						5/27/59	

Table A1-4. Details of Wells and Logs Used in Evaluation of WMUs 216-B-20 through -34, -52, -53A, -53B, -54, and -58.

Well #	Northing	Easting	TOC	TD	Perforations	Logs Used	
E13-16	35660	54840	744.51	347	308-365	7/9/87	
						3/21/84/	
						4/30/76	
						4/25/68	
						5/13/63	
						5/26/59	
E13-17	35230	55250	732.78	334	308-356	7/9/87	*
						5/3/76	
						5/27/59	
E13-18	35230	55050	729.18	380	305-410	7/9/87	*
						5/3/76	
						5/13/63	
						5/27/59	
E13-19	34720	54530	728.49	358	310-360	7/10/87	*
						4/24/68	
						5/10/63	
						5/26/59	
E13-51	35500	54200	738	70	-	7/8/87	*
E13-52	35700	55200	730	90	-	7/9/87	*
E13-54	35445	54460	740	46	-	7/13/87	*
E13-55	35320	54495	738	46	-	7/9/87	*
E13-56	35120	54495	738	44	-	7/9/87	*
E13-57	34920	54495	732	46	-	7/9/87	*
E13-58	35747	51550	730	46	-	7/9/87	*
E13-59	35617	55150	730	46	-	7/8/87	*
E13-60	35453	55150	730	46	-	7/8/87	*
E13-61	35995	54720	740	38	-	7/13/87	*

* Digitized Logs

Source: Westinghouse GIS Listing of Well Statistics.

Table A1-5. Details of Wells and Logs Used in Evaluation of WMUs 216-B-35 through -42.

Well #	Northing	Westing	TOC	TD	Perforations	Logs Used
E33-8	45832	53851	650.73	256	230-257	2/20/76 *
						4/27/70 *
						4/19/68 *
						5/17/63 *
						5/4/59
E33-10	45216	54566	671.18	290	259-285	12/3/76 *
						4/17/68 *
						5/17/63 *
E33-21	45324	53855	668.13	280	235-275	5/4/76 *
						4/27/70
						5/17/63
						5/4/59
						7/13/57 *
E33-28	45596	54668	664.23	276	256-276	10/15/87 *
E33-29	45124	54665	673.77	283	263-283	9/14/87 *
E33-32	45524	53689	659.83	267	246-267	8/9/89 *
E33-286	45257	54017	---	50	---	7/15/87 *
E33-287	45383	53980	---	50	---	7/15/87 *
E33-288	45428	53980	---	49	---	7/15/87 *
E33-289	45479	53980	---	49	---	7/15/87 *
E33-290	45520	53980	---	---	---	7/15/87 *

* Digitized Logs
Source: Westinghouse GIS Listing of Well Statistics; Latst et al. (1989).

Table A1-6. Details of Wells and Logs Used in Evaluation of WMUs 216-B-7, -8, -11, and -51. Page 1 of 2

Well #	Northing	Westing	TOC	TD	Perforations	Logs Used
E33-11	46444	52452	620.27	229	---	5/5/76 * 4/24/70 5/20/63 5/5/59
E33-12	46436	52850	623	414	305-385	1/12/82 * 5/4/76 *
E33-14	46223	52177	622.12	230	212-227	5/5/76 * 4/24/70 5/20/63 5/5/59
E33-15	46066	52751	627.4	251	222-237	5/5/76 * 5/5/59
E33-16	45887	52815	635.51	258	231-246	2/20/76 * 4/28/689 5/22/63 5/5/59
E33-17	45894	52529	631.65	244	220-244	5/5/76 * 4/27/70 * 4/23/68 * 5/5/59 *
E33-18	45627	52825	643.84	263	240-260	5/5/76 * 4/27/70 * 4/24/68 * 5/23/63 * 5/5/59
E33-19	45744	52629	639	245	217-248	5/5/76 * 5/5/59
E33-20	45664	52629	640.87	250	225-251	2/20/76 * 4/27/70 * 4/23/68 * 5/22/63 5/5/59
E33-39	46451	52641	623.11	230	---	1/21/91 *
E33-58	45633	52761	642.82	153	---	5/5/76 * 5/23/63
E33-59	45633	52794	643.05	153	---	5/5/76 * 5/23/63
E33-61	45537	53145	653.23	150	---	5/27/63 * 8/26/59 *
E33-66	45885	52883	635.89	142	---	5/5/76 * 5/22/63
E33-67	45875	52857	637.71	150	---	5/5/76 * 5/22/63
E33-68	45897	52845	636.88	150	---	5/5/76 * 5/22/63
E33-69	45855	52833	636.46	145	---	5/5/76 * 5/22/63
E33-70	45873	52865	637.58	150	---	5/5/76 * 5/22/63
E33-71	45905	52847	636.37	146	---	5/5/76 * 5/22/63
E33-72	45795	52819	638.78	150	---	5/5/76 * 5/22/63 *

* Digitized Log

Source: Westinghouse GIS Listing of Well Statistics.

Table A1-6. Details of Wells and Logs Used in Evaluation of WMUs 216-B-7, -8, -11, and -51.

Well #	Northing	Westing	TOC	TD	Perforations	Logs Used
E33-73	45993	52815	631.69	146	---	5/5/76 * 5/22/63
E33-74	46011	52747	629.92	145	---	5/5/76 * 5/22/63
E33-75	45709	52798	641.78	144	---	5/5/76 * 5/22/63
E33-76	46155	52681	625.31	143	---	5/5/76 * 5/22/63 *
E33-84	46058	53198	649.18	150	40-100	5/27/63 *
E33-89	45863	52835	650	145	---	5/5/76 * 5/22/63

* Digitized Log

Source: Westinghouse GIS Listing of Well Statistics.

Table A1-7. Details of Wells and Logs Used in Evaluation of WMUs 216-B-5 and 241-B-361.

Well #	Northing	Easting	TOC	TD	Perforations	Logs Used
E28-1	43480	52355	685.2	322	277-311	5/4/76 *
						5/11/59 *
E28-7	43437	52812	685.91	310	270-335	7/15/89 *
						5/4/76
						5/17/63 *
						8/26/59
E28-23	43477	52852	---	328	278-328	Not Available
E28-24	43466	52841	---	322	277-327	7/15/87 *
						9/22/86 *
E28-25	43494	52869	---	329	279-328	Not Available
E28-73	43415	52890	---	---	---	8/12/87 *
E28-74	43385	52890	---	---	---	8/12/87 *

*Digitized Logs

Source: Westinghouse GIS Listing of Well Statistics.

Table A1-8. Details of Wells and Logs Used in Evaluation of WMUs 216-B-9, 241-BX-155 and -302C.

Well #	Northing	Easting	TOC	TD	Perforations	Logs Used	
E28-2	43913	53105	680.91	310	288-318	7/6/79	*
						1/28/78	*
E28-5	43887	52024	672.32	325	259-304	5/4/76	*
E28-53	43732	52593	680.6	25		5/4/76	*
						5/24/63	
E28-54	43732	52643	680.43	150		8/25/87	*
						5/4/76	*
						5/24/63	
E28-55	43782	52643	680.3	150		5/4/76	*
						5/24/63	
E28-56	43862	52578	676.25	150		5/4/76	*
E28-57	43862	52660	678.24	150		5/4/76	*
E28-58	43916	52575	675.78	145		5/4/76	*
						5/24/63	
E28-59	43916	52660	676.45	141		5/4/76	*
E28-60	43977	52618	674.65	145		5/4/76	*
E28-61	43782	52593	680.51	150		5/4/76	*
						5/24/63	

* Digitized Logs
Source: Westinghouse GIS Listing of Well Statistics

Table A1-9. Details of Wells and Logs Used in Evaluation of WMUs 216-B-56, -59, 241-B-154 and -302B.

Well #	Northing	Easting	TOC	TD	Perforations	Logs Used
E28-3	43071	53093	692.86	318	314-324	1/28/87 *
						7/6/79 *
E28-4	42773	52148	691.55	312	295-321	1/28/87 *
						7/6/79 *
E28-6	42445	52855	700.11	334	310-340	7/15/87
						5/13/65
						5/17/63
E28-14	42885	52635	694.74	352		2/5/87 *
						7/6/79 *
						5/4/76 *
						4/18/63 *

* Digitized Logs
Source: Westinghouse GIS Listing of Well Statistics

Table A1-10. Details of Wells and Logs Used in Evaluation of WMUs 216-B-2-1, -2, -3, and -63.

Well #	Northing	Easting	TOC	TD	Perforations	Logs Used
E27-8	44496	49642	637.83	281	241-281	8/14/87
E27-9	44484	49122	629.21	239		8/3/87 *
E27-11	44558	49990	643.29	264	231-251	7/21/89 *
						7/12/89 *
E27-16	51544	44897	652.13	268		2/8/90
						12/22/89
E33-33	45348	51868	640.17	248	227-248	8/9/89
E33-36	45145	51906	646.67	264		12/28/89 *
E33-37	44965	51832	653.01	268		12/28/89 *

* Digitized Logs
Source: Weestinghouse GIS Listing of Well Statistics

Table A1-11. Details of Wells and Logs Used in Evaluation of WMUs 216-B-12, -55, and -63.

Well #	Northing	Westing	TOC	TD	Perforations	Logs Used
E28-9	43044	55101	700.77	350	290-340	8/25/87 * 5/5/76 * 4/28/70 * 5/15/63 *
E28-12 02-55-04	42490	54885	708.6	349	---	9/17/91 * 3/20/84 * 10/8/80 * 2/19/76 * 4/28/70 4/18/68
E28-13	42675	55145	706	372	---	9/29/82 * 4/18/68 *
E28-16	42927	54975	703.12	318	270-323	5/5/76 4/28/70 * 11/15/68 *
E28-19	43324	55205	697.49	308	260-325	3/20/84 * 4/28/70 *
E28-64	43000	55000	700	33	---	5/5/76 * 9/21/67
E28-65	43060	55000	700	---	---	5/5/76 * 9/27/68
E28-66	43120	55000	699	---	---	5/5/76 * 9/27/68
E28-76	43088	54965	---	---	---	8/25/87 *

* Digitized Log

Sources: Westinghouse GIS Listing of Well Statistics; Welty & Vermeulen (1989).

Table A1-12. Details of Wells and Logs Used in Evaluation of WMU 216-B-62.

Well #	Northing	Westing	TOC	TD	Perforations	Logs Used
E28-18 02-62-05	43603	55105	692.58	309	260-325	4/9/87 * 9/29/82 * 2/19/76
E28-20 02-62-06	43705	55188	690.29	298	260-325	9/17/91 * 10/8/80 * 5/4/76 4/28/70 *
E28-21	43806	55290	688.75	314	257-325	9/29/82 * 5/3/76 4/28/70 *
E28-75 02-62-04	43600	55000	---	150	---	9/17/91 * 3/21/84 *

* Digitized Log

Sources: Westinghouse GIS Listing of Well Statistics; Welty & Vermeulen (1989).

Table A1-13. Details of Wells and Logs Used in Evaluation of WMUs 218-E-2, -2A, -4, -5, -5A, -9, and -10.

Well #	Northing	Westing	TOC	TD	Perforations	Logs Used
E28-2	43915	53105	680.91	310	288-318	1/28/87 * 7/6/79 * 5/17/63 * 6/25/58
E28-8	44603	53124	668.52	314	250-294	5/17/63 *
E28-26	44446	55606	687.26	299	279-299	N/A
E28-27	44595	54670	680.37	290	270-290	N/A
E28-28	44724	56056	686.55	295	275-295	1/10/90° *
E32-1	46488	56684	656.17	274	241-271	5/11/58
E32-2	45904	56565	670.06	278	258-278	8/28/87 *
E32-3	45631	56721	676.51	286	266-286	8/28/87 *
E32-4	44985	56713	685.88	298	278-298	9/14/87 *
E32-5	45306	56725	682.14	290	270-290	10/19/89 *
E33-28	45596	54668	664.23	276	256-276	10/15/87 *
E33-29	45124	54665	673.77	283	263-283	9/14/87 *
E33-30	45903	55660	663.7	275	255-275	9/15/87 *
E33-34	46796	55065	633.33	239	219-239	4/4/90 *
E33-35	46351	54685	643.01	249	228-249	2/8/90 *

* Digitized Log

°Log from upper portion of well only.

Sources: Westinghouse GIS Listing of Well Statistics; Last et al. (1989).

Table A1-14. Details of Wells and Logs Used in Evaluation of WMUs 216-B-3 and 216-E-28.

Well #	Northing	Easting	TOC	TD	Perforations	Logs Used	
E26-8	43317	47142	602.76	246	326-396	7/14/82	*
E26-9	44780	46960	602.9	201.5		8/1/90	
E26-10	44420	46919	601.49	206		9/6/90	
E26-11	44779	44972	599.7	205.8		9/6/90	
E35-1	45867	47339	598.31	234	23-251	8/29/89	
E35-2	45180	46959	602.12			7/13/90	
6-39-39	39044	38851	536.65	180	110-194	5/6/80	
6-40-39	39878	39224	541.84	212	201-212	6/27/89	
6-40-40A				227		8/30/91	
6-40-40B				202		9/19/91	
6-40-43				135		10/24/91	
6-41-40	41030	40285	545.94	174	164-174	6/8/89	*
6-42-39A						8/2/91	
6-42-40C	42414	40181	546.16	385	306-390	7/14/82	
6-42-42A	42004	42012	602.2	1092	174-301	7/2/80	
6-42-42B	42473	42301	583.23	203		9/14/88	
6-43-40				137		8/27/91	
6-43-41E	42995	40723	550.86	146	136-146	7/30/91	
6-43-41F	42945	40721	551.01	176.07		4/28/89	
6-43-42	41817	43116	566.36	223		5/27/80	
6-43-42J	42532	42274	581.68	177		8/10/88	*
6-43-42K	42509	42304	581.38	262		11/18/88	
6-43-43	42942	43184	579.37	177		9/1/88	
6-43-45	42977	44644	597.68	203	183-203	6/6/89	
6-44-42	43783	41965	579.22	172		9/19/88	
6-44-43B	43998	43363	580.12	176	156-176	5/18/89	
6-45-42	42099	45274	577.33	173	158-180	8/18/80	
6-47-46A	47039	45994	580.14	205	168-181	8/15/80	

* Digitized Logs
Source: Westinghouse GIS Listing of Well Statistics

Table A1-15. Details of Wells and Logs Used in Evaluation of WMUs 216-A-25 and 216-N-8.

Well #	Northing	Easting	TOC	TD	Perforations	Logs Used
6-50-45	50150	44992	451.41	178	133-178	5/6/82 *
6-50-48						6/4/80
6-52-46						5/1/80
6-52-48	51556	48076	466.06	195	145-195	3/24/80 *
6-54-42	54396	42431	511.49	140	100-200	5/7/80
6-54-45B	54250	44510	492.94		299-314	7/19/82
6-55-44	55462	43677	519.67	152	140-150	3/10/80
6-55-55	55000	55000				11/13/90
6-56-53	56343	52779	434.34	270	190-270	7/19/82
6-60-57	60350	56612	469.64	154		5/15/81

* Digitized Logs
Source: Westinghouse GIS Listing of Well Statistics

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APPENDIX A.2

SAMPLE DATA

Table A-2.1. Results of Fenceline Soil Sampling (pCi/g).

Location 2E-N											
	1985		1986		1987		1988		1989		
Radio-nuclide	Result	Error	Result	Error	Result	Error	Result	Error	Result	Error	Average Result
Ce-141	–	–	–	–	<1.20E-02	2.90E-02	<-7.60E-03	3.60E-02	-5.72E-02	9.29E-02	-1.76E-02
Ce-144	–	–	–	–	–	–	–	–	-8.70E-02	1.27E-01	-8.70E-02
Co-58	–	–	–	–	<-3.30E-03	1.30E-02	–	–	7.90E-03	2.54E-02	2.30E-03
Co-60	–	–	–	–	1.60E-02	1.30E-02	–	–	4.66E-03	1.54E-02	1.03E-02
Cs-134	–	–	–	–	6.50E-02	1.70E-02	<1.40E-02	2.00E-02	-1.70E-02	1.81E-02	2.28E-02
Cs-137	–	–	–	–	9.10E+00	9.20E-01	1.20E+01	1.20E+00	6.84E+00	6.95E-01	9.42E+00
Eu-152	–	–	–	–	9.40E-02	6.80E-02	<8.30E-02	9.10E-02	1.12E-01	6.62E-02	9.75E-02
Eu-154	–	–	–	–	<3.30E-02	4.20E-02	<6.50E-03	5.40E-02	-5.63E-02	5.37E-02	-5.60E-03
Eu-155	–	–	–	–	7.10E-02	5.80E-02	<4.40E-02	7.70E-02	6.19E-02	5.94E-02	5.90E-02
K-40	–	–	–	–	–	–	–	–	1.58E+01	1.75E+00	1.58E+01
Mn-54	–	–	2.90E-02	2.40E-02	2.70E-02	1.30E-02	<6.40E-03	1.80E-02	1.69E-02	1.77E-02	1.98E-02
Nb-95	–	–	–	–	–	–	–	–	1.34E-02	6.48E-02	1.34E-02
Pb-212	–	–	–	–	–	–	–	–	8.38E-01	9.59E-02	8.38E-01
Pb-214	–	–	–	–	–	–	–	–	6.92E-01	1.00E-01	6.92E-01
Pu-238	–	–	–	–	<2.00E-04	2.90E-04	<-3.20E-05	4.00E-04	–	–	-3.20E-05
Pu-239	–	–	–	–	6.00E-03	1.40E-03	4.30E-03	1.60E-03	–	–	4.30E-03
Ru-106	–	–	–	–	<7.90E-02	1.60E-01	<6.20E-02	2.00E-01	-1.45E-01	1.82E-01	-1.33E-03
Sr-90	–	–	1.65E+00	3.06E-01	1.90E+00	4.70E-01	1.10E+00	2.10E-01	–	–	1.55E+00
U (total)	–	–	–	–	2.80E-01	1.30E-01	8.70E-02	3.50E-02	–	–	8.70E-02
Zn-65	–	–	–	–	<-3.60E-02	3.40E-02	–	–	-6.85E-02	4.72E-02	-5.23E-02
Zr-95	–	–	–	–	4.80E-03	2.40E-02	<3.50E-03	3.40E-02	-3.64E-03	5.38E-02	1.55E-03

Table A-2.1. Results of Fenceline Soil Sampling (pCi/g).

Location B-TF-NE											
	1985		1986		1987		1988		1989		
Radio-nuclide	Result	Error	Result	Error	Result	Error	Result	Error	Result	Error	Average Result
Ce-141	–	–	–	–	<1.60E-02	5.40E-02	<-8.00E-02	1.30E-01	-5.08E-02	3.48E-02	-3.83E-02
Ce-144	–	–	–	–	<-5.80E-02	1.80E-01	–	–	1.51E-01	4.52E-01	4.65E-02
Co-58	*	–	–	–	1.20E-02	1.10E-02	–	–	-5.39E-03	2.82E-02	3.31E-03
Co-60	*	–	–	–	1.80E-02	1.20E-02			1.48E-02	1.81E-02	1.64E-02
Cs-134	*	–	–	–	<1.30E-02	1.80E-02	<9.70E-03	8.80E-02	-5.51E-02	6.18E-02	-1.08E-02
Cs-137	8.10E+01	–	–	–	2.80E+01	2.80E+00	1.90E+02	1.90E+01	2.00E+02	2.00E+01	1.57E+02
Eu-152	*	–	–	–	<1.20E-02	7.40E-02	1.20E-01	9.00E-02	-3.54E-02	7.42E-02	4.23E-02
Eu-154	*	–	–	–	<01.10E-02	5.10E-02	<-1.20E-01	7.00E-02	-1.04E-02	5.25E-02	-4.71E-02
Eu-155	*	–	–	–	<2.50E-02	1.00E-01	<2.10E-01	3.00E-01	4.69E-02	2.10E-01	9.40E-02
K-40	–	–	–	–	–	–	–	–	1.39E+01	1.57E+00	1.39E+01
Mn-54	*	–	–	–	1.10E-02	1.10E-02	<1.60E-O2	2.20E-02	-9.63E-03	1.89E-02	5.79E-03
Nb-95	*	–	–	–	–	–	–	–	-3.71E-02	6.65E-02	-3.71E-02
Pb-212	–	–	–	–	–	–	–	–	4.31E-01	1.43E-01	4.31E-01
Pb-214	–	–	–	–	–	–	–	–	5.57E-01	2.14E-01	5.57E-01
Pu-238	*	–	–	–	<1.80E-04	4.60E-04	2.60E-04	1.60E-04	–	–	2.60E-04
Pu-239	*	–	–	–	9.90E-03	2.10E-03	7.40E-03	1.10E-03	–	–	7.40E-03
Ru-106	*	–	4.44E-01	3.79E-01	<-5.30E-02	2.60E-01	<-4.40E-01	9.50E-01	-3.98E-01	6.59E-01	-1.12E-01
Sr-90	1.00E+01	–	5.75E+00	1.03E+00	8.20E+00	2.00E+00	6.30E+00	1.20E+00	–	–	7.56E+00
U(total)	*	–	–	–	5.50E-02	3.90E-02	3.20E-01	1.00E-01	–	–	3.20E-01
Zn-65	*	–	–	–	<-1.50E-02	3.70E-02	–	–	-7.63E-02	4.85E-02	-4.57E-02
Zr-95	*	–	6.30E-02	5.40E-02	<-3.10E-02	2.90E-02	<1.20E-02	4.10E-02	7.64E-02	6.37E-02	2.41E-02

Table A-2.1. Results of Fenceline Soil Sampling (pCi/g).

Location B-TF-SE

Radio-nuclide	1985		1986		1987		1988		1989		
	Result	Error	Result	Error	Result	Error	Result	Error	Result	Error	Average Result
Ce-141	–	–	–	–	5.20E-02	4.70E-02	<-4.40E-03	5.20E-02	-6.96E-02	7.72E-02	-7.33E-03
Ce-144	–	–	–	–	<-1.90E-02	1.60E-01	–	–	-6.61E-02	9.82E-02	-4.26E-02
Co-58	*	–	–	–	<7.20E-03	1.40E-02	–	–	7.19E-03	2.47E-02	7.20E-03
Co-60	*	–	1.80E-02	1.70E-02	2.40E-02	1.30E-02	–	–	-1.39E-02	1.82E-02	9.37E-03
Cs-134	*	–	–	–	2.20E-02	2.10E-02	<-4.30E-03	2.90E-02	-3.67E-02	1.61E-02	-6.33E-03
Cs-137	1.08E+01	7.43E-01	–	–	1.40E+01	1.40E+00	3.80E+01	3.80E+00	4.76E-01	6.04E-02	1.64E+01
Eu-152	*	–	–	–	<2.20E-03	7.30E-02	<3.50E-02	6.80E-02	-5.40E-03	8.24E-02	1.48E-02
Eu-154	1.43E-01	8.30E-02	–	–	<-2.50E-03	4.60E-02	7.20E-02	4.30E-02	-1.57E-02	5.65E-02	4.92E-02
Eu-155	*	–	–	–	<7.50E-02	9.30E-02	<4.20E-02	1.10E-01	1.88E-02	5.57E-02	4.53E-02
K-40	–	–	–	–	–	–	–	–	1.43E+01	1.61E+00	1.43E+01
Mn-54	*	–	2.30E-02	1.70E-02	<3.40E-03	1.50E-02	<1.20E-03	1.30E-02	1.24E-03	1.89E-02	7.21E-03
Nb-95	*	–	–	–	–	–	–	–	-4.84E-02	6.28E-02	-4.84E-02
Pb-212	–	–	–	–	–	–	–	–	6.78E-01	7.95E-02	6.78E-01
Pb-214	–	–	–	–	–	–	–	–	5.84E-01	8.19E-02	5.84E-01
Pu-238	3.00E-04	2.00E-04	–	–	<6.30E-05	2.70E-04	4.50E-04	3.30E-04	–	–	3.75E-04
Pu-239	6.00E-03	7.00E-03	–	–	5.50E-03	1.30E-03	1.30E-02	2.30E-03	–	–	9.50E-03
Ru-106	*	–	–	–	<-7.00E-02	2.00E-01	<-1.90E-01	2.80E-01	9.21E-02	1.35E-01	-5.60E-02
Sr-90	7.12E+00	1.29E+00	3.30E+00	5.99E-01	6.40E+00	1.60E+00	1.10E+01	2.10E+00	–	–	6.96E+-00
U (total)	1.84E-01	6.80E-02	–	–	1.30E-01	6.70E-02	6.00E-02	2.80E-02	–	–	1.22E-01
Zn-65	*	–	–	–	5.60E-02	3.10E-02	–	–	-8.34E-02	5.76E-02	-1.37E-02
Zr-95	*	–	–	–	3.80E-02	2.80E-02	<-2.20E-03	2.60E-02	9.32E-03	5.44E-02	1.50E-02

Table A-2.1. Results of Fenceline Soil Sampling (pCi/g).

Location BX-TF-W

Radio-nuclide	1985 Result	1985 Error	1986 Result	1986 Error	1987 Result	1987 Error	1988 Result	1988 Error	1989 Result	1989 Error	Average Result
Ce-141	--	--	--	--	<-2.60E-02	5.10E-02	<6.50E-03	3.00E-02	2.54E-02	1.17E-01	1.97E-03
Ce-144	--	--	--	--	<1.10E-01	1.70E-01	--	--	-1.22E-01	1.54E-01	-6.00E-03
Co-58	*	--	--	--	<-2.10E-02	1.60E-02	--	--	-2.03E-02	2.74E-02	-2.07E-02
Co-60	*	--	--	--	<-2.20E-02	1.80E-02	--	--	3.40E-03	1.74E-02	-9.30E-03
Cs-134	*	--	--	--	4.50E-02	2.10E-02	<-4.70E-02	1.90E-02	1.45E-02	1.93E-02	4.17E-03
Cs-137	2.43E+00	2.20E-01	--	--	2.30E+01	2.30E+00	2.50E+00	2.70E-01	9.17E+00	9.30E-01	4.70E+00
Eu-152	*	--	--	--	1.90E-01	5.70E-02	1.30E-01	8.20E-02	4.10E-02	7.70E-02	8.55E-02
Eu-154	*	--	--	--	<1.10E-02	4.50E-02	<-4.90E-02	6.00E-02	-4.86E-02	5.74E-02	-2.89E-02
Eu-155	*	--	--	--	<7.00E-04	9.30E-02	<-5.40E-03	7.10E-02	4.80E-02	7.87E-02	1.44E-02
K-40	--	--	--	--	--	--	--	--	1.33E+01	1.53E+00	1.33E+01
Mn-54	*	--	--	--	<-2.80E-03	1.60E-02	<1.00E-02	1.60E-02	1.55E-02	1.83E-02	7.57E-03
Nb-95	*	--	--	--	--	--	--	--	-6.80E-02	6.69E-02	-6.80E-02
Pb-212	--	--	--	--	--	--	--	--	5.89E-01	7.79E-02	5.89E-01
Pb-214	--	--	--	--	--	--	--	--	5.62E-01	9.21E-02	5.62E-01
Pu-238	2.00E-04	2.00E-04	--	--	<-1.00E-04	2.20E-04	2.70E-04	1.60E-04	--	--	2.35E-04
Pu-239	4.00E-03	1.00E-03	--	--	2.70E-03	9.60E-04	5.90E-03	9.00E-04	--	--	4.95E-03
Ru-106	*	--	--	--	<-8.60E-02	2.30E-01	<4.00E-02	1.60E-01	-1.70E-02	2.03E-01	-2.10E-02
Sr-90	1.37E-01	3.00E-02	--	--	2.70E-01	7.20E-02	4.00E-01	7.80E-02	--	--	2.69E-01
U (total)	2.64E-01	9.10E-02	--	--	3.30E-01	1.60E-01	4.00E-01	1.20E-01	--	--	3.32E-01
Zn-65	1.40E-01	6.00E-02	--	--	<-4.00E-02	3.90E-02	--	--	-1.03E-02	4.58E-02	2.99E-02
Zr-95	*	--	--	--	<-3.80E-02	2.80E-02	<1.50E-02	3.10E-02	1.29E-02	5.15E-02	-3.37E-03

Source: Schmidt et al. 1990: Elder et al. 1986, 1987, 1988, 1989.
Negative values indicate concentrations at or near background levels of radioactivity.
Shaded areas indicate a positive detection, the result is greater than the error.
An asterisk (*) indicates that radionuclide concentration is less than detectable. The detection limits are as follows: Mn-54=2.0E-02, Co-58=2.0E-02, Co-60=2.0E-02, Zn-65=4.0E-02, Sr-90=5.0E-03, Nb-95=3.0E-02, Zr-95=3.0E-02, Ru-106=1.7E-01, Cs-134=2.0E-02, Cs-137=2.0E-02, Eu-152=1.1E-01, Eu-154=5.0E-02, Eu-155=5.0E-02, Pu-238=6.0E-04, Pu-239=6.0E-04, and U (total) = 1.0E-02.

Table A-2.2. Results of Vegetation Soil Sampling (pCi/g).

Location 2E1											
	1985		1986		1987		1988		1989		
Radio-nuclide	Result	Error	Result	Error	Result	Error	Result	Error	Result	Error	Average Result
Be-7	—	—	—	—	—	—	—	—	—	—	—
Ce-141	—	—	—	—	—	—	<-7.70E-03	6.50E-02	—	—	-7.70E-03
Co-58	—	—	—	—	—	—	—	—	—	—	—
Co-60	*	—	—	—	<-7.30E-03	1.60E-02	<3.50E-03	1.70E-02	—	—	-1.90E-03
Cs-134	—	—	—	—	4.30E-02	1.60E-02	—	—	—	—	4.30E-02
Cs-137	1.64E-02	1.06E-01	—	—	1.60E-01	2.60E-02	9.30E-02	2.40E-02	—	—	8.98E-02
Eu-152	*	—	—	—	<4.20E-02	6.50E-02	<6.60E-02	7.40E-02	—	—	5.40E-02
Eu-154	*	—	—	—	<8.20E-03	4.80E-02	5.40E-02	5.30E-02	—	—	3.11E-02
Eu-155	*	—	—	—	<9.60E-03	3.50E-02	<2.80E-02	4.20E-02	—	—	1.88E-02
I-129	—	—	—	—	—	—	—	—	—	—	—
Mn-54	—	—	—	—	—	—	—	—	—	—	—
Nb-95	2.03E-02	1.46E-02	—	—	3.00E-02	1.90E-02	<-2.50E-02	6.20E-02	—	—	8.43E-03
Pb-212	—	—	—	—	—	—	—	—	—	—	—
Pb-214	—	—	—	—	—	—	—	—	—	—	—
Pu-238	*	—	—	—	—	—	—	—	—	—	—
Pu-239	4.00E-04	3.00E-04	—	—	—	—	—	—	—	—	4.00E-04
Ru-103	*	—	—	—	—	—	—	—	—	—	—
Ru-106	*	—	—	—	—	—	—	—	—	—	—
Sr-90	2.15E-01	6.58E-02	—	—	—	—	—	—	—	—	2.15E-01
Tc-99	—	—	—	—	—	—	—	—	—	—	—
Zr-95	*	—	—	—	<-1.30E-02	3.00E-02	<2.50E-02	5.60E-02	—	—	6.00E-03

Table A-2.2. Results of Vegetation Soil Sampling (pCi/g).

Location 2E2

Radio-nuclide	1985 Result	1985 Error	1986 Result	1986 Error	1987 Result	1987 Error	1988 Result	1988 Error	1989 Result	1989 Error	Average Result
Be-7	–	–	–	–	–	–	–	–	–	–	–
Ce-141	–	–	–	–	–	–	<-7.70E-03	6.60E-02	–	–	-7.70E-03
Co-58	–	–	–	–	–	–	–	–	–	–	–
Co-60	2.82E-02	1.52E-02	–	–	–	–	<8.70E-03	1.50E-02	–	–	1.85E-02
Cs-134	–	–	9.86E-02	4.46E-02	–	–	6.10E-02	1.60E-02	–	–	7.98E-02
Cs-137	1.58E-01	2.47E-02	1.78E-01	5.11E-02	–	–	5.70E-01	6.50E-02	–	–	3.02E-01
Eu-152	6.76E-02	5.95E-02	–	–	–	–	<6.20E-02	6.40E-02	–	–	6.48E-02
Eu-154	*	–	–	–	–	–	<4.10E-02	4.60E-02	–	–	4.10E-02
Eu-155	*	–	–	–	–	–	<6.20E-03	3.60E-02	–	–	6.20E-03
I-129	–	–	–	–	–	–	–	–	–	–	–
K-40	–	–	–	–	–	–	–	–	–	–	–
Nb-95	*	–	–	–	–	–	6.00E-02	5.30E-02	–	–	6.00E-02
Pb-212	–	–	–	–	–	–	–	–	–	–	–
Pb-214	–	–	–	–	–	–	–	–	–	–	–
Pu-238	*	–	–	–	–	–	–	–	–	–	–
Pu-239	*	–	–	–	–	–	–	–	–	–	–
Ru-103	*	–	–	–	–	–	–	–	–	–	–
Ru-106	*	–	3.04E-01	2.86E-01	–	–	–	–	–	–	–
Sr-90	*	–	–	–	–	–	–	–	–	–	–
Tc-99	–	–	–	–	–	–	–	–	–	–	–
Zr-95	*	–	–	–	–	–	<3.50E-02	4.70E-02	–	–	3.50E-02

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Table A-2.2. Results of Vegetation Soil Sampling (pCi/g).

Location 2E3											
	1985		1986		1987		1988		1989		
Radio-nuclide	Result	Error	Result	Error	Result	Error	Result	Error	Result	Error	Average Result
Be-7	–	–	–	–	–	–	–	–	2.61E+00	3.61E-01	–
Ce-141	–	–	–	–	–	–	<-2.30E-02	6.40E-02	-1.27E-02	2.18E-02	-1.79E-02
Co-58	–	–	–	–	–	–	–	–	–	–	–
Co-60	*	–	–	–	<1.30E-02	1.40E-02	<3.50E-03	1.70E-02	5.09E-02	2.25E-02	2.25E-02
Cs-134	–	–	–	–	–	–	–	–	–	–	–
Cs-137	5.07E-01	5.49E-01	–	–	4.20E-01	5.10E-02	4.60E-01	5.40E-02	4.64E-01	5.86E-02	4.63E-01
Eu-152	*	–	–	–	<-3.30E-02	6.10E-02	<-3.30E-02	7.40E-02	-5.63E-03	8.07E-02	-2.39E-02
Eu-154	*	–	–	–	<-3.80E-02	4.70E-02	<3.10E-02	5.50E-02	3.80E-02	5.79E-02	1.03E-02
Eu-155	*	–	–	–	<1.80E-01	3.10E-02	<3.20E-04	3.80E-02	-9.08E-03	4.17E-02	5.71E-02
I-129	–	–	–	–	–	–	–	–	-2.29E-01	3.22E-01	-2.29E-01
K-40	–	–	–	–	–	–	–	–	1.10E+01	1.30E+00	1.10E+01
Nb-95	*	–	–	–	<-2.70E-02	1.90E-02	<-2.50E-02	6.20E-02	-1.52E-02	2.17E-02	-2.24E-02
Pb-212	–	–	–	–	–	–	–	–	-4.25E-01	3.25E-02	-4.25E-01
Pb-214	–	–	–	–	–	–	–	–	5.33E-02	3.22E-02	5.33E-02
Pu-238	*	–	–	–	–	–	–	–	1.22E-04	1.45E-04	1.22E-04
Pu-239	*	–	–	–	–	–	–	–	7.26E-04	3.17E-04	7.26E-04
Ru-103	*	–	–	–	–	–	–	–	–	–	–
Ru-106	*	–	–	–	–	–	–	–	–	–	–
Sr-90	*	–	–	–	–	–	–	–	2.48E-01	4.92E-02	2.48E-01
Tc-99	–	–	–	–	–	–	–	–	6.07E-01	1.14E+00	6.07E-01
Zr-95	*	–	–	–	<-4.00E-03	2.50E-02	<2.50E-02	5.60E-02	-6.30E-03	3.02E-02	6.79E-03

Table A-2.2. Results of Vegetation Soil Sampling (pCi/g).

Location 2E7											
	1985		1986		1987		1988		1989		
Radio-nuclide	Result	Error	Result	Error	Result	Error	Result	Error	Result	Error	Average Result
Be-7	–	–	–	–	–	–	–	–	–	–	–
Ce-141	–	–	–	–	–	–	<-5.20E-02	6.80E-02	–	–	-5.20E-02
Co-58	–	–	–	–	–	–	–	–	–	–	–
Co-60	*	–	–	–	–	–	<-3.10E-03	1.70E-02	–	–	-3.10E-03
Cs-134	–	–	–	–	–	–					
Cs-137	*	–	–	–	–	–	8.60E-01	2.50E-02	–	–	8.60E-02
Eu-152	*	–	–	–	–	–	<-2.30E-02	8.50E-02	–	–	-2.30E-02
Eu-154	*	–	–	–	–	–	<7.10E-02	5.80E-02	–	–	-7.10E-02
Eu-155	*	–	–	–	–	–	<-2.20E-03	4.30E-02	–	–	-2.20E-03
I-129	–	–	–	–	–	–	–	–	–	–	–
K-40	–	–	–	–	–	–	–	–	–	–	–
Nb-95	*	–	–	–	–	–	<6.24E-04	6.40E-02	–	–	6.24E-04
Pb-212	–	–	–	–	–	–	–	–	–	–	–
Pb-214	–	–	–	–	–	–	–	–	–	–	–
Pu-238	*	–	–	–	–	–	–	–	–	–	–
Pu-239	*	–	–	–	–	–	–	–	–	–	–
Ru-103	*	–	–	–	–	–	–	–	–	–	–
Ru-106	*	–	–	–	–	–	–	–	–	–	–
Sr-90	*	–	–	–	–	–	–	–	–	–	–
Tc-99	–	–	–	–	–	–	–	–	–	–	–
Zr-95	*	–	–	–	–	–	<-3.70E-02	6.00E-02	–	–	-3.70E-02

Table A-2.2. Results of Vegetation Soil Sampling (pCi/g).

Location 2E8											
	1985		1986		1987		1988		1989		
Radio-nuclide	Result	Error	Result	Error	Result	Error	Result	Error	Result	Error	Average Result
Be-7	–	–	–	–	–	–	–	–	1.77E+00	2.51E-01	–
Ce-141	–	–	–	–	–	–	<-2.00E-02	7.60E-02	-1.08E-02	1.77E-02	-1.54E-02
Co-58	–	–	–	–	–	–	–	–	–	–	–
Co-60	*	–	–	–	–	–	<6.70E-03	1.60E-02	2.04E-02	1.40E-02	1.36E-02
Cs-134	–	–	1.45E-01	3.70E-02	–	–	–	–	–	–	1.45E-01
Cs-137	2.86E-02	2.10E-02	3.66E-01	5.78E-02	–	–	7.00E-02	2.00E-02	6.33E-02	1.97E-02	1.32E-01
Eu-152	2.02E-01	7.84E-02	1.08E-01	9.78E-02	–	–	<2.10E-02	6.50E-02	8.22E-03	6.13E-02	8.48E-02
Eu-154	7.10E-02	6.20E-02	–	–	–	–	<3.30E-02	5.80E-02	2.21E-02	4.44E-02	1.34E-02
Eu-155	1.13E-01	6.40E-02	–	–	–	–	<1.60E-02	3.90E-03	2.59E-02	3.00E-02	5.16E-02
I-129	–	–	–	–	–	–	–	–	6.43E-01	2.28E-01	6.43E-02
K-40	–	–	–	–	–	–	–	–	1.09E+01	1.26E+00	1.09E+01
Nb-95	3.03E-02	2.25E-02	–	–	–	–	<1.30E-02	5.00E-02	7.69E-02	1.78E-03	1.70E-02
Pb-212	–	–	–	–	–	–	–	–	5.21E-02	1.80E-02	5.21E-02
Pb-214	–	–	–	–	–	–	–	–	3.91E-02	2.69E-02	3.91E-02
Pu-238	–	–	–	–	–	–	–	–	9.34E-05	1.04E-04	9.34E-05
Pu-239	–	–	–	–	–	–	–	–	1.80E-03	5.01E-04	1.80E-03
Ru-103	*	–	1.94E-01	9.74E-02	–	–	–	–	–	–	1.94E-01
Ru-106	*	–	4.94E-01	2.73E-01	–	–	–	–	–	–	–
Sr-90	*	–	–	–	–	–	5.50E-02	1.30E-02	3.12E-02	7.86E-03	4.31E-02
Tc-99	–	–	–	–	–	–	–	–	8.03E-02	1.10E+00	8.03E-02
Zr-95	*	–	–	–	–	–	<-2.90E-02	5.00E-02	1.78E-03	2.60E-02	-1.36E-02

Table A-2.2. Results of Vegetation Soil Sampling (pCi/g).

Location 2E9

	1985		1986		1987		1988		1989		
Radio-nuclide	Result	Error	Result	Error	Result	Error	Result	Error	Result	Error	Average Result
Be-7	–	–	–	–	–	–	–	–	1.77E+00	2.51E-01	–
Ce-141	–	–	–	–	–	–	<2.30E-02	7.10E-02	-1.08E-02	1.77E-02	6.10E-03
Co-58	–	–	–	–	–	–	–	–	–	–	–
Co-60	3.52E-02	3.10E-02	–	–	–	–	<-8.80E-03	1.80E-02	2.04E-02	1.40E-01	1.56E-02
Cs-134	–	–	–	–	–	–	–	–	–	–	–
Cs-137	2.24E-01	4.29E-02	2.15E-01	4.72E-02	–	–	4.00E-01	5.20E-02	6.33E-02	1.97E-02	2.26E-01
Eu-152	1.72E-01	1.13E-01	–	–	–	–	<1.20E-02	7.10E-02	8.22E-03	6.13E-02	6.41E-02
Eu-154	*	–	–	–	–	–	<3.10E-02	5.30E-02	2.21E-03	4.44E-02	1.66E-02
Eu-155	*	–	–	–	–	–	<3.90E-02	4.20E-02	2.59E-02	3.00E-02	3.25E-02
I-129	–	–	–	–	–	–	<2.60E-01	4.10E-01	6.43E-01	2.28E-01	1.62E-01
K-40	–	–	–	–	–	–	–	–	1.09E+01	1.26E+00	1.09E+01
Nb-95	*	–	–	–	–	–	<-1.50E-02	6.30E-02	7.69E-03	1.78E-02	-3.66E-03
Pb-212	–	–	–	–	–	–	–	–	5.21E-02	1.80E-02	5.21E-02
Pb-214	–	–	–	–	–	–	–	–	3.91E-02	2.69E-02	3.91E-02
Pu-238	*	–	–	–	–	–	<-1.50E-05	3.90E-05	9.34E-05	1.04E-04	3.92E-05
Pu-239	*	–	–	–	–	–	1.70E-03	6.00E-04	1.80E-03	5.01E-04	1.75E-03
Ru-103	*	–	–	–	–	–	–	–	–	–	–
Ru-106	*	–	–	–	–	–	–	–	–	–	–
Sr-90	*	–	–	–	–	–	8.00E-01	1.50E-01	3.12E-02	7.86E-03	4.16E-01
Tc-99	–	–	–	–	–	–	<6.40E-01	2.90E+00	8.03E-02	1.10E-+00	3.60E-01
Zr-95	*	–	–	–	–	–	<-2.80E-04	5.80E-02	1.78E-03	2.60E-02	7.50E-04

Table A-2.2. Results of Vegetation Soil Sampling (pCi/g).

Location 2E13

Radio-nuclide	1985 Result	1985 Error	1986 Result	1986 Error	1987 Result	1987 Error	1988 Result	1988 Error	1989 Result	1989 Error	Average Result
Be-7	--	--	--	--	--	--	--	--	3.02E+00	4.09E-01	--
Ce-141	--	--	--	--	--	--	<2.10E-03	9.70E-02	-1.25E-02	2.02E-02	-5.20E-03
Co-58	--	--	--	--	--	--	--	--	--	--	--
Co-60	*	--	--	--	--	--	<3.90E-03	2.20E-02	3.58E-03	1.96E-02	3.74E-03
Cs-134	--	--	1.19E-01	3.16E-02	--	--	--	--	--	--	1.19E-01
Cs-137	3.38E-02	1.22E-02	2.59E-01	4.44E-02	--	--	3.60E-02	2.50E-02	9.90E+01	2.31E-02	2.48E+01
Eu-152	*	--	1.20E-01	7.65E-02	--	--	<4.20E-02	8.90E-02	2.52E-02	6.82E-02	6.24E-02
Eu-154	*	--	--	--	--	--	<-2.80E-02	7.50E-02	8.52E-03	6.03E-02	-9.74E-03
Eu-155	*	--	--	--	--	--	<-7.90E-03	6.30E-02	-1.07E-02	4.19E-02	-9.30E-03
I-129	--	--	--	--	--	--	--	--	1.29E-01	1.69E-01	1.29E-01
K-40	--	--	--	--	--	--	--	--	1.27E+01	1.46E+00	1.27E+01
Nb-95	1.67E-02	1.32E-02	--	--	--	--	<1.80E-02	6.90E-02	1.66E-02	2.05E-02	1.71E-02
Pb-212	--	--	--	--	--	--	--	--	6.24E-02	3.29E-02	6.24E-02
Pb-214	--	--	--	--	--	--	--	--	7.09E-02	3.08E-02	7.09E-02
Pu-238	*	--	--	--	--	--	--	--	2.20E-03	6.71E-04	2.20E-03
Pu-239	*	--	--	--	--	--	--	--	5.79E-03	1.19E-03	5.79E-03
Ru-103	*	--	1.75E-01	7.12E-02	--	--	--	--	--	--	1.75E-01
Ru-106	*	--	--	--	--	--	--	--	--	--	--
Sr-90	*	--	--	--	--	--	--	--	1.21E-01	2.42E-02	1.21E-01
Tc-99	--	--	--	--	--	--	--	--	4.26E-01	1.12E+00	4.26E-01
Zr-95	3.06E-02	2.00E-02	--	--	--	--	<6.10E-03	6.70E-02	-6.54E-03	2.84E-02	1.01E-02

Table A-2.2. Results of Vegetation Soil Sampling (pCi/g).

Location 2E14											
	1985		1986		1987		1988		1989		
Radio-nuclide	Result	Error	Result	Error	Result	Error	Result	Error	Result	Error	Average Result
Be-7	--	--	--	--	--	--	--	--	3.02E+00	4.09E-01	--
Ce-141	--	--	--	--	--	--	<-1.60E-02	5.80E-02	-1.25E-02	2.02E-02	-1.43E-02
Co-58	--	--	--	--	--	--	--	--	--	--	--
Co-60	4.72E-02	2.49E-02	--	--	<-4.20E-03	1.40E-02	<8.10E-04	1.70E-02	3.58E-03	1.96E-02	1.18E-02
Cs-134	--	--	3.91E-02	2.45E-02	--	--	--	--	--	--	3.91E-02
Cs-137	6.04E-01	5.95E-02	9.48E-01	2.98E-02	8.20E-01	9.30E-02	8.70E-02	1.90E-02	9.90E-02	2.31E-02	5.12E-01
Eu-152	*	--	--	--	<2.40E-02	7.30E-02	<4.30E-02	6.20E-02	2.52E-02	6.82E-02	3.07E-02
Eu-154	*	--	--	--	<1.20E-02	4.30E-02	<1.70E-02	4.90E-02	8.52E-03	6.03E-02	1.25E-02
Eu-155	*	--	--	--	<1.90E-03	4.00E-02	<1.30E-02	4.00E-02	-1.07E-02	4.19E-02	1.40E-03
I-129	--	--	--	--	<5.80E-02	3.20E-01	<3.30E-02	3.60E-01	1.20E-01	1.69E-01	3.17E-02
K-40	--	--	--	--	--	--	--	--	1.27E+01	1.46E+00	1.27E+01
Nb-95	*	--	--	--	<-1.90E-02	2.40E-02	<1.30E-02	4.70E-02	1.66E-02	2.05E-02	3.53E-03
Pb-212	--	--	--	--	--	--	--	--	6.24E-02	3.29E-02	6.24E-02
Pb-214	--	--	--	--	--	--	--	--	7.09E-02	3.08E-02	7.09E-02
Pu-238	*	--	--	--	--	--	--	--	2.20E-03	6.71E-04	2.20E-03
Pu-239	*	--	--	--	--	--	--	--	5.79E-03	1.19E-03	5.79E-03
Ru-103	*	--	--	--	--	--	--	--	--	--	--
Ru-106	*	--	6.34E-01	1.89E-01	--	--	--	--	--	--	--
Sr-90	*	--	--	--	--	--	2.20E-02	8.50E-03	1.21E-01	2.42E-02	7.15E-02
Tc-99	--	--	--	--	<3.10E-01	8.50E-01	--	--	4.26E-01	1.12E+00	3.68E-01
Zr-95	*	--	--	--	3.70E-02	2.50E-02	<5.20E-03	4.50E-02	-6.54E-03	2.84E-02	1.19E-02

Table A-2.2. Results of Vegetation Soil Sampling (pCi/g).

Location 2E15											
	1985		1986		1987		1988		1989		
Radio-nuclide	Result	Error	Result	Error	Result	Error	Result	Error	Result	Error	Average Result
Be-7	–	–	–	–	–	–	–	–	–	–	–
Ce-141	–	–	–	–	–	–	<3.50E-02	6.20E-02	–	–	3.50E-02
Co-58	–	–	–	–	–	–	–	–	–	–	–
Co-60	*	–	–	–	–	–	<-1.40E-03	1.30E-02	–	–	-1.40E-03
Cs-134	–	–	–	–	–	–	–	–	–	–	–
Cs-137	1.95E-01	3.28E-02	1.12E-01	4.94E-02	–	–	2.20E-01	3.10E-02	–	–	1.76E-01
Eu-152	*	–	–	–	–	–	<5.70E-02	6.00E-02	–	–	5.70E-02
Eu-154	*	–	–	–	–	–	<-8.90E-03	3.80E-02	–	–	-8.90E-03
Eu-155	6.16E-02	5.73E-02	–	–	–	–	<9.80E-03	3.90E-02	–	–	3.57E-02
I-129	–	–	–	–	–	–	–	–	–	–	–
K-40	–	–	–	–	–	–	–	–	–	–	–
Nb-95	*	–	–	–	–	–	<1.50E-02	4.70E-02	–	–	1.50E-02
Pb-212	–	–	–	–	–	–	–	–	–	–	–
Pb-214	–	–	–	–	–	–	–	–	–	–	–
Pu-238	*	–	–	–	–	–	–	–	–	–	–
Pu-239	*	–	–	–	–	–	–	–	–	–	–
Ru-103	*	–	1.04E-01	1.02E-01	–	–	–	–	–	–	1.04E-01
Ru-106	*	–	–	–	–	–	–	–	–	–	–
Sr-90	*	–	–	–	–	–	–	–	–	–	–
Tc-99	–	–	–	–	–	–	–	–	–	–	–
Zr-95	*	–	–	–	–	–	<-7.10E-02	4.10E-02	–	–	-7.10E-02

Table A-2.2. Results of Vegetation Soil Sampling (pCi/g).

Location 2E19											
	1985		1986		1987		1988		1989		
Radio-nuclide	Result	Error	Result	Error	Result	Error	Result	Error	Result	Error	Average Result
Be-7	–	–	–	–	–	–	–	–	–	–	–
Ce-141	–	–	–	–	–	–	<-2.10E-02	5.40E-02	–	–	-2.10E-02
Co-58	–	–	–	–	–	–	–	–	–	–	–
Co-60	*	–	–	–	<7.30E-03	1.70E-02	2.00E-02	1.60E-02	–	–	1.37E-02
Cs-134	–	–	–	–	–	–	–	–	–	–	–
Cs-137	7.82E-02	2.74E-02	–	–	2.50E-02	1.10E-01	2.70E-02	1.40E-02	–	–	4.34E-02
Eu-152	*	–	–	–	<-2.20E-02	7.30E-02	<2.60E-02	7.20E-02	–	–	2.00E-03
Eu-154	*	–	–	–	5.80E-02	5.10E-02	<3.80E-02	5.30E-02	–	–	4.80E-02
Eu-155	1.82E-01	7.08E-02	–	–	<9.70E-03	4.00E-02	<-1.00E-02	3.40E-02	–	–	6.06E-02
I-129	–	–	–	–	–	–	–	–	–	–	–
K-40	–	–	–	–	–	–	–	–	–	–	–
Nb-95	*	–	–	–	<-1.30E-02	2.70E-02	<7.20E-03	5.40E-02	–	–	-2.90E-03
Pb-212	–	–	–	–	–	–	–	–	–	–	–
Pb-214	–	–	–	–	–	–	–	–	–	–	–
Pu-238	*	–	–	–	–	–	–	–	–	–	–
Pu-239	*	–	–	–	–	–	–	–	–	–	–
Ru-103	*	–	–	–	–	–	–	–	–	–	–
Ru-106	*	–	–	–	–	–	–	–	–	–	–
Sr-90	*	–	–	–	–	-	1.70E-01	3.50E-02	–	–	1.70E-01
Tc-99	–	–	–	–	–	–	–	–	–	–	–
Zr-95	*	–	–	–	<2.70E-02	3.30E-02	<2.60E-03	5.20E-02	–	–	1.48E-02

Table A-2.2. Results of Vegetation Soil Sampling (pCi/g).

Location 2E20											
	1985		1986		1987		1988		1989		
Radio-nuclide	Result	Error	Result	Error	Result	Error	Result	Error	Result	Error	Average Result
Be-7	–	–	–	–	–	–	–	–	2.10E+00	3.56E-01	–
Ce-141	–	–	–	–	–	–	<-1.40E-02	6.10E-02	-1.63E-02	2.76E-02	-1.52E-02
Co-58	–	–	–	–	–	–	–	–	–	–	–
Co-60	*	–	–	–	–	–	<-1.30E-02	1.70E-02	-4.36E-03	1.95E-02	-8.68E-03
Cs-134	–	–	6.10E-01	1.11E-01	–	–	–	–	–	–	6.10E-01
Cs-137	6.63E-02	1.91E-02	8.24E-01	1.38E-01	–	–	1.70E-01	2.80E-02	1.67E-02	3.11E-02	3.07E-01
Eu-152	*	–	–	–	–	–	<9.90E-03	7.30E-02	2.70E-02	7.84E-02	1.85E-02
Eu-154	*	–	–	–	–	–	<7.90E-03	4.90E-02	1.85E-02	6.11E-02	1.32E-02
Eu-155	*	–	–	–	–	–	<1.40E-02	3.70E-02	-4.61E-03	5.07E-02	4.70E-03
I-129	–	–	–	–	–	–	–	–	3.21E-01	2.30E-01	3.21E-01
K-40	–	–	–	–	–	–	–	–	1.04E+01	1.24E+00	1.04E+01
Nb-95	*	–	2.68E-01	1.68E-01	–	–	<4.90E-02	5.60E-02	-8.40E-04	2.63E-02	1.05E-01
Pb-212	–	–	–	–	–	–	–	–	1.10E-01	3.78E-02	1.10E-01
Pb-214	–	–	–	–	–	–	–	–	6.68E-02	3.26E-02	6.68E-02
Pu-238	*	–	–	–	–	–	–	–	1.47E-04	1.44E-04	1.47E-04
Pu-239	*	–	–	–	–	–	–	–	3.17E-03	7.56E-04	3.17E-03
Ru-103	*	–	2.46E-01	1.51E-01	–	–	–	–	–	–	2.46E-01
Ru-106	*	–	–	–	–	–	–	–	–	–	–
Sr-90	*	–	–	–	–	–	2.80E-01	5.40E-02	2.41E-01	4.87E-02	2.61E-01
Tc-99	–	–	–	–	–	–	–	–	9.33E-01	1.22E+00	9.33E-01
Zr-95	*	–	–	–	–	–	<1.10E-02	5.00E-02	-1.30E-02	3.76E-02	-1.00E-03

Table A-2.2. Results of Vegetation Soil Sampling (pCi/g).

Location 2E21											
	1985		1986		1987		1988		1989		
Radio-nuclide	Result	Error	Result	Error	Result	Error	Result	Error	Result	Error	Average Result
Be-7	–	–	–	–	–	–	–	–	–	–	–
Ce-141	–	–	–	–	–	–	<2.60E-02	5.50E-02	–	–	2.60E-02
Co-58	–	–	–	–	–	–	–	–	–	–	–
Co-60	1.87E-02	1.20E-02	–	–	–	–	<1.10E-02	1.30E-02	–	–	1.49E-02
Cs-134	–	–	–	–	–	–	–	–	–	–	–
Cs-137	9.12E-02	1.29E-02	–	–	–	–	1.70E-01	2.50E-02	–	–	1.31E-01
Eu-152	*	–	–	–	–	–	<3.40E-02	5.90E-02	–	–	3.40E-02
Eu-154	*	–	–	–	–	–	<-1.60E-02	4.40E-02	–	–	-1.60E-02
Eu-155	*	–	–	–	–	–	<-6.50E-03	3.20E-02	–	–	-6.50E-03
I-129	–	–	–	–	–	–	–	–	–	–	–
K-40	–	–	–	–	–	–	–	–	–	–	–
Nb-95	*	–	–	–	–	–	<2.80E-03	4.60E-02	–	–	2.80E-03
Pb-212	–	–	–	–	–	–	–	–	–	–	–
Pb-214	–	–	–	–	–	–	–	–	–	–	–
Pu-238	*	–	–	–	–	–	–	–	–	–	–
Pu-239	*	–	–	–	–	–	–	–	–	–	–
Ru-103	3.95E-02	1.43E-02	–	–	–	–	–	–	–	–	3.95E-02
Ru-106	3.70E-01	1.00E-01	–	–	–	–	–	–	–	–	–
Sr-90	*	–	–	–	–	–	–	–	–	–	–
Tc-99	–	–	–	–	–	–	–	–	–	–	–
Zr-95	*	–	–	–	–	–	<1.50E-02	4.60E-02	–	–	1.50E-02

Table A-2.2. Results of Vegetation Soil Sampling (pCi/g).

Location 2E25

Radio-nuclide	1985 Result	1985 Error	1986 Result	1986 Error	1987 Result	1987 Error	1988 Result	1988 Error	1989 Result	1989 Error	Average Result
Be-7	--	--	--	--	--	--	--	--	--	--	--
Ce-141	--	--	--	--	--	--	<-3.20E-03	7.80E-02	--	--	-3.20E-03
Co-58	--	--	--	--	--	--	--	--	--	--	--
Co-60	*	--	--	--	--	--	<-1.70E-02	1.80E-02	--	--	-1.70E-02
Cs-134	--	--	--	--	--	--	--	--	--	--	--
Cs-137	9.29E-02	4.04E-02	--	--	--	--	2.20E-01	3.50E-02	--	--	1.56E-01
Eu-152	*	--	--	--	--	--	<3.40E-02	8.00E-02	--	--	3.40E-02
Eu-154	*	--	--	--	--	--	<2.40E-02	5.70E-02	--	--	2.40E-02
Eu-155	1.18E-01	9.90E-02	--	--	--	--	<-8.50E-04	5.30E-02	--	--	5.86E-02
I-129	--	--	--	--	--	--	--	--	--	--	--
K-40	--	--	--	--	--	--	--	--	--	--	--
Nb-95	*	--	--	--	--	--	<2.30E-02	6.10E-02	--	--	2.30E-02
Pb-212	--	--	--	--	--	--	--	--	--	--	--
Pb-214	--	--	--	--	--	--	--	--	--	--	--
Pu-238	*	--	--	--	--	--	--	--	--	--	--
Pu-239	*	--	--	--	--	--	--	--	--	--	--
Ru-103	*	--	--	--	--	--	--	--	--	--	--
Ru-106	*	--	--	--	--	--	--	--	--	--	--
Sr-90	*	--	--	--	--	--	--	--	--	--	--
Tc-99	--	--	--	--	--	--	--	--	--	--	--
Zr-95	7.94E-02	7.25E-02	--	--	--	--	<-1.30-02	5.80E-02	--	--	3.32E-02

Table A-2.2. Results of Vegetation Soil Sampling (pCi/g).

Location 2E26											
	1985		1986		1987		1988		1989		
Radio-nuclide	Result	Error	Result	Error	Result	Error	Result	Error	Result	Error	Average Result
Be-7	--	--	--	--	--	--	--	--	--	--	--
Ce-141	--	--	--	--	--	--	<3.00E-02	7.70E-02	--	--	3.00E-02
Co-58	--	--	--	--	--	--	--	--	--	--	--
Co-60	--	--	--	--	--	--	<-1.80E-03	1.90E-02	--	--	-1.80E-03
Cs-134	--	--	--	--	--	--	--	--	--	--	--
Cs-137	--	--	--	--	--	--	9.60E-02	2.20E-02	--	--	9.60E-02
Eu-152	--	--	--	--	--	--	6.30E-02	6.20E-02	--	--	6.30E-02
Eu-154	--	--	--	--	--	--	<1.30E-02	5.40E-02	--	--	1.30E-02
Eu-155	--	--	--	--	--	--	<3.70E-02	4.50E-02	--	--	3.70E-02
I-129	--	--	--	--	--	--	--	--	--	--	--
K-40	--	--	--	--	--	--	--	--	--	--	--
Nb-95	--	--	--	--	--	--	<2.90E-02	6.00E-02	--	--	2.90E-02
Pb-212	--	--	--	--	--	--	--	--	--	--	--
Pb-214	--	--	--	--	--	--	--	--	--	--	--
Pu-238	--	--	--	--	--	--	--	--	--	--	--
Pu-239	--	--	--	--	--	--	--	--	--	--	--
Ru-103	--	--	--	--	--	--	--	--	--	--	--
Ru-106	--	--	--	--	--	--	--	--	--	--	--
Sr-90	--	--	--	--	--	--	4.90E-02	1.20E-02	--	--	4.90E-02
Tc-99	--	--	--	--	--	--	--	--	--	--	--
Zr-95	--	--	--	--	--	--	<1.10E-02	5.10E-02	--	--	1.10E-02

Table A-2.2. Results of Vegetation Soil Sampling (pCi/g).

Location 2E27

Radio-nuclide	1985		1986		1987		1988		1989		
	Result	Error	Result	Error	Result	Error	Result	Error	Result	Error	Average Result
Be-7	--	--	--	--	--	--	--	--	--	--	--
Ce-141	--	--	--	--	--	--	<-8.40E-02	7.60E-02	--	--	-8.40E-02
Co-58	--	--	--	--	--	--	--	--	--	--	--
Co-60	*	--	--	--	--	--	<1.10E-02	1.90E-02	--	--	1.10E-02
Cs-134	--	--	5.60E-02	2.87E-02	--	--	--	--	--	--	5.60E-02
Cs-137	2.69E-01	7.94E-02	6.94E-02	2.98E-02	--	--	8.00E-02	2.40E-02	--	--	1.39E-01
Eu-152	*	--	--	--	--	--	<3.10E-02	7.00E-02	--	--	3.10E-02
Eu-154	*	--	--	--	--	--	<-6.30E-03	5.30E-02	--	--	-6.30E-03
Eu-155	*	--	--	--	--	--	<2.60E-02	4.60E-02	--	--	2.60E-02
I-129	--	--	--	--	--	--	--	--	--	--	--
K-40	--	--	--	--	--	--	--	--	--	--	--
Nb-95	*	--	--	--	--	--	<-1.30E-02	6.60E-02	--	--	-1.30E-02
Pb-212	--	--	--	--	--	--	--	--	--	--	--
Pb-214	--	--	--	--	--	--	--	--	--	--	--
Pu-238	*	--	--	--	--	--	--	--	--	--	--
Pu-239	*	--	--	--	--	--	--	--	--	--	--
Ru-103	*	--	8.95E-02	7.47E-02	--	--	--	--	--	--	8.95E-02
Ru-106	*	--	--	--	--	--	--	--	--	--	--
Sr-90	*	--	--	--	--	--	--	--	--	--	--
Tc-99	--	--	--	--	--	--	--	--	--	--	--
Zr-95	*	--	--	--	--	--	<4.90E-02	6.00E-02	--	--	4.90E-02

Table A-2.2. Results of Vegetation Soil Sampling (pCi/g).

Location 2E31											
	1985		1986		1987		1988		1989		
Radio-nuclide	Result	Error	Result	Error	Result	Error	Result	Error	Result	Error	Average Result
Be-7	–	–	–	–	–	–	–	–	–	–	–
Ce-141	–	–	–	–	–	–	<3.50E-02	7.00E-02	–	–	3.50E-02
Co-58	–	–	–	–	–	–	–	–	–	–	–
Co-60	*	–	–	–	–	–	<-5.60E-03	1.90E-02	–	–	-5.60E-03
Cs-134	–	–	2.32E-01	4.97E-02	–	–	–	–	–	–	2.32E-01
Cs-137	7.56E-02	3.86E-02	4.71E-01	7.22E-02	–	–	2.90E-02	1.60E-02	–	–	1.92E-01
Eu-152	1.57E-01	1.22E-01	–	–	–	–	<2.80E-02	6.90E-02	–	–	9.25E-02
Eu-154	*	–	–	–	–	–	<4.90E-02	5.90E-02	–	–	4.90E-02
Eu-155	*	–	–	–	–	–	<3.30E-03	4.90E-02	–	–	3.30E-03
I-129	–	–	–	–	–	–	–	–	–	–	–
K-40	–	–	–	–	–	–	–	–	–	–	–
Nb-95	*	–	–	–	–	–	<-5.10E-02	6.00E-02	–	–	-5.10E-02
Pb-212	–	–	–	–	–	–	–	–	–	–	–
Pb-214	–	–	–	–	–	–	–	–	–	–	–
Pu-238	*	–	–	–	–	–	–	–	–	–	–
Pu-239	1.70E-03	6.00E-04	–	–	–	–	–	–	–	–	1.70E-03
Ru-103	*	–	2.06E-01	9.28E-02	–	–	–	–	–	–	2.06E-01
Ru-106	*	–	4.35E-01	2.34E-01	–	–	–	–	–	–	–
Sr-90	7.87E-01	1.68E-01	1.21E-01	4.12E-02	–	–	–	–	–	–	4.54E-01
Tc-99	–	–	–	–	–	–	–	–	–	–	–
Zr-95	*	–	1.02E-01	8.45E-02	–	–	<2.50E-02	5.10E-02	–	–	6.35E-02

Table A-2.2. Results of Vegetation Soil Sampling (pCi/g).

Location 2E32											
	1985		1986		1987		1988		1989		
Radio-nuclide	Result	Error	Result	Error	Result	Error	Result	Error	Result	Error	Average Result
Be-7	–	–	–	–	–	–	–	–	–	–	–
Ce-141	–	–	–	–	–	–	<-8.60E-03	7.40E-02	–	–	-8.60E-03
Co-58	–	–	–	–	–	–	–	–	–	–	–
Co-60	*	–	–	–	–	–	<-8.40E-03	2.00E-02	–	–	-8.40E-03
Cs-134	–	–	3.13E-01	7.60E-02	–	–	–	–	–	–	3.13E-01
Cs-137	6.58E-02	3.80E-02	5.62E-01	9.43E-02	–	–	1.30E-01	2.80E-02	–	–	2.54E-01
Eu-152	*	–	–	–	–	–	<-6.50E-02	9.20E-02	–	–	-6.50E-02
Eu-154	*	–	–	–	–	–	<6.70E-03	6.50E-02	–	–	6.70E-03
Eu-155	*	–	–	–	–	–	<1.80E-02	4.70E-02	–	–	1.80E-02
I-129	–	–	–	–	–	–	–	–	–	–	–
K-40	–	–	–	–	–	–	–	–	–	–	–
Nb-95	*	–	–	–	–	–	<-2.20E-02	6.30E-02	–	–	-2.20E-02
Pb-212	–	–	–	–	–	–	–	–	–	–	–
Pb-214	–	–	–	–	–	–	–	–	–	–	–
Pu-238	*	–	–	–	–	–	–	–	–	–	–
Pu-239	*	–	–	–	–	–	–	–	–	–	–
Ru-103	*	–	1.90E-01	1.21E-01	–	–	–	–	–	–	1.90E-01
Ru-106	*		4.90E-01	3.03E-01	–	–	–	–	–	–	–
Sr-90	*	–	–	–	–	–	–	–	–	–	–
Tc-99	–	–	–	–	–	–	–	–	–	–	–
Zr-95	*	–	–	–	–	–	<-2.70E-03	5.60E-02	–	–	-2.70E-03

Table A-2.2. Results of Vegetation Soil Sampling (pCi/g).

Location 2E33

Radio-nuclide	1985 Result	1985 Error	1986 Result	1986 Error	1987 Result	1987 Error	1988 Result	1988 Error	1989 Result	1989 Error	Average Result
Be-7	--	--	--	--	--	--	--	--	--	--	--
Ce-141	--	--	--	--	--	--	<-5.20E-02	9.60E-02	--	--	-5.20E-02
Co-58	--	--	--	--	--	--	--	--	--	--	--
Co-60	*	--	--	--	--	--	<4.60E-03	2.20E-02	--	--	4.60E-03
Cs-134	--	--	--	--	--	--	--	--	--	--	--
Cs-137	6.92E-02	2.97E-02	--	--	--	--	1.30E-01	4.10E-02	--	--	9.96E-02
Eu-152	*	--	--	--	--	--	<3.30E-02	1.10E-01	--	--	3.30E-02
Eu-154	*	--	--	--	--	--	<-1.80E-02	7.90E-02	--	--	-1.80E-02
Eu-155	*	--	--	--	--	--	<5.20E-02	6.60E-02	--	--	5.20E-02
I-129	--	--	--	--	--	--	--	--	--	--	--
K-40	--	--	--	--	--	--	--	--	--	--	--
Nb-95	--	--	--	--	--	--	<-2.60E-02	9.00E-02	--	--	-2.60E-02
Pb-212	--	--	--	--	--	--	--	--	--	--	--
Pb-214	--	--	--	--	--	--	--	--	--	--	--
Pu-238	*	--	--	--	--	--	--	--	--	--	--
Pu-239	*	--	--	--	--	--	--	--	--	--	--
Ru-103	*	--	--	--	--	--	--	--	--	--	--
Ru-106	*	--	--	--	--	--	--	--	--	--	--
Sr-90	*	--	--	--	--	--	1.80E-01	3.40E-02	--	--	1.80E-01
Tc-99	--	--	--	--	--	--	--	--	--	--	--
Zr-95	*	--	--	--	--	--	<-2.90E-02	8.40E-02	--	--	-2.90E-02

Source: Schmidt et al. 1990; Elder et al. 1986, 1987, 1988, 1989.
Negative values indicate concentrations at or near background levels of radioactivity.
Shaded areas indicate a positive detection, the result is greater than the error.
An asterisk (*) indicates that radionuclide concentration is less than detectable. The detection limits are as follows: Mn-54=2.0E-02, Co-58=2.0E-02, Co-60=2.0E-02, Zn-65=4.0E-02, Sr-90=5.0E-03, Nb-95=3.0E-02, Zr-95=3.0E-02, Ru-106=1.7E-01, Cs-134=2.0E-02, Cs-137=2.0E-02, Eu-152=1.1E-01, Eu-154=5.0E-02, Eu-155=5.0E-02, Pu-238=6.0E-04, Pu-239=6.0E-04, and U (total) = 1.0E-02.

Table A-2.3. Results of Grid Soil Sampling (pCi/g).

Location 2E1											
	1985		1986		1987		1988		1989		
Radio-nuclide	Result	Error	Result	Error	Result	Error	Result	Error	Result	Error	Average Result
Ce-141	--	--	--	--	<-9.40E-03	3.00E-02	--	--	--	--	-9.40E-03
Ce-144	--	--	--	--	<-1.30E-02	9.00E-02	<-4.30E-02	1.10E-01	--	--	-2.80E-02
Co-58	--	--	--	--	<3.40E-03	1.50E-02	<-9.30E-03	1.80E-02	--	--	-2.95E-03
Co-60	--	--	--	--	<-8.00E-03	1.60E-02	<-3.70E-03	1.80E-02	--	--	-5.85E-03
Cs-134	--	--	--	--	3.70E-02	1.90E-02	<-9.00E-02	2.40E-02	--	--	-2.65E-02
Cs-137	--	--	--	--	1.70E+00	1.80E-01	3.20E+00	3.30E-01	--	--	2.45E+00
Eu-152	--	--	--	--	1.00E-01	6.00E-02	9.30E-02	7.70E-02	--	--	9.65E-02
Eu-154	--	--	--	--	<-4.10E-02	5.00E-02	<-2.10E-02	5.80E-02	--	--	-3.10E-02
Eu-155	--	--	--	--	<2.40E-02	4.90E-02	<5.40E-02	6.70E-02	--	--	3.90E-02
I-129	--	--	--	--	--	--	--	--	--	--	--
K-40	--	--	--	--	--	--	--	--	--	--	--
Mn-54	--	--	--	--	<8.60E-03	1.50E-02	1.80E-02	1.60E-02	--	--	1.33E-02
Nb-95	--	--	--	--	--	--	--	--	--	--	--
Pb-212	--	--	--	--	--	--	--	--	--	--	--
Pb-214	--	--	--	--	--	--	7.00E-01	9.80E-02	--	--	7.00E-01
Pu-238	--	--	--	--	4.70E-04	2.70E-04	3.60E-03	7.50E-04	--	--	2.04E-03
Pu-239	--	--	--	--	2.60E-02	3.20E-03	2.20E-01	2.40E-02	--	--	1.23E-01
Ru-106	--	--	--	--	<2.00E-02	1.30E-01	<-1.80E-01	1.70E-01	--	--	-8.00E-02
Sr-90	--	--	--	--	2.40E-01	6.10E-02	4.40E-01	8.30E-02	--	--	3.40E-01
Tc-99	--	--	--	--	--	--	--	--	--	--	--
U (total)	--	--	--	--	1.80E-01	5.50E-02	1.30E-01	4.70E-02	--	--	1.55E-01
Zn-65	--	--	--	--	<1.40E-02	3.10E-02	<-8.20E-02	4.70E-02	--	--	-3.40E-02
Zr-95	--	--	--	--	<-9.00E-03	3.30E-02	<2.70E-02	3.40E-02	--	--	9.00E-03

Table A-2.3. Results of Grid Soil Sampling (pCi/g).

Location 2E2

Radio-nuclide	1985		1986		1987		1988		1989		
	Result	Error	Result	Error	Result	Error	Result	Error	Result	Error	Average Result
Ce-141	–	–	–	–	–	–	–	–	–	–	–
Ce-144	–	–	–	–	–	–	<2.10E-04	8.60E-02	–	–	-2.10E-04
Co-58	*	–	3.00E-02	2.00E-02	–	–	<4.70E-03	1.70E-02	–	–	1.74E-02
Co-60	*	–	–	–	–	–	1.80E-02	1.70E-02	–	–	1.80E-02
Cs-134	8.20E-02	4.30E-02	5.00E-02	3.00E-02	–	–	<-1.20E-02	1.30E-02	–	–	4.00E-02
Cs-137	6.80E+00	4.61E-01	1.10E-01	3.00E-02	–	–	2.50E-01	3.70E-02	–	–	2.39E+00
Eu-152	*	–	2.10E-01	9.00E-02	–	–	<5.00E-02	7.40E-02	–	–	1.30E-01
Eu-154	*	–	1.10E-01	6.00E-02	–	–	<1.40E-02	5.70E-02	–	–	6.20E-02
Eu-155	*	–	1.00E-01	7.00E-02	–	–	6.70E-02	4.80E-02	–	–	8.35E-02
I-129	–	–	–	–	–	–	–	–	–	–	–
K-40	–	–	–	–	–	–	–	–	–	–	–
Mn-54	*	–	4.00E-02	2.00E-02	–	–	<6.00E-03	1.60E-02	–	–	2.30E-02
Nb-95	*	–	–	–	–	–	–	–	–	–	–
Pb-212	–	–	–	–	–	–	–	–	–	–	–
Pb-214	–	–	–	–	–	–	7.90E-01	9.70E-02	–	–	7.90E-01
Pu-238	1.50E-03	6.00E-04	–	–	–	–	<-1.60E-05	1.00E-04	–	–	7.42E-04
Pu-239	3.20E-02	4.00E-03	3.00E-03	1.00E-03	–	–	2.00E-03	5.60E-04	–	–	1.23E-02
Ru-106	*	–	–	–	–	–	<0.00E+00	1.30E-01	–	–	–
Sr-90	3.90E-01	8.30E-02	5.00E-02	2.00E-02	–	–	7.90E-02	1.70E-02	–	–	1.73E-01
Tc-99	–	–	–	–	–	–	–	–	–	–	–
U (total)	2.36E-01	8.30E-02	2.70E-01	9.00E-02	–	–	1.30E-01	4.70E-02	–	–	2.12E-01
Zn-65	*	–	–	–	–	–	<-1.20E-01	4.50E-02	–	–	-1.20E-01
Zr-95	*	–	–	–	–	–	<-7.30E-03	2.70E-02	–	–	-7.30E-03

Table A-2.3. Results of Grid Soil Sampling (pCi/g).

Location 2E3											
	1985		1986		1987		1988		1989		
Radio-nuclide	Result	Error	Result	Error	Result	Error	Result	Error	Result	Error	Average Result
Ce-141	–	–	–	–	<1.20E-03	4.80E-02	–	–	-5.06E-02	1.53E-01	-2.59E-02
Ce-144	–	–	–	–	<-5.10E-02	1.50E-01	<1.10E-01	1.60E-01	-1.68E-03	2.40E-01	1.91E-02
Co-58	*	–	–	–	<1.20E-02	1.70E-02	<-6.80E-03	1.60E-02	3.34E-03	3.06E-02	2.85E-03
Co-60	*	–	–	–	<3.00E-03	1.50E-02	<0.00E+00	1.60E-02	1.44E-02	1.87E-02	5.80E-03
Cs-134	5.20E-02	3.70E-02	–	–	4.80E-02	2.10E-02	<-9.70E-02	2.90E-02	-9.00E-03	3.59E-02	-1.50E-03
Cs-137	3.17E+01	1.90E+00	–	–	1.30E+01	1.03E+00	1.40E+01	1.40E+00	2.99E+01	3.00E+00	2.22E+01
Eu-152	*	–	–	–	<4.80E-02	6.90E-02	1.20E-01	8.30E-02	1.39E-01	1.02E-01	1.02E-01
Eu-154	8.30E-02	6.00E-02	–	–	<3.20E-02	4.70E-02	<-1.30E-02	6.60E-02	9.04E-03	6.95E-02	2.78E-02
Eu-155	–	–	–	–	<7.40E-02	8.20E-02	<8.20E-02	9.20E-02	1.65E-01	1.28E-01	1.07E-01
I-129	–	–	–	–	–	–	–	–	-1.68E+00	6.47E-01	-1.68E+00
K-40	–	–	–	–	–	–	–	–	1.52E+01	1.75E+00	1.52E+01
Mn-54	*	–	–	–	1.90E-02	1.70E-02	<1.60E-03	1.80E-02	1.83E-02	2.21E-02	1.30E-02
Nb-95	*	–	–	–	–	–	–	–	-4.12E-02	7.22E-02	-4.12E-02
Pb-212	–	–	–	–	–	–	–	–	8.84E-01	1.17E-01	8.84E-01
Pb-214	–	–	–	–	–	–	7.20E-01	1.30E-01	7.28E-01	1.32E-01	7.24E-01
Pu-238	9.00E-04	5.00E-04	–	–	<8.00E-04	4.20E-04	2.60E-04	2.00E-04	1.64E-03	4.31E-04	9.00E-04
Pu-239	3.60E-02	4.00E-03	–	–	2.30E-02	3.00E-03	2.10E-02	2.80E-03	4.21E-02	4.61E-03	3.05E-02
Ru-106	*	–	–	–	<1.50E-01	2.00E-01	<1.50E-01	2.40E-01	-8.59E-02	3.92E-01	7.14E-02
Sr-90	7.69E-01	1.47E-01	–	–	<7.80E-01	2.00E-01	9.60E-01	1.90E-01	1.13E+00	2.22E-01	9.10E-01
Tc-99	–	–	–	–	–	–	–	–	4.80E-01	1.08E+00	4.80E-01
U (total)	2.82E-01	9.60E-02	–	–	2.30E-01	7.10E-02	1.00E-01	4.10E-02	2.18E-01	7.12E-02	2.08E-01
Zn-65	*	–	–	–	<-3.60E-02	4.60E-02	<-9.20E-02	5.10E-02	-1.13-01	6.68E-02	-8.03E-02
Zr-95	*	–	–	–	<-2.30E-03	3.60E-02	<1.80E-02	3.10E-02	3.71E-04	5.97E-02	5.36E-03

Table A-2.3. Results of Grid Soil Sampling (pCi/g).

Location 2E7											
	1985		1986		1987		1988		1989		
Radio-nuclide	Result	Error	Result	Error	Result	Error	Result	Error	Result	Error	Average Result
Ce-141	–	–	–	–	–	–	–	–	–	–	–
Ce-144	–	–	–	–	–	–	<4.40E-02	1.00E-01	–	–	4.40E-02
Co-58	–	–	–	–	–	–	<8.00E-03	1.50E-02	–	–	8.00E-03
Co-60	–	–	–	–	–	–	<-1.40E-03	1.70E-02	–	–	-1.40E-03
Cs-134	–	–	–	–	–	–	<-1.00E-02	1.60E-02	–	–	-1.00E-02
Cs-137	–	–	–	–	–	–	1.80E+00	1.90E-01	–	–	1.80E+00
Eu-152	–	–	–	–	–	–	8.10E-02	7.80E-02	–	–	8.10E-02
Eu-154	–	–	–	–	–	–	<2.40E-02	5.30E-02	–	–	2.40E-02
Eu-155	–	–	–	–	–	–	6.60E-02	5.80E-02	–	–	6.60E-02
I-129	–	–	–	–	–	–	–	–	–	–	–
K-40	–	–	–	–	–	–	–	–	–	–	–
Mn-54	–	–	–	–	–	–	<-5.90E-03	1.60E-02	–	–	-5.90E-03
Nb-95	–	–	–	–	–	–	–	–	–	–	–
Pb-212	–	–	–	–	–	–	–	–	–	–	–
Pb-214	–	–	–	–	–	–	7.20E-01	9.40E-02	–	–	7.20E-01
Pu-238	–	–	–	–	–	–	4.60E-04	2.30E-04	–	–	4.60E-04
Pu-239	–	–	–	–	–	–	3.80E-01	4.30E-03	–	–	3.80E-01
Ru-106	–	–	–	–	–	–	<-4.70E-02	1.50E-01	–	–	-4.70E-02
Sr-90	–	–	–	–	–	–	3.30E-01	6.40E-02	–	–	3.30E-01
Tc-99	–	–	–	–	–	–	–	–	–	–	–
U (total)	–	–	–	–	–	–	2.90E-01	9.30E-02	–	–	2.90E-01
Zn-65	–	–	–	–	–	–	<-4.60E-02	4.20E-02	–	–	-4.60E-02
Zr-95	–	–	–	–	–	–	<-5.50E-03	3.00E-02	–	–	-5.50E-03

Table A-2.3. Results of Grid Soil Sampling (pCi/g).

Location 2E8											
	1985		1986		1987		1988		1989		
Radio-nuclide	Result	Error	Result	Error	Result	Error	Result	Error	Result	Error	Average Result
Ce-141	–	–	–	–	<-9.00E-03	3.10E-02	–	–	7.03E-02	9.61E-02	3.07E-02
Ce-144	–	–	–	–	<-9.30E-03	1.00E-01	<9.70E-02	1.40E-01	-1.06E-01	1.50E-01	-6.10E-03
Co-58	*	–	*	–	<-7.80E-03	1.60E-02	<1.20E-02	2.00E-02	2.05E-02	2.60E-02	8.23E-03
Co-60	3.80E-02	1.70E-02	–	–	<1.20E-02	1.70E-02	<1.10E-02	2.00E-02	-1.52E-02	2.05E-02	1.15E-02
Cs-134	*	–	4.00E-02	3.00E-02	4.90E-02	2.00E-02	<-9.60E-02	2.80E-02	2.46E-03	2.01E-02	-1.14E-03
Cs-137	1.24E+01	7.82E-01	5.80E+00	6.00E-01	3.80E+00	3.90E-01	8.50E+00	8.70E-01	6.51E+00	6.65E-01	7.40E+00
Eu-152	*	–	2.00E-01	1.20E-01	8.90E-02	7.20E-02	<6.60E-02	9.40E-02	7.84E-02	8.39E-02	1.08E-01
Eu-154	8.80E-02	8.60E-02	–	–	<-4.40E-02	5.70E-02	<-4.30E-02	6.90E-02	8.79E-02	5.43E-02	2.22E-02
Eu-155	*	–	–	–	6.10E-02	5.60E-02	<6.20E-02	8.10E-02	4.47E-02	6.55E-02	5.59E-02
I-129	–	–	–	–	<-2.60E-01	4.20E-01	–	–	-1.76E-01	4.28E-01	-2.18E-01
K-40	–	–	–	–	–	–	–	–	1.38E+01	1.59E+00	1.38E+01
Mn-54	*	–	–	–	2.30E-02	1.50E-02	2.40E-02	1.90E-02	2.47E-02	2.12E-02	2.39E-02
Nb-95	*	–	–	–	–	–	–	–	-1.56E-01	6.08E-02	-1.56E-01
Pb-212	–	–	–	–	–	–	–	–	8.95E-01	1.05E-01	8.95E-01
Pb-214	–	–	–	–	–	–	7.20E-01	1.10E-01	7.10E-01	1.03E-01	7.15E-01
Pu-238	2.20E-03	8.00E-03	8.00E-04	5.00E-04	6.80E-04	3.10E-04	8.70E-04	4.70E-04	2.21E-03	5.28E-04	1.23E-03
Pu-239	9.70E-02	1.00E-02	3.30E-02	4.00E-03	2.40E-02	3.00E-03	5.40E-02	6.40E-03	6.63E-02	7.05E-03	5.49E-02
Ru-106	*	–	–	–	<8.20E-02	1.50E-01	<-2.20E-01	2.30E-01	1.18E-02	2.06E-01	-4.21E-02
Sr-90	6.94E-01	1.30E-01	7.60E-01	1.40E-01	4.00E-01	9.90E-02	5.10E-01	9.90E-02	4.13E-01	7.75E-02	5.55E-01
Tc-99	–	–	–	–	<4.70E-01	1.10E+00	–	–	4.85E-01	1.08E+00	4.78E-01
U (total)	3.07E-01	1.04E-01	3.00E-01	1.00E-01	2.70E-01	8.10E-02	2.90E-01	9.40E-02	3.16E-01	9.71E-02	2.97E-01
Zn-65	*	–	–	–	<-2.40E-02	3.80E-02	<-8.80E-02	5.70E-02	-4.24E-02	4.95E-02	-5.15E-02
Zr-95	*	–	–	–	<2.00E-02	2.90E-02	3.70E-02	3.40E-02	3.05E-02	5.74E-02	2.92E-02

Table A-2.3. Results of Grid Soil Sampling (pCi/g).

Location 2E9											
	1985		1986		1987		1988		1989		
Radio-nuclide	Result	Error	Result	Error	Result	Error	Result	Error	Result	Error	Average Result
Ce-141	–	–	–	–	–	–	–	–	-8.10E-02	1.05E-01	-8.10E-02
Ce-144	–	–	–	–	–	–	<-8.20E-02	1.60E-01	4.49E-02	1.56E-01	-1.86E-02
Co-58	*	–	3.00E-02	2.00E-02	–	–	<-4.80E-03	1.50E-02	-8.64E-03	2.10E-02	5.52E-03
Co-60	3.40E-02	2.10E-02	–	–	–	–	<-2.20E-03	1.60E-02	-1.50E-02	1.59E-02	5.60E-03
Cs-134	*	–	4.00E-02	2.00E-02	–	–	<1.40E-02	2.30E-02	-1.06E-01	2.77E-02	-1.73E-02
Cs-137	1.28E+01	8.06E-01	1.67E+01	1.68E+00	–	–	2.20E+01	2.30E+00	1.79E+01	1.80E+00	1.74E+01
Eu-152	2.35E-01	9.30E-02	–	–	–	–	1.10E-01	7.90E-02	9.98E-02	5.89E-02	1.48E-01
Eu-154	*	–	–	–	–	–	<-3.50E-03	4.90E-02	-2.23E-02	5.20E-02	-1.29E-02
Eu-155	*	–	–	–	–	–	<2.40E-04	8.60E-02	1.08E-04	7.73E-02	1.74E-04
I-129	–	–	–	–	–	–	–	–	8.29E-02	2.85E-01	8.29E-02
K-40	–	–	–	–	–	–	–	–	1.32E+01	1.46E+00	1.32E+01
Mn-54	*	–	2.00E-02	2.00E-02	–	–	<-1.60E-01	1.60E-02	8.30E-03	1.59E-02	-4.39E-02
Nb-95	*	–	–	–	–	–	–	–	-5.88E-02	4.97E-02	-5.88E-02
Pb-212	–	–	–	–	–	–	–	–	6.87E-01	8.48E-02	6.87E-01
Pb-214	–	–	–	–	–	–	7.20E-01	1.30E-01	5.64E-01	9.18E-02	6.42E-01
Pu-238	5.00E-04	4.00E-04	–	–	–	–	<4.20E-04	5.20E-04	2.09E-03	5.08E-04	1.00E-03
Pu-239	2.00E-02	3.00E-03	1.70E-02	3.00E-03	–	–	1.70E-02	3.10E-03	2.58E-02	3.03E-03	2.00E-02
Ru-106	*	–	–	–	–	–	<8.60E-02	2.20E-01	1.17E-01	2.30E-01	1.29E-01
Sr-90	2.61E+00	4.72E-01	1.60E+00	3.00E-01	–	–	2.00E+00	3.80E-01	2.90E+00	5.46E-01	2.28E+00
Tc-99	–	–	–	–	–	–	–	–	3.28E-01	1.07E+00	3.28E-01
U (total)	2.77E-01	9.50E-02	1.90E-01	6.00E-02	–	–	1.40E-01	5.30E-02	3.43E-01	1.05E-01	2.38E-01
Zn-65	*	–	–	–	–	–	<-3.60E-02	3.60E-02	-1.39E-01	5.00E-02	-8.75E-02
Zr-95	*	–	–	–	–	–	<4.00E-03	2.60E-02	-1.16E-03	4.56E-02	1.42E-03

Table A-2.3. Results of Grid Soil Sampling (pCi/g).

Location 2E13											
	1985		1986		1987		1988		1989		
Radio-nuclide	Result	Error	Result	Error	Result	Error	Result	Error	Result	Error	Average Result
Ce-141	–	–	–	–	–	–	–	–	3.44E-02	6.34E-02	3.44E-02
Ce-144	–	–	–	–	–	–	<1.20E-02	9.50E-02	8.11E-02	8.34E-02	4.66E-02
Co-58	*	–	–	–	–	–	<1.30E-03	1.60E-02	5.16E-03	2.26E-02	3.23E-03
Co-60	*	–	–	–	–	–	<1.30E-02	1.70E-02	1.67E-03	1.46E-02	7.34E-03
Cs-134	5.30E-02	2.80E-02	–	–	–	–	<-3.70E-03	1.30E-02	5.33E-02	1.64E-02	3.42E-02
Cs-137	1.19E+00	1.15E-01	1.00E+00	1.20E-01	–	–	4.90E-01	6.00E-02	4.08E-01	5.10E-02	7.72E-01
Eu-152	1.32E-01	1.14E-01	–	–	–	–	8.10E-02	7.60E-02	9.26E-02	6.18E-02	1.02E-01
Eu-154	1.46E-01	8.90E-02	–	–	–	–	<-7.20E-02	5.70E-02	4.67E-02	4.87E-02	4.02E-02
Eu-155	*	–	1.90E-01	1.00E-01	–	–	<2.30E-02	6.30E-02	2.24E-02	4.42E-02	7.85E-02
I-129	–	–	–	–	–	–	–	–	9.19E-02	3.50E-01	9.19E-02
K-40	–	–	–	–	–	–	–	–	1.36E+01	1.49E+00	1.36E+01
Mn-54	*	–	–	–	–	–	<-4.40E-03	1.50E-02	9.04E-03	1.48E-02	2.32E-03
Nb-95	*	–	–	–	–	–	–	–	2.31E-02	4.94E-02	2.31E-02
Pb-212	–	–	–	–	–	–	–	–	6.37E-01	7.27E-02	6.37E-01
Pb-214	–	–	–	–	–	–	5.70E-01	7.80E-02	5.05E-01	6.60E-02	5.38E-01
Pu-238	*	–	1.09E-02	1.80E-03	–	–	8.70E-04	3.70E-04	5.19E-05	8.00E-05	3.94E-03
Pu-239	1.30E-02	5.00E-03	1.70E-02	3.00E-03	–	–	1.10E-01	1.20E-02	8.31E-03	1.19E-03	3.71E-02
Ru-106	*	–	–	–	–	–	<0.00E+00	1.20E-01	5.66E-02	1.33E-01	2.83E-02
Sr-90	2.67E-01	5.40E-02	2.80E-01	6.00E-02	–	–	1.30E-01	2.60E-02	1.18E-01	2.42E-02	1.99E-01
Tc-99	–	–	–	–	–	–	–	–	9.95E-01	1.12E+00	9.95E-01
U (total)	2.79E-01	9.50E-02	4.40E-01	1.40E-01	–	–	2.60E-01	8.50E-02	2.39E-01	7.59E-02	3.05E-01
Zn-65	6.30E-02	5.20E-02	–	–	–	–	<-2.60E-02	3.70E-02	9.93E-02	4.63E-02	4.54E-02
Zr-95	*	–	–	–	–	–	<1.10E-02	2.70E-02	3.21E-02	4.20E-02	2.16E-02

Table A-2.3. Results of Grid Soil Sampling (pCi/g).

Location 2E14											
	1985		1986		1987		1988		1989		
Radio-nuclide	Result	Error	Result	Error	Result	Error	Result	Error	Result	Error	Average Result
Ce-141	–	–	–	–	<9.50E-03	3.40E-02	–	–	1.79E-02	8.13E-02	1.37E-02
Ce-144	–	–	–	–	<-4.70E-02	1.20E-01	<2.70E-02	1.20E-01	6.71E-03	1.11E-01	-4.43E-03
Co-58	*	–	–	–	<1.60E-03	1.40E-02	<-1.10E-02	1.70E-02	1.12E-02	2.99E-02	6.00E-04
Co-60	*	–	–	–	1.90E-02	1.60E-02	<4.70E-03	1.40E-03	1.23E-02	1.75E-02	1.20E-02
Cs-134	5.30E-02	2.80E-02	4.00E-02	3.00E-02	4.50E-02	2.00E-02	<-6.90E-02	2.10E-02	9.01E-03	1.51E-02	1.56E-02
Cs-137	1.19E+00	1.15E-01	2.29E+01	2.31E+00	2.90E+00	3.00E-01	2.50E+00	2.60E-01	1.01E+00	1.13E-01	6.10E+00
Eu-152	1.16E-01	8.10E-02	–	–	<-4.50E-02	8.90E-02	1.40E-01	8.60E-02	5.16E-02	7.55E-02	6.57E-02
Eu-154	*	–	–	–	<-8.10E-02	6.40E-02	<-3.00E-02	6.50E-02	4.38E-03	5.85E-02	-3.55E-02
Eu-155	1.08E-01	8.80E-02	–	–	<4.60E-02	6.80E-02	<7.20E-02	7.20E-02	5.22E-02	5.32E-02	6.96E-02
I-129	–	–	–	–	<2.90E-01	3.20E-01	–	–	8.64E-02	3.76E-01	1.88E-01
K-40	–	–	–	–	–	–	–	–	1.48E+01	1.66E+00	1.48E+01
Mn-54	*	–	5.00E-02	2.00E-02	<1.30E-02	1.50E-02	<3.10E-03	1.60E-02	2.58E-03	1.90E-02	1.72E-02
Nb-95	*	–	–	–	–	–	–	–	1.03E-01	6.69E-02	1.03E-01
Pb-212	–	–	–	–	–	–	–	–	1.85E-01	9.05E-02	1.85E-01
Pb-214	–	–	–	–	–	–	6.50E-01	8.90E-02	6.92E-01	9.22E-02	6.71E-01
Pu-238	6.00E-04	4.00E-04	3.00E-04	3.00E-04	4.00E-04	2.60E-04	4.00E-04	2.20E-04	1.90E-04	1.58E-04	3.78E-04
Pu-239	1.30E-02	5.00E-03	1.50E-02	2.00E-03	1.30E-02	1.80E-02	1.60E-02	2.10E-03	1.91E-02	2.46E-03	1.52E-02
Ru-106	*	–	–	–	<-9.08E-02	1.50E-01	<-5.20E-02	1.60E-01	1.08E-01	1.59E-01	-1.40E-02
Sr-90	2.37E-01	5.00E-02	1.50E+00	2.80E-01	5.00E-01	1.20E-03	1.10E+00	2.10E-01	1.25E-01	2.58E-02	6.92E-01
Tc-99	–	–	–	–	<4.00E-01	1.10E+00	–	–	3.43E-02	1.04E+00	2.17E-01
U (total)	2.73E-01	9.30E-02	1.90E-01	6.00E-02	2.00E-01	6.20E-02	1.80E-01	6.30E-02	3.56E-01	1.08E-01	2.40E-01
Zn-65	*	–	6.00E-02	4.00E-02	<-9.60E-03	3.70E-02	<-9.00E-02	5.10E-02	4.83E-02	4.76E-02	2.18E-03
Zr-95	*	–	–	–	<8.10E-03	3.30E-02	<3.90E-03	3.10E-02	4.96E-02	5.42E-02	2.05E-02

Table A-2.3. Results of Grid Soil Sampling (pCi/g).

Location 2E15											
	1985		1986		1987		1988		1989		
Radio-nuclide	Result	Error	Result	Error	Result	Error	Result	Error	Result	Error	Average Result
Ce-141	--	--	--	--	--	--	--	--	--	--	--
Ce-144	--	--	--	--	--	--	<-7.70E-03	1.10E-01	--	--	-7.70E-03
Co-58	*	--	--	--	--	--	<-1.30E-02	1.70E-02	--	--	-1.30E-02
Co-60	*	--	--	--	--	--	<-1.50E-03	1.80E-02	--	--	-1.50E-03
Cs-134	4.40E-02	3.00E-02	--	--	--	--	<-8.50E-03	1.70E-02	--	--	1.78E-02
Cs-137	1.38E+00	1.23E-01	2.09E+00	2.40E-01	--	--	1.70E+00	1.80E-01	--	--	1.35E+00
Eu-152	*	--	1.80E-01	1.10E-01	--	--	<4.90E-02	7.70E-02	--	--	1.13E-01
Eu-154	*	--	--	--	--	--	<5.70E-02	5.70E-02	--	--	5.70E-02
Eu-155	*	--	--	--	--	--	<4.10E-02	6.20E-02	--	--	4.10E-02
I-129	--	--	--	--	--	--	--	--	--	--	--
K-40	--	--	--	--	--	--	--	--	--	--	--
Mn-54	*	--	--	--	--	--	<6.40E-03	1.80E-02	--	--	6.40E-03
Nb-95	*	--	--	--	--	--	--	--	--	--	--
Pb-212	--	--	--	--	--	--	--	--	--	--	--
Pb-214	--	--	--	--	--	--	6.60E-01	9.00E-02	--	--	6.60E-01
Pu-238	4.00E-04	3.00E-04	9.00E-04	5.00E-04	--	--	5.60E-04	2.70E-04	--	--	5.90E-04
Pu-239	1.90E-02	3.00E-03	5.90E-02	7.00E-03	--	--	7.40E-02	8.20E-03	--	--	3.98E-02
Ru-106	*	--	--	--	--	--	<-4.00E-02	1.60E-01	--	--	-4.00E-02
Sr-90	9.89E-01	1.85E-01	1.25E+00	2.30E-01	--	--	9.10E-01	1.80E-01	--	--	1.05E+00
Tc-99	--	--	--	--	--	--	--	--	--	--	--
U (total)	2.84E-01	9.70E-02	5.90E-01	1.90E-01	--	--	2.30E-01	7.60E-02	--	--	3.24E-01
Zn-65	*	--	--	--	--	--	<-3.90E-02	4.70E-02	--	--	-3.90E-02
Zr-95	*	--	--	--	--	--	<5.90E-03	3.10E-02	--	--	5.90E-03

Table A-2.3. Results of Grid Soil Sampling (pCi/g).

Location 2E19											
	1985		1986		1987		1988		1989		
Radio-nuclide	Result	Error	Result	Error	Result	Error	Result	Error	Result	Error	Average Result
Ce-141	--	--	--	--	<-1.80E-02	3.20E-02	--	--	--	--	-1.80E-02
Ce-144	--	--	--	--	1.40E-01	9.60E-02	<2.30E-02	1.20E-01	--	--	8.15E-02
Co-58	--	--	--	--	<-2.10E-02	1.70E-02	<-1.60E-02	1.80E-02	--	--	-1.85E-02
Co-60	--	--	--	--	1.50E-02	1.40E-02	<-8.80E-03	1.90E-02	--	--	3.10E-03
Cs-134	--	--	--	--	4.20E-02	2.00E-02	<-2.60E-02	1.60E-02	--	--	8.00E-03
Cs-137	--	--	--	--	7.30E-01	8.30E-02	9.00E-01	1.00E-01	--	--	9.00E-01
Eu-152	--	--	--	--	9.30E-02	6.30E-02	<5.80E-02	9.70E-02	--	--	5.80E-02
Eu-154	--	--	--	--	<-2.40E-02	5.70E-02	<6.30E-03	6.10E-02	--	--	-8.85E-03
Eu-155	--	--	--	--	<3.00E-02	5.90E-02	8.30E-02	7.10E-02	--	--	5.65E-02
I-129	--	--	--	--	--	--	--	--	--	--	--
K-40	--	--	--	--	--	--	--	--	--	--	--
Mn-54	--	--	--	--	<1.40E-02	1.70E-02	<1.20E-02	1.70E-02	--	--	-1.00E-03
Nb-95	--	--	--	--	--	--	--	--	--	--	--
Pb-212	--	--	--	--	--	--	--	--	--	--	--
Pb-214	--	--	--	--	4.30E-04	2.70E-04	7.20E-01	9.50E-02	--	--	3.60E-01
Pu-238	--	--	--	--	2.00E-02	2.70E-03	7.40E-04	3.90E-04	--	--	7.04E-04
Pu-239	--	--	--	--	--	--	2.70E-02	3.50E-03	--	--	2.70E-02
Ru-106	--	--	--	--	<-9.20E-02	1.30E-01	<1.10E-01	1.50E-01	--	--	9.00E-03
Sr-90	--	--	--	--	1.90E-01	4.90E-02	1.90E-01	3.70E-02	--	--	1.90E-01
Tc-99	--	--	--	--	--	--	--	--	--	--	--
U (total)	--	--	--	--	1.40E-01	4.50E-02	2.80E-01	9.00E-02	--	--	2.80E-01
Zn-65	--	--	--	--	<2.20E-03	3.50E-02	<-7.80E-02	4.80E-02	--	--	-3.79E-02
Zr-95	--	--	--	--	3.70E-02	2.70E-02	<1.50E-02	3.10E-02	--	--	2.60E-02

Table A-2.3. Results of Grid Soil Sampling (pCi/g).

Location 2E20

Radio-nuclide	1985		1986		1987		1988		1989		Average Result
	Result	Error	Result	Error	Result	Error	Result	Error	Result	Error	
Ce-141	–	–	–	–	–	–	–	–	5.20E-02	1.27E-01	5.20E-02
Ce-144	–	–	–	–	–	–	<-7.00E-03	1.00E-01	-6.31E-02	1.69E-01	-3.51E-02
Co-58	3.90E-02	2.30E-02	–	–	–	–	<-7.00E-04	1.60E-02	1.91E-02	2.88E-02	1.91E-02
Co-60	2.70E-02	2.60E-02	–	–	–	–	<-2.10E-02	1.70E-02	1.45E-02	1.92E-02	6.83E-03
Cs-134	4.60E-02	3.00E-02	4.00E-02	3.00E-02	–	–	-2.10E-04	1.50E-02	-5.06E-02	2.86E-02	8.80E-03
Cs-137	1.92E+00	1.54E-01	1.49E+00	1.70E-01	–	–	7.00E-01	8.20E-02	8.31E+00	8.44E-01	2.52E+00
Eu-152	1.65E-01	1.09E-01	1.40E-01	1.00E-01	–	–	1.00E-01	7.90E-02	4.58E-02	9.61E-02	1.10E-01
Eu-154	*	–	1.40E-01	9.00E-02	–	–	8.00E-02	5.50E-02	-5.94E-03	6.89E-02	7.14E-02
Eu-155	1.06E-01	1.03-01	–	–	–	–	<5.50E-02	6.40E-02	8.74E-02	9.11E-02	8.28E-02
I-129	–	–	–	–	–	–	–	–	-5.94E-01	4.82E-01	-5.94E-01
K-40	–	–	–	–	–	–	–	–	1.51E+01	1.71E+00	1.51E+01
Mn-54	2.60E-02	2.30E-02	–	–	–	–	<2.10E-03	1.70E-02	1.19E-02	2.60E-02	1.33E-02
Nb-95	*	–	–	–	–	–	–	–	-3.70E-04	7.78E-02	-3.70E-04
Pb-212	–	–	–	–	–	–	–	–	7.79E-01	9.64E-02	7.79E-01
Pb-214	–	–	–	–	–	–	6.50E-01	8.90E-02	6.44E-01	1.04E-01	6.47E-01
Pu-238	7.00E-04	4.00E-04	5.00E-04	4.00E-04	–	–	<1.10E-04	1.20E-04	6.43E-04	2.62E-04	4.71E-04
Pu-239	6.20E-02	7.00E-03	3.90E-02	5.00E-03	–	–	1.60E-02	2.10E-03	3.82E-02	4.24E-03	3.20E-02
Ru-106	*	–	–	–	–	–	<-1.00E-01	1.30E-01	1.22E-01	2.40E-01	1.10E-02
Sr-90	4.82E-01	9.30E-02	3.20E-01	6.00E-02	–	–	1.90E-01	3.80E-02	1.47E+00	2.90E-01	6.16E-01
Tc-99	–	–	–	–	–	–	–	–	1.26E-01	1.05E+00	1.26E-01
U (total)	3.03E-01	1.02E-01	4.90E-01	1.60E-01	–	–	3.20E-01	1.00E-01	3.73E-01	1.13E-01	3.29E-01
Zn-65	*	–	–	–	–	–	<-4.80E-02	4.30E-02	-1.44E-01	6.74E-02	-9.60E-02
Zr-95	*	–	–	–	–	–	3.80E-02	3.00E-02	2.27E-02	6.13E-02	3.04E-02

Table A-2.3. Results of Grid Soil Sampling (pCi/g).

Location 2E21											
	1985		1986		1987		1988		1989		
Radio-nuclide	Result	Error	Result	Error	Result	Error	Result	Error	Result	Error	Average Result
Ce-141	--	--	--	--	<-4.70E-02	4.00E-02	--	--	--	--	-4.70E-02
Ce-144	--	--	--	--	<1.50E-02	1.30E-01	<-6.20E-02	9.60E-02	--	--	-3.85E-02
Co-58	*	--	--	--	<7.40E-03	1.60E-02	<-7.00E-04	1.60E-02	--	--	3.35E-03
Co-60	3.40E-02	1.60E-02	--	--	<-9.10E-04	1.70E-02	<-2.10E-02	1.70E-02	--	--	4.03E-03
Cs-134	3.30E-02	3.00E-02	--	--	3.10E-02	2.20E-02	<-2.50E-03	1.40E-02	--	--	2.05E-02
Cs-137	1.02E+00	9.40E-02	--	--	6.40E-01	7.80E-02	7.20E-01	8.50E-02	--	--	8.70E-01
Eu-152	1.52E-01	1.12E-01	--	--	1.00E-01	7.90E-02	<1.20E-02	7.90E-02	--	--	8.20E-02
Eu-154	*	--	--	--	<3.40E-02	4.40E-02	<4.00E-02	5.70E-02	--	--	3.70E-02
Eu-155	*	--	--	--	8.40E-02	7.50E-02	<1.70E-02	5.50E-02	--	--	5.05E-02
I-129	--	--	--	--	<-9.10E-02	5.10E-01	--	--	--	--	-9.10E-02
K-40	--	--	--	--	--	--	--	--	--	--	--
Mn-54	*	--	--	--	3.00E-02	1.40E-02	<2.10E-03	1.70E-02	--	--	1.61E-02
Nb-95	*	--	--	--	--	--	--	--	--	--	--
Pb-212	--	--	--	--	--	--	--	--	--	--	--
Pb-214	--	--	--	--	--	--	6.60E-01	8.60E-02	--	--	6.60E-01
Pu-238	5.00E-05	3.00E-04	--	--	4.10E-04	2.50E-04	7.50E-04	3.70E-04	--	--	4.00E-04
Pu-239	2.60E-02	3.00E-03	--	--	2.30E-02	2.80E-03	4.80E-02	6.00E-03	--	--	3.70E-02
Ru-106	*	--	--	--	<-2.40E-03	1.60E-01	<3.70E-02	1.40E-01	--	--	1.73E-02
Sr-90	4.24E-01	8.20E-02	--	--	2.00E-01	5.20E-02	1.90E-01	3.80E-02	--	--	2.71E-01
Tc-99	--	--	--	--	<4.60E-01	1.10E+00	--	--	--	--	4.60E-01
U (total)	3.42E-01	1.13E-01	--	--	2.10E-01	6.40E-02	2.30E-01	7.70E-02	--	--	2.86E-01
Zn-65	*	--	--	--	<2.60E-02	3.70E-02	<-4.80E-02	4.30E-02	--	--	-1.10E-02
Zr-95	*	--	--	--	6.90E-02	2.90E-02	<-2.30E-02	3.00E-02	--	--	2.30E-02

Table A-2.3. Results of Grid Soil Sampling (pCi/g).

Location 2E25

Radio-nuclide	1985		1986		1987		1988		1989		Average Result
	Result	Error	Result	Error	Result	Error	Result	Error	Result	Error	
Ce-141	–	–	–	–	–	–	–	–	–	–	–
Ce-144	–	–	–	–	–	–	<-3.10E-02	8.30E-02	–	–	-3.10E-02
Co-58	–	–	–	–	–	–	1.60E-02	1.40E-02	–	–	1.60E-02
Co-60	–	–	–	–	–	–	<5.80E-03	1.40E-02	–	–	5.80E-03
Cs-134	–	–	–	–	–	–	<-8.10E-03	1.30E-02	–	–	-8.10E-03
Cs-137	–	–	–	–	–	–	4.60E-01	5.70E-02	–	–	4.60E-01
Eu-152	–	–	–	–	–	–	7.50E-02	5.60E-02	–	–	7.50E-02
Eu-154	–	–	–	–	–	–	<1.10E-02	4.50E-02	–	–	1.10E-02
Eu-155	–	–	–	–	–	–	5.00E-02	5.00E-02	–	–	5.00E-02
I-129	–	–	–	–	–	–	–	–	–	–	–
K-40	–	–	–	–	–	–	–	–	–	–	–
Mn-54	–	–	–	–	–	–	1.70E-02	1.20E-02	–	–	1.70E-02
Nb-95	–	–	–	–	–	–	–	–	–	–	–
Pb-212	–	–	–	–	–	–	–	–	–	–	–
Pb-214	–	–	–	–	–	–	5.60E-01	7.20E-02	–	–	5.60E-01
Pu-238	–	–	–	–	–	–	4.90E-04	2.40E-04	–	–	4.90E-04
Pu-239	–	–	–	–	–	–	1.30E-02	1.70E-03	–	–	1.30E-02
Ru-106	–	–	–	–	–	–	<0.00E+00	1.20E-01	–	–	–
Sr-90	–	–	–	–	–	–	4.20E-02	9.90E-03	–	–	4.20E-02
Tc-99	–	–	–	–	–	–	–	–	–	–	–
U (total)	–	–	–	–	–	–	3.00E-01	9.40E-02	–	–	3.00E-01
Zn-65	–	–	–	–	–	–	<-5.20E-02	4.00E-02	–	–	-5.20E-02
Zr-95	–	–	–	–	–	–	1.50E-02	2.50E-02	–	–	1.50E-02

Table A-2.3. Results of Grid Soil Sampling (pCi/g).

Location 2E26											
	1985		1986		1987		1988		1989		
Radio-nuclide	Result	Error	Result	Error	Result	Error	Result	Error	Result	Error	Average Result
Ce-141	--	--	--	--	<-1.10E-02	3.50E-02	--	--	--	--	-1.10E-02
Ce-144	--	--	--	--	<-5.70E-03	1.20E-01	<3.00E-02	1.20E-01	--	--	1.22E-02
Co-58	--	--	--	--	<1.30E-03	1.70E-02	<-7.70E-03	1.50E-02	--	--	-3.20E-03
Co-60	--	--	--	--	<-1.10E-02	2.10E-02	<-6.80E-03	1.80E-02	--	--	-8.90E-03
Cs-134	--	--	--	--	5.00E-02	2.30E-02	<-2.60E-03	1.50E-02	--	--	2.63E-02
Cs-137	--	--	--	--	6.80E-01	8.20E-02	8.00E-01	9.40E-02	--	--	7.40E-01
Eu-152	--	--	--	--	<-5.10E-02	1.00E-01	<7.80E-02	8.10E-02	--	--	1.35E-02
Eu-154	--	--	--	--	<3.20E-02	5.40E-02	<5.50E-02	5.70E-02	--	--	4.35E-02
Eu-155	--	--	--	--	<4.60E-02	7.00E-02	<5.80E-02	6.20E-02	--	--	5.20E-02
I-129	--	--	--	--	--	--	--	--	--	--	--
K-40	--	--	--	--	--	--	--	--	--	--	--
Mn-54	--	--	--	--	<1.00E-02	1.80E-02	1.30E-02	1.70E-02	--	--	1.15E-02
Nb-95	--	--	--	--	--	--	--	--	--	--	--
Pb-212	--	--	--	--	--	--	--	--	--	--	--
Pb-214	--	--	--	--	--	--	6.50E-01	9.10E-02	--	--	6.50E-01
Pu-238	--	--	--	--	4.60E-04	2.50E-04	5.40E-04	2.80E-04	--	--	5.00E-04
Pu-239	--	--	--	--	1.50E-02	2.00E-03	1.60E-02	2.10E-03	--	--	1.55E-02
Ru-106	--	--	--	--	<1.30E-01	1.30E-01	<1.20E-02	1.40E-01	--	--	7.10E-02
Sr-90	--	--	--	--	2.10E-01	5.30E-02	6.80E-01	1.30E-01	--	--	4.45E-01
Tc-99	--	--	--	--	--	--	--	--	--	--	--
U (total)	--	--	--	--	1.70E-01	5.40E-02	4.00E-01	1.20E-01	--	--	2.85E-01
Zn-65	--	--	--	--	<1.50E-03	3.80E-02	<4.20E-02	4.40E-02	--	--	-2.03E-02
Zr-95	--	--	--	--	<-5.70E-04	3.40E-02	<-4.60E-03	3.30E-02	--	--	-2.59E-03

Table A-2.3. Results of Grid Soil Sampling (pCi/g).

Location 2E27											
	1985		1986		1987		1988		1989		
Radio-nuclide	Result	Error	Result	Error	Result	Error	Result	Error	Result	Error	Average Result
Ce-141	–	–	–	–	–	–	–	–	–	–	–
Ce-144	–	–	–	–	–	–	<4.70E-02	7.30E-02	–	–	4.70E-02
Co-58	2.80E-02	2.70E-02	–	–	–	–	<5.90E-03	1.20E-02	–	–	1.70E-02
Co-60	*	–	–	–	–	–	<3.20E-03	1.40E-02	–	–	3.20E-03
Cs-134	3.50E-02	3.00E-02	–	–	–	–	<-4.10E-03	1.20E-02	–	–	1.55E-02
Cs-137	3.21E-01	5.20E-02	3.20E-01	5.00E-02	–	–	1.30E-01	2.50E-02	–	–	2.57E-01
Eu-152	*	–	1.30E-01	8.00E-02	–	–	<2.90E-02	6.30E-02	–	–	7.95E-02
Eu-154	1.38E-01	7.00E-02	8.00E-02	5.00E-02	–	–	<2.20E-02	4.40E-02	–	–	8.00E-02
Eu-155	*	–	–	–	–	–	<3.60E-02	4.00E-02	–	–	3.60E-02
I-129	–	–	–	–	–	–	–	–	–	–	–
K-40	–	–	–	–	–	–	–	–	–	–	–
Mn-54	*	–	–	–	–	–	2.40E-02	1.40E-02	–	–	2.40E-02
Nb-95	–	–	–	–	–	–	–	–	–	–	–
Pb-212	–	–	–	–	–	–	–	–	–	–	–
Pb-214	–	–	–	–	–	–	5.60E-01	7.40E-02	–	–	5.60E-01
Pu-238	*	–	–	–	–	–	–	–	–	–	–
Pu-239	5.00E-03	3.00E-03	6.00E-03	2.00E-03	–	–	<9.90E-05	1.50E-04	–	–	3.70E-03
Ru-106	*	–	–	–	–	–	<1.80E-03	4.50E-04	–	–	1.80E-03
Sr-90	2.45E-01	5.10E-02	1.20E-01	3.00E-02	–	–	8.10E-01	1.50E-01	–	–	3.92E-01
Tc-99	–	–	–	–	–	–	–	–	–	–	–
U (total)	3.16E-01	1.06E-01	4.70E-01	1.50E-01	–	–	3.10E-01	9.60E-02	–	–	3.65E-01
Zn-65	*	–	–	–	–	–	<-1.40E-01	4.60E-02	–	–	-1.40E-01
Zr-95	*	–	–	–	–	–	<1.30E-03	2.40E-02	–	–	1.30E-03

Table A-2.3. Results of Grid Soil Sampling (pCi/g).

Location 2E31

Radio-nuclide	1985		1986		1987		1988		1989		Average Result
	Result	Error	Result	Error	Result	Error	Result	Error	Result	Error	
Ce-141	--	--	--	--	--	--	--	--	--	--	--
Ce-144	--	--	--	--	--	--	<-6.30E-02	6.80E-02	--	--	-6.30E-02
Co-58	*	--	--	--	--	--	<1.80E-03	1.20E-02	--	--	1.80E-03
Co-60	*	--	4.00E-02	3.00E-02	--	--	<1.10E-02	1.40E-02	--	--	2.55E-02
Cs-134	6.20E-02	3.70E-02	4.00E-02	3.00E-02	--	--	<-6.90E-03	1.30E-02	--	--	3.17E-02
Cs-137	4.25E-01	6.30E-02	5.00E-01	7.00E-02	--	--	4.50E-01	5.70E-02	--	--	4.58E-01
Eu-152	1.55E-01	1.45E-01	--	--	--	--	7.80E-02	5.80E-02	--	--	1.17E-01
Eu-154	*	--	7.00E-02	7.00E-02	--	--	<2.30E-02	4.70E-02	--	--	4.65E-02
Eu-155	*	--	--	--	--	--	<3.50E-02	3.90E-02	--	--	3.50E-02
I-129	--	--	--	--	--	--	--	--	--	--	--
K-40	--	--	--	--	--	--	--	--	--	--	--
Mn-54	*	--	3.00E-02	2.00E-02	--	--	<1.00E-02	1.40E-02	--	--	2.00E-02
Nb-95	*	--	--	--	--	--	--	--	--	--	--
Pb-212	--	--	--	--	--	--	--	--	--	--	--
Pb-214	--	--	--	--	--	--	5.70E-01	7.40E-02	--	--	5.70E-01
Pu-238	*	--	4.00E-04	3.00E-04	--	--	6.30E-04	2.50E-04	--	--	5.15E-04
Pu-239	7.00E-03	2.00E-03	9.00E-03	2.00E-03	--	--	1.30E-02	1.60E-03	--	--	9.67E-03
Ru-106	3.97E-01	2.60E-01	--	--	--	--	<4.60E-02	1.10E-01	--	--	2.22E-01
Sr-90	5.57E-01	1.07E-01	1.30E-01	3.00E-02	--	--	1.60E-01	3.20E-02	--	--	2.82E-01
Tc-99	--	--	--	--	--	--	--	--	--	--	--
U (total)	4.14E-01	1.35E-01	3.90E-01	1.30E-01	--	--	1.50E-01	5.30E-02	--	--	3.18E-01
Zn-65	*	--	--	--	--	--	<-3.80E-02	3.50E-02	--	--	-3.80E-02
Zr-95	*	--	--	--	--	--	<2.70E-02	2.70E-02	--	--	2.70E-02

Table A-2.3. Results of Grid Soil Sampling (pCi/g).

Location 2E32											
	1985		1986		1987		1988		1989		
Radio-nuclide	Result	Error	Result	Error	Result	Error	Result	Error	Result	Error	Average Result
Ce-141	–	–	–	–	<2.50E-02	3.20E-02	–	–	–	–	2.50E-02
Ce-144	–	–	–	–	<1.40E-02	1.00E-01	<-7.10E-02	9.40E-02	–	–	-2.85E-02
Co-58	*	–	–	–	<-9.00E-03	1.60E-02	<-1.70E-02	1.80E-02	–	–	-1.30E-02
Co-60	*	–	–	–	<-2.00E-02	2.00E-02	<-2.30E-03	1.50E-02	–	–	-1.12E-02
Cs-134	4.40E-02	1.90E-02	7.00E-02	3.00E-02	3.40E-02	2.00E-02	<-1.80E-02	1.50E-02	–	–	3.25E-02
Cs-137	1.38E+00	1.01E-01	7.70E-01	1.00E-01	4.70E-01	5.90E-02	7.30E-01	8.50E-02	–	–	8.38E-01
Eu-152	*	–	1.30E-01	1.20E-01	9.10E-02	7.20E-02	<8.20E-03	7.80E-02	–	–	7.64E-02
Eu-154	8.20E-02	4.80E-02	–	–	<-2.50E-02	6.00E-02	<-4.60E-02	5.10E-02	–	–	3.67E-03
Eu-155	5.90E-02	5.30E-02	1.80E-01	1.20E-01	<5.60E-02	6.10E-02	<3.30E-02	5.40E-02	–	–	8.20E-02
I-129	–	–	–	–	–	–	–	–	–	–	–
K-40	–	–	–	–	–	–	–	–	–	–	–
Mn-54	*	–	–	–	2.10E-02	1.60E-02	<4.80E-03	1.60E-02	–	–	1.29E-02
Nb-95	*	–	–	–	–	–	–	–	–	–	–
Pb-212	–	–	–	–	–	–	–	–	–	–	–
Pb-214	–	–	–	–	–	–	6.10E-01	8.00E-02	–	–	6.10E-01
Pu-238	*	–	–	–	<-2.60E-05	7.20E-05	1.30E-04	1.10E-04	–	–	5.20E-05
Pu-239	2.60E-02	5.00E-03	1.40E-02	3.00E-03	2.70E-03	6.00E-04	1.20E-02	1.50E-03	–	–	1.37E-02
Ru-106	*	–	–	–	<-4.60E-02	1.300E-01	<2.60E-02	1.30E-01	–	–	-1.00E-02
Sr-90	1.06E+00	1.97E-01	7.20E-01	1.40E-01	1.20E-01	3.10E-02	5.00E-01	9.40E-02	–	–	6.00E-01
Tc-99	–	–	–	–	–	–	–	–	–	–	–
U (total)	3.57E-01	1.18E-01	4.10E-01	1.30E-01	1.30E-01	4.40E-02	2.60E-01	8.40E-01	–	–	2.89E-01
Zn-65	*	–	–	–	<-2.40E-02	4.30E-02	<-5.60E-02	4.00E-02	–	–	-4.00E-02
Zr-95	3.50E-02	3.10E-02	–	–	<-3.60E-02	3.60E-02	<2.60E-03	2.90E-02	–	–	5.33E-04

Table A-2.3. Results of Grid Soil Sampling (pCi/g).

Location 2E33

Radio-nuclide	1985 Result	1985 Error	1986 Result	1986 Error	1987 Result	1987 Error	1988 Result	1988 Error	1989 Result	1989 Error	Average Result
Ce-141	--	--	--	--	--	--	--	--	--	--	--
Ce-144	--	--	--	--	--	--	<-5.00E-03	7.50E-02	--	--	-5.00E-03
Co-58	*	--	--	--	--	--	1.70E-02	1.30E-02	--	--	1.70E-02
Co-60	*	--	--	--	--	--	<-4.50E-03	1.50E-02	--	--	-4.50E-03
Cs-134	*	--	--	--	--	--	<-1.50E-03	1.20E-02	--	--	-1.50E-03
Cs-137	5.80E-02	2.40E-02	--	--	--	--	5.90E-02	1.90E-02	--	--	5.85E-02
Eu-152	*	--	--	--	--	--	<5.70E-02	7.10E-02	--	--	5.70E-02
Eu-154	*	--	--	--	--	--	<-1.70E-02	4.90E-02	--	--	-1.70E-02
Eu-155	*	--	--	--	--	--	4.50E-02	4.10E-02	--	--	4.50E-02
I-129	--	--	--	--	--	--	--	--	--	--	--
K-40	--	--	--	--	--	--	--	--	--	--	--
Mn-54	2.00E-02	1.60E-02	--	--	--	--	<1.70E-03	1.40E-02	--	--	1.09E-02
Nb-95	*	--	--	--	--	--	--	--	--	--	--
Pb-212	--	--	--	--	--	--	--	--	--	--	--
Pb-214	--	--	--	--	--	--	5.10E-01	6.70E-02	--	--	5.10E-01
Pu-238	*	--	--	--	--	--	1.70E-04	1.30E-04	--	--	1.70E-04
Pu-239	1.00E-03	0.00E+00	--	--	--	--	8.00E-04	2.80E-04	--	--	9.00E-04
Ru-106	*	--	--	--	--	--	<-5.10E-02	1.10E-01	--	--	-5.10E-02
Sr-90	2.92E-01	6.00E-02	--	--	--	--	7.20E-02	1.60E-02	--	--	1.82E-01
Tc-99	--	--	--	--	--	--	--	--	--	--	--
U (total)	2.60E-01	9.00E-02	--	--	--	--	2.20E-01	7.20E-02	--	--	2.40E-01
Zn-65	*	--	--	--	--	--	<-4.50E-02	4.00E-02	--	--	-4.50E-02
Zr-95	6.70E-02	3.20E-02	--	--	--	--	<1.40E-02	2.60E-02	--	--	4.05E-02

Source: Schmidt et al. 1990: Elder et al. 1986, 1987, 1988, 1989.
Negative values indicate concentrations at or near background levels of radioactivity.
Shaded areas indicate a positive detection, the result is greater than the error.
An asterisk (*) indicates that radionuclide concentration is less than detectable. The detection limits are as follows: Mn-54=2.0E-02, Co-58=2.0E-02, Co-60=2.0E-02, Zn-65=4.0E-02, Sr-90=5.0E-03, Nb-95=3.0E-02, Zr-95=3.0E-02, Ru-106=1.7E-01, Cs-134=2.0E-02, Cs-137=2.0E-02, Eu-152=1.1E-01, Eu-154=5.0E-02, Eu-155=5.0E-02, Pu-238=6.0E-04, Pu-239=6.0E-04, and U (total) = 1.0E-02.

Table A-2.4. Results of Air Monitoring (pCi/m³).

Location N116: North of BC Cribs											
	1985		1986		1987		1988		1989		
Radio-nuclide	Result	Error	Result	Error	Result	Error	Result	Error	Result	Error	Average Result
Sr-90	Max 9.85E-04	--	5.38E-03	--	4.42E-04	--	4.10E-04	1.80E-04	1.72E-04	1.18E-04	--
	Min 1.27E-04	--	3.35E-04	--	2.73E-04	--	1.50E-04	9.40E-05	3.34E-05	6.15E-05	--
	Avg. 4.20E-04	9.79E-04	1.89E-03	4.69E-03	3.33E-04	1.52E-04	2.20E-04	1.30E-04	8.06E-05	8.60E-05	5.89E-04
Cs-137	Max 2.91E-04	--	1.26E-03	--	2.35E-04	--	7.30E-04	4.80E-04	3.62E-04	4.24E-04	--
	Min 8.82E-05	--	-1.68E-04	--	-1.59E-04	--	<-2.6E-04	6.20E-04	1.00E-09	3.96E-04	--
	Avg. 1.84E-04	2.04E-04	5.51E-04	1.24E-03	8.00E-06	3.97E-04	2.30E-04	4.20E-04	2.05E-05	4.54E-04	9.94E-04
Pu-239	Max 2.93E-05	--	6.56E-05	--	5.75E-06	--	4.00E-06	3.50E-06	1.06E-05	5.45E-06	--
	Min 7.99E-06	--	5.49E-07	--	-5.96E-08	--	<1.1E-06	2.00E-06	6.05E-07	1.67E-06	--
	Avg. 1.66E-05	2.24E-05	1.78E-05	6.38E-05	2.27E-06	4.93E-06	5.10E-06	6.50E-06	3.64E-06	2.83E-06	4.54E-05
U (tot)	Max 3.16E-04	--	4.07E-05	--	2.06E-05	--	<6.2E-06	2.20E-05	1.01E-04	3.72E-05	--
	Min 5.97E-05	--	1.82E-05	--	4.25E-06	--	<-8.3E-06	1.80E-05	0.00E+00	1.84E-05	--
	Avg. 1.74E-04	2.61E-04	3.07E-05	2.04E-05	1.36E-05	1.37E-05	-4.70E-06	8.20E-06	3.86E-05	2.42E-05	2.52E-04

Table A-2.4. Results of Air Monitoring (pCi/m³).

Location N157: 241-BY Tank Farm

Radio-nuclide		1985 Result	1985 Error	1986 Result	1986 Error	1987 Result	1987 Error	1988 Result	1988 Error	1989 Result	1989 Error	Average Result
Sr-90	Max	1.24E-03	--	4.70E-04	--	2.45E-04	--	1.80E-04	1.00E-04	1.13E-04	1.06E-04	--
	Min	2.94E-04	--	1.01E-04	--	4.06E-05	--	<4.30E-05	9.80E-05	6.11E-06	5.61E-05	--
	Avg.	6.97E-04	7.89E-04	2.82E-04	3.63E-04	1.35E-04	1.78E-04	1.10E-04	5.90E-05	3.94E-05	7.66E-05	2.95E-04
Cs-137	Max	1.23E-02	--	8.19E-03	--	5.00E-03	--	4.00E-03	1.10E-03	4.79E-03	9.55E-04	--
	Min	6.12E-03	--	3.88E-03	--	2.75E-03	--	1.00E-03	7.40E-04	9.18E-04	6.28E-04	--
	Avg.	8.24E-03	5.78E-03	5.70E-03	3.69E-03	3.61E-03	2.00E-03	2.20E-03	1.50E-03	2.37E-03	7.92E-04	2.21E-02
Pu-239	Max	1.82E-05	--	4.02E-06	--	1.38E-05	--	1.30E-05	6.90E-06	3.09E-05	8.76E-06	--
	Min	6.14E-06	--	1.52E-06	--	1.07E-06	--	<-5.60E-07	2.10E-06	0.00E+00	1.15E-06	--
	Avg.	1.19E-05	1.20E-05	3.24E-06	2.35E-06	7.72E-06	1.05E-05	3.60E-06	6.90E-06	8.41E-06	3.71E-06	3.49E-05
U (tot)	Max	1.21E-04	--	5.42E-05	--	2.52E-05	--	<1.80E-05	2.30E-05	5.80E-05	2.53E-05	--
	Min	3.82E-05	--	2.59E-05	--	2.07E-06	--	<-3.30E-06	1.90E-05	0.00E+00	1.92E-05	--
	Avg.	7.78E-05	6.95E-05	3.86E-05	2.43E-05	1.36E-05	2.02E-05	3.00E-06	1.00E-05	2.58E-05	2.07E-05	1.59E-04

Table A-2.4. Results of Air Monitoring (pCi/m^3).

Location N159: B Plant

Radio-nuclide	1985 Result	1985 Error	1986 Result	1986 Error	1987 Result	1987 Error	1988 Result	1988 Error	1989 Result	1989 Error	Average Result
Sr-90	Max 6.49E-04	--	4.35E-04	--	3.85E-04	--	1.70E-04	9.90E-05	1.35E-04	4.57E-04	--
	Min 2.12E-04	--	1.43E-04	--	3.70E-05	--	8.20E-05	8.00E-05	1.61E-05	6.76E-05	--
	Avg. 3.90E-04	3.73E-04	2.41E-04	2.74E-04	1.46E-04	3.26E-04	1.40E-04	4.10E-05	6.34E-05	1.69E-04	9.80E-04
Cs-137	Max 3.58E-03	--	1.75E-02	--	2.62E-02	--	8.50E-04	6.90E-04	2.32E-03	9.63E-04	--
	Min 6.70E-04	--	1.35E-03	--	9.69E-04	--	<4.50E-05	5.40E-04	4.56E-04	4.72E-04	--
	Avg. 1.89E-03	2.44E-03	5.57E-03	1.59E-02	7.60E-03	2.48E-02	4.90E-04	4.10E-04	9.84E-04	7.29E-04	1.65E-02
Pu-239	Max 4.27E-05	--	1.20E-04	--	4.00E-05	--	1.60E-05	7.70E-06	1.22E-05	5.61E-06	--
	Min 8.53E-06	--	6.88E-06	--	3.10E-06	--	<1.1E-06	2.50E-06	5.35E-06	3.93E-06	--
	Avg. 2.88E-05	3.04E-05	3.97E-05	1.07E-04	1.89E-05	3.53E-05	6.90E-06	6.80E-06	8.60E-06	4.62E-06	1.03E-04
U (tot)	Max 1.13E-04	--	5.25E-05	--	1.43E-05	--	<6.40E-06	2.10E-05	5.56E-05	2.37E-05	--
	Min 4.06E-05	--	1.33E-05	--	2.13E-08	--	<9.50E-07	1.90E-05	0.00E+00	2.03E-05	--
	Avg. 7.38E-05	7.61E-05	3.49E-05	3.30E-05	9.11E-06	1.32E-05	8.50E-07	4.40E-06	2.47E-05	2.06E-05	1.43E-04

Table A-2.4. Results of Air Monitoring (pCi/m^3).

Location N957: BC Cribs											
	1985		1986		1987		1988		1989		
Radio-nuclide	Result	Error	Result	Error	Result	Error	Result	Error	Result	Error	Average Result
Sr-90	Max 7.26E-04	–	1.94E-03	–	3.17E-04	–	4.20E-04	1.60E-04	2.30E-04	1.14E-04	–
	Min 1.33E-04	–	1.07E-04	–	3.96E-05	–	<3.10E-05	6.70E-05	0.00E+00	5.48E-05	–
	Avg. 3.01E-04	5.68E-04	5.98E-04	1.79E-03	1.21E-04	2.64E-04	1.80E-04	1.70E-04	5.51E-05	6.91E-05	1.26E-03
Cs-137	Max 5.80E-04	–	1.49E-03	–	4.22E-04	–	<4.00E-04	6.00E-04	5.97E-04	5.06E-04	–
	Min -1.91E-04	–	-7.35E-05	–	0.00E+00	–	<-2.00E-04	7.60E-04	-3.37E-05	5.41E-04	–
	Avg. 1.57E-04	6.43E-04	5.87E-04	1.34E-03	1.77E-04	4.02E-04	1.90E-04	3.00E-04	7.45E-05	4.60E-04	1.19E-03
Pu-239	Max 1.41E-05	–	6.49E-06	–	3.31E-06	–	2.50E-05	9.70E-06	3.69E-06	3.05E-06	–
	Min 2.15E-06	–	0.00E+00	–	1.10E-06	–	<1.90E-06	3.00E-06	3.83E-08	1.23E-06	–
	Avg. 9.01E-06	1.01E-05	3.07E-06	6.37E-06	2.03E-06	1.85E-06	9.50E-06	1.10E-05	1.21E-06	2.08E-06	2.48E-05
U (tot)	Max 2.29E-04	–	5.82E-05	–	3.18E-05	–	<2.10E-06	2.00E-05	5.14E-05	2.24E-05	–
	Min 5.56E-05	–	3.05E-05	–	9.49E-06	–	<4.30E-07	2.00E-05	3.81E-06	1.96E-05	–
	Avg. 1.17E-04	1.60E-04	5.09E-05	2.73E-05	1.85E-05	1.93E-05	-2.30E-06	5.30E-06	2.33E-05	1.96E-05	2.07E-04

Table A-2.4. Results of Air Monitoring (pCi/m³).

Location N967: North of B and BY Tank Farms

Radio-nuclide	1985 Result	1985 Error	1986 Result	1986 Error	1987 Result	1987 Error	1988 Result	1988 Error	1989 Result	1989 Error	Average Result
Sr-90	Max 3.87E-04	--	1.48E-04	--	1.10E-04	--	2.70E-04	1.30E-04	3.52E-04	1.42E-04	--
	Min 9.94E-05	--	5.42E-05	--	2.14E-05	--	<4.80E-05	7.10E-05	1.41E-06	6.33E-05	--
	Avg. 2.33E-04	2.37E-04	1.17E-04	8.84E-05	5.96E-05	8.57E-05	1.40E-04	1.10E-04	9.66E-05	8.39E-05	6.46E-04
Cs-137	Max 2.45E-03	--	2.18E-03	--	9.25E-04	--	7.10E-04	6.60E-04	8.19E-04	5.17E-04	--
	Min 1.07E-03	--	3.43E-04	--	2.64E-04	--	<1.70E-04	5.20E-04	3.74E-04	6.60E-04	--
	Avg. 1.62E-03	1.18E-03	1.00E-03	1.62E-03	5.34E-04	5.59E-04	3.50E-04	2.70E-04	6.33E-04	5.74E-04	4.14E-03
Pu-239	Max 1.96E-05	--	9.96E-06	--	6.68E-06	--	<1.90E-06	2.80E-06	1.55E-06	1.89E-06	--
	Min 3.31E-06	--	0.00E+00	--	1.12E-06	--	<5.50E-07	2.30E-06	0.00E+00	1.42E-06	--
	Avg. 1.19E-05	1.38E-05	5.46E-06	9.81E-06	4.55E-06	4.95E-06	9.60E-07	7.60E-07	7.24E-07	1.64E-06	2.36E-05
U (tot)	Max 7.94E-05	--	4.85E-05	--	4.87E-05	--	<8.60E-06	2.20E-05	4.07E-05	1.94E-05	--
	Min 3.18E-05	--	2.50E-05	--	-3.50E-06	--	<-5.10E-06	1.80E-05	0.00E+00	1.90E-05	--
	Avg. 5.25E-05	4.13E-05	3.30E-05	2.12E-05	1.75E-05	4.51E-05	-7.30E-07	6.50E-06	1.84E-05	1.85E-05	1.21E-04

Table A-2.4. Results of Air Monitoring (pCi/m^3).

Location N968: 200 East Area West Gate

Radio-nuclide		1985 Result	1985 Error	1986 Result	1986 Error	1987 Result	1987 Error	1988 Result	1988 Error	1989 Result	1989 Error	Average Result
Sr-90	Max	3.29E-04	--	2.77E-04	--	9.28E-05	--	1.40E-04	1.20E-04	7.89E-05	7.85E-05	--
	Min	7.47E-05	--	8.69E-05	--	1.14E-05	--	<4.60E-05	7.20E-05	0.00E+00	6.10E-05	--
	Avg.	1.79E-04	2.38E-04	1.58E-04	1.76E-04	6.53E-05	7.48E-05	9.30E-05	4.70E-05	9.98E-06	6.26E-05	5.05E-04
Cs-137	Max	5.94E-04	--	1.64E-03	--	5.02E-04	--	<3.30E-04	5.40E-04	2.29E-04	4.59E-04	--
	Min	1.32E-04	--	9.55E-05	--	1.83E-04	--	<0.00E+00	4.90E-04	-5.88E-04	6.38E-04	--
	Avg.	3.71E-04	4.75E-04	5.99E-04	1.41E-03	3.49E-04	2.74E-04	4.70E-06	2.50E-04	-1.73E-04	5.28E-04	1.15E-03
Pu-239	Max	2.15E-05	--	7.35E-06	--	3.12E-05	--	6.20E-06	3.70E-06	2.67E-06	2.68E-06	--
	Min	8.83E-06	--	3.34E-06	--	-5.31E-07	--	<2.50E-08	1.20E-06	0.00E+00	1.65E-06	--
	Avg.	1.32E-05	1.15E-05	4.98E-06	3.52E-06	1.69E-05	2.93E-05	1.90E-06	3.20E-06	1.19E-06	1.95E-06	3.82E-05
U (tot)	Max	1.21E-04	--	8.66E-05	--	4.99E-05	--	4.10E-05	2.70E-05	6.99E-05	2.74E-05	--
	Min	3.77E-05	--	4.71E-05	--	2.03E-05	--	<-7.90E-06	1.80E-05	6.31E-06	2.03E-05	--
	Avg.	6.21E-05	7.89E-05	6.16E-05	3.47E-05	3.21E-05	2.62E-05	1.30E-05	2.30E-05	3.65E-05	2.34E-05	2.05E-04

Table A-2.4. Results of Air Monitoring (pCi/m^3).

Location N157: 241-BY Tank Farm

		1985		1986		1987		1988		1989		
Radio-nuclide		Result	Error	Result	Error	Result	Error	Result	Error	Result	Error	Average Result
Sr-90	Max	7.89E-04	--	1.56E-04	--	1.99E-04	--	1.70E-04	1.00E-04	1.87E-04	1.05E-04	--
	Min	1.05E-04	--	6.79E-05	--	7.89E-05	--	<6.70E-05	7.40E-05	5.78E-07	8.39E-05	--
	Avg.	3.82E-04	5.83E-04	1.11E-04	8.69E-05	1.37E-04	1.02E-04	1.30E-04	5.00E-05	1.35E-04	9.80E-05	8.95E-04
Cs-137	Max	4.02E-03	--	2.04E-03	--	2.09E-03	--	8.60E-04	6.70E-04	1.06E-03	6.94E-04	--
	Min	1.20E-03	--	-5.34E-04	--	2.56E-04	--	<-3.90E-04	6.70E-04	-6.81E-05	4.84E-04	--
	Avg.	2.27E-03	2.61E-03	8.17E-04	2.11E-03	9.92E-04	1.57E-03	3.40E-04	5.30E-04	4.29E-04	5.20E-04	4.85E-03
Pu-239	Max	8.68E-05	--	6.18E-06	--	1.01E-05	--	6.10E-06	3.80E-06	9.88E-04	1.06E-04	--
	Min	1.38E-05	--	1.83E-06	--	5.86E-07	--	<1.80E-07	3.00E-06	1.03E-06	1.87E-06	--
	Avg.	3.29E-05	7.19E-05	3.61E-06	3.72E-06	4.81E-06	9.77E-06	3.20E-06	2.60E-06	2.48E-04	2.82E-05	2.93E-04
U (tot)	Max	1.06E-04	--	6.86E-05	--	3.48E-05	--	<5.80E-06	2.00E-05	5.96E-05	2.43E-05	--
	Min	1.46E-05	--	2.12E-05	--	1.38E-06	--	<-8.90E-06	1.80E-05	0.00E+00	1.94E-05	--
	Avg.	5.31E-05	7.66E-05	4.57E-05	3.97E-05	1.74E-05	2.74E-05	-4.80E-06	7.20E-06	2.72E-05	2.14E-05	1.39E-04

Source: Schmidt et al. 1990: Elder et al. 1986, 1987, 1988, 1989.
Negative values indicate concentrations at or near background levels of radioactivity.
Shaded areas indicate a positive detection, the result is greater than the error.
An asterisk (*) indicates that radionuclide concentration is less than detectable. The detection limits are as follows: Mn-54=2.0E-02, Co-58=2.0E-02, Co-60=2.0E-02, Zn-65=4.0E-02, Sr-90=5.0E-03, Nb-95=3.0E-02, Zr-95=3.0E-02, Ru-106=1.7E-01, Cs-134=2.0E-02, Cs-137=2.0E-02, Eu-152=1.1E-01, Eu-154=5.0E-02, Eu-155=5.0E-02, Pu-238=6.0E-04, Pu-239=6.0E-04, and U (total) = 1.0E-02.

APPENDIX B

HEALTH AND SAFETY PLAN

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CONTENTS

ACRONYMS AND ABBREVIATIONS

AAMS	aggregate area management study
CERCLA	Comprehensive Environmental Response, Compensation and Liability Act of 1980
CFR	Code of Federal Regulations
DOE	U.S. Department of Energy
EII	Environmental Investigations Instructions
HEHF	Hanford Environmental Health Foundation
HSP	Health and Safety Plan
HWOP	Hazardous Waste Operations Permit
JSA	Job Safety Analysis
NIOSH	National Institute for Occupational Safety and Health
OSHA	Occupational Safety and Health Administration
RCRA	Resource Conservation and Recovery Act
RWP	radiation work permit
SCBA	self-contained breathing apparatus
WISHA	Washington Industrial Safety and Health Act

1.0 GENERAL CONSIDERATIONS AND REQUIREMENTS

1.1 INTRODUCTION

The purpose of this Health and Safety Plan (HSP) is to outline standard health and safety procedures for Westinghouse Hanford employees and contractors engaged in investigation activities for the B Plant Aggregate Area Management Study (AAMS). These activities will include surface investigation, drilling and sampling boreholes, and environmental sampling in areas of known chemical and radiological contamination. Appropriate site-specific safety documents (e.g., Hazardous Waste Operations Permit [HWOP] or Job Safety Analysis [JSA]) will be written for each task or group of tasks. A more complete discussion of Westinghouse Hanford environmental safety procedures is presented in the Westinghouse Hanford manual *Health and Safety for Hazardous Waste Field Operations*, WHC-CM-4-3 Vol. 4 (WHC 1992).

All employees of Westinghouse Hanford or any other contractors who are participating in onsite activities for the B Plant AAMS shall read the site-specific safety document and attend a pre-job safety or tailgate meeting to review and discuss the task.

1.2 DESIGNATED SAFETY PERSONNEL

The field team leader and site safety officer are responsible for site safety and health. Specific individuals will be assigned on a task-by-task basis by project management, and their names will be properly recorded before the task is initiated.

All activities onsite must be cleared through the field team leader. The field team leader has responsibility for the following:

- Allocating and administering resources to successfully comply with all technical and health and safety requirements

- Verifying that all permits, supporting documentation, and clearances are in place (e.g., electrical outage requests, welding permits, excavation permits, HWOP or JSA, sampling plan, radiation work permits [RWPs], and onsite/offsite radiation shipping records)

- Providing technical advice during routine operations and emergencies

- Informing the appropriate site management and safety personnel of the activities to be performed each day

- Coordinating resolution of any conflicts that may arise between RWPs and the implementation of the HWOP or JSA with health physics

- Handling emergency response situations as may be required

- Conducting pre-job and daily tailgate safety meetings

- Interacting with adjacent building occupants and/or inquisitive public.

The site safety officer is responsible for implementing the HWOP at the site. The site safety officer shall do the following:

- Monitor chemical, physical, and (in conjunction with the health physics technician) radiation hazards to assess the degree of hazard present; monitoring shall specifically include organic vapor detection, radiation screening, and confined space evaluation where appropriate.

- Determine protection levels, clothing, and equipment needed to ensure the safety of personnel in conjunction with the health physics department.

- Monitor the performance of all personnel to ensure that the required safety procedures are followed.

- Halt operations immediately, if necessary, due to safety or health concerns.

- Conduct safety briefings as necessary.

- Assist the field team leader in conducting safety briefings as necessary.

The health physics technician is responsible for ensuring that all radiological monitoring and protection procedures are being followed as specified in the Radiation Protection Manual and in the appropriate RWP. Westinghouse Hanford Industrial Safety and Fire Protection personnel will provide safety overview during drilling operations consistent with Westinghouse Hanford policy and, as requested, will provide technical advice. Also, downwind sampling for hazardous materials and radiological contaminants and other analyses may be requested from appropriate contractor personnel as required.

The ultimate responsibility and authority for employee's health and safety lies with the employee and the employee's colleagues. Each employee is responsible for exercising the utmost care and good judgment in protecting his or her personal health and safety and that of fellow employees. Should any employee observe a potentially unsafe condition or situation, it is the responsibility of that employee to immediately bring the observed condition to the attention of the appropriate health and safety personnel, as designated previously. In the event of an immediately dangerous or life-threatening situation, the employee automatically has temporary "stop work" authority and the responsibility to immediately notify the field team leader or site safety officer. When work is temporarily halted because of a safety or health concern, personnel will exit the exclusion zone and meet at a predetermined place in the support zone. The field team leader, site safety officer, and health physics technician will determine the next course of action.

1.3 MEDICAL SURVEILLANCE

All field team members engaged in operable unit activities at sites governed by an HWOP must have baseline physical examinations and be participants in Westinghouse Hanford (or an equivalent) hazardous waste worker medical surveillance program.

Medical examinations will be designed to identify any pre-existing conditions that may place an employee at high risk, and will verify that each worker is physically able to perform the work required by this plan without undue risk to personal health. The physician shall determine the existence of conditions that may reduce the effectiveness or prevent the employee's use of respiratory protection. The physician shall also determine the presence of conditions that may pose undue risk to the employee while performing the physical tasks of this work plan using level B personal protection equipment. This would include any condition that increases the employee's susceptibility to heat stress.

The examining physician's report will not include any nonoccupational diagnoses unless directly applicable to the employee's fitness for the work required.

1.4 TRAINING

Before engaging in any onsite activities, each team member is required to have received 40 hours of health and safety training related to hazardous waste site operations and at least 8 hours of refresher training each year thereafter as specified in 29 Code of Federal Regulations (CFR) 1910.120. In addition, each inexperienced employee (never having performed site characterization) will be directly supervised by a trained/experienced person for a minimum of 24 hours of field experience.

The field team leader and the site safety officer shall receive an additional 8 hours of training (in addition to the refresher training previously discussed).

1.5 TRAINING FOR VISITORS

For the purposes of this plan, a visitor is defined as any person visiting the Hanford Site, who is not a Westinghouse Hanford employee or a Westinghouse Hanford contractor directly involved in the Resource Conservation and Recovery Act (RCRA)/Comprehensive Environmental Response, Compensation and Liability Act of 1980 (CERCLA) facility investigation activities, including but not limited to those engaged in surveillance, inspection, or observation activities.

Visitors who must, for whatever reason, enter a controlled (either contamination reduction or exclusion) zone, shall be subject to all of the applicable training, respirator fit testing, and medical surveillance requirements discussed in Westinghouse Hanford Environmental Investigations Instructions (EII) 1.1 and Appendix B to EII 1.1 (WHC 1991).

All visitors shall be informed of potential hazards and emergency procedures by their escorts and shall conform to EII 1.1 (WHC 1991).

1.6 RADIATION DOSIMETRY

All personnel engaged in onsite activities shall be assigned dosimeters according to the requirements of the RWP applicable to that activity. All visitors shall be assigned basic dosimeters, as a minimum, that will be exchanged annually.

1.7 REQUIREMENTS FOR THE USE OF RESPIRATORY PROTECTION

All employees of Westinghouse Hanford and subcontractors who may be required to use air-purifying or air-supplied respirators must be included in the medical surveillance program and be approved for the use of respiratory protection by the Hanford Environmental Health Foundation (HEHF) or other licensed physician. Each team member must be trained in the selection, limitations, and proper use and maintenance of respiratory protection (existing respiratory protection training may be applicable towards the 40-hour training requirement).

Before using a negative pressure respirator, each employee must have been fit-tested (within the previous year) for the specific make, model, and size according to Westinghouse

Hanford fit-testing procedures. Beards (including a few days' growth), large sideburns, or moustaches that may interfere with a proper respirator seal are not permitted.

Subcontractors must provide evidence to Westinghouse Hanford that personnel are participants in a medical surveillance and respiratory protection program that complies with 29 CFR 1910.120 and 29 CFR 1910.134, respectively.

2.0 GENERAL PROCEDURES

The following personal hygiene and work practice guidelines are intended to prevent injuries and adverse health effects. A hazardous waste site poses a multitude of health and safety concerns because of the variety and number of hazardous substances present. These guidelines represent the minimum standard procedures for reducing potential risks associated with this project and are to be followed by all job-site employees <u>at all times</u>.

2.1 GENERAL WORK SAFETY PRACTICES

2.1.1 Work Practices

The following work practices must be observed:

- Eating, drinking, smoking, taking certain medications, chewing gum, and similar actions are prohibited within the exclusion zone. All sanitation facilities shall be located outside the exclusion zone; decontamination is required before using such facilities.

- Personnel shall avoid direct contact with contaminated materials unless necessary for sample collecting or required observation. Remote handling of such things as casings and auger flights will be practiced whenever practical.

- While operating in the controlled zone, personnel shall use the "buddy system" where appropriate, or be in visual contact with someone outside of the controlled zone.

- The buddy system will be used where appropriate for manual lifting.

- Requirements of Westinghouse Hanford radiation protection and RWP manuals shall be followed for all work involving radioactive materials or conducted within a radiologically controlled area.

- Onsite work operations shall only be carried out during daylight hours, unless the entire control zone is adequately illuminated with artificial lighting. A new tour (shift) will operate the drilling rig after completion of each shift.

- Do not handle soil, waste samples, or any other potentially contaminated items unless wearing the protective equipment specified in the HWOP or JSA.

- Whenever possible, stand upwind of excavations, boreholes, well casings, drilling spoils, and the like, as indicated by an onsite windsock.

- Stand clear of trenches during excavation. Always approach an excavation from upwind.

- Be alert to potentially changing exposure conditions as evidenced by such indications as perceptible odors, unusual appearance of excavated soils, or oily sheen on water.

- Do not enter any test pit or trench deeper than 1.2 m (4 ft) unless in accordance with procedures specified in the HWOP.

- Do not under any circumstances enter or ride in or on any backhoe bucket, materials hoist, or any other similar device not specifically designed for carrying passengers.

- All drilling team members must make a conscientious effort to remain aware of their own and others' positions in regards to rotating equipment, cat heads, or u-joints. Drilling operations members must be extremely careful when assembling, lifting, and carrying flights or pipe to avoid pinch-point injuries and collisions.

- Tools and equipment will be kept off the ground whenever possible to avoid tripping hazards and the spread of contamination.

- Personnel not involved in operation of the drill rig or monitoring activities shall remain a safe distance from the rig as indicated by the field team leader.

- Follow all provisions of each site-specific hazardous work permit as addressed in the HWOP, including cutting and welding, confined space entry, and excavation.

- Catalytic converters on the underside of vehicles are sufficiently hot to ignite dry prairie grass. Team members should not drive over dry grass that is higher than the ground clearance of the vehicle and should be aware of the potential fire hazard posed by catalytic converters at all times. Never allow a running or hot vehicle to sit in a stationary location over dry grass or other combustible materials.

- Follow all provisions of each site-specific RWP.

- Team members will attempt to minimize truck tire disturbance of all stabilized sites.

2.1.2 Personal Protective Equipment

- Personal protective equipment will be selected specifically for the hazards identified in the HWOP. The site safety officer in conjunction with Westinghouse Hanford Health Physics and Industrial Hygiene and Safety is responsible for choosing the appropriate type and level of protection required for different activities at the job site.

- Levels of protection shall be appropriate to the hazard to avoid either excessive exposure or additional hazards imposed by excessive levels of protection. The HWOP will contain provisions for adjusting the level of protection as necessary. These personal protective equipment specifications must be followed at all times, as directed by the field team leader, health physics technician, and site safety officer.

- Each employee must have a hard hat, safety glasses, and substantial protective footwear available to wear as specified in the HWOP or JSA.

- The exclusion zone around drilling or other noisy operations will be posted "Hearing Protection Required" and team members will have had noise control training.

- Personnel should maintain a high level of awareness of the limitations in mobility, dexterity, and visual impairment inherent in the use of level B and level C personal protective equipment.

- Personnel should be alert to the symptoms of fatigue, heat stress, and cold stress and their effects on the normal caution and judgment of personnel.

- Rescue equipment as required by Occupational Safety and Health Administration (OSHA), Washington Industrial Safety and Health Act (WISHA), or standards for working over water will be available and used.

2.1.3 Personal Decontamination

- The HWOP will describe in detail methods of personnel decontamination, including the use of contamination control corridors and step-off pads when appropriate.

- Thoroughly wash hands and face before eating or putting anything in the mouth to avoid hand-to-mouth contamination.

- At the end of each work day or each job, disposable clothing shall be removed and placed in (chemical contamination) drums, plastic-lined boxes or other containers as appropriate. Clothing that can be cleaned may be sent to the Hanford Site laundry.

- Individuals are expected to thoroughly shower before leaving the work site or Hanford Site if directed to do so by the health physics technician, site safety officer, or field team leader.

2.1.4 Emergency Preparation

- A multipurpose dry chemical fire extinguisher, a fire shovel, a complete field first-aid kit, and a portable pressurized spray wash unit shall be available at every site where there is potential for personnel contamination.

- Prearranged hand signals or other means of emergency communication will be established when respiratory protection equipment is to be worn, because this equipment seriously impairs speech.

- The Hanford Fire Department shall be initially notified before the start of the site investigation project. This notification shall include the location and nature of the various types of field work activities as described in the work plan. A site location map shall be included in this notification.

2.2 CONFINED SPACE/TEST PIT ENTRY PROCEDURES

The following procedures apply to the entry of any confined space, which for the purpose of this document shall be defined as any space having limited egress (access to an exit) and the potential for the presence or accumulation of a toxic or explosive atmosphere. This includes manholes, certain trenches (particularly those through waste disposal areas), and all test pits greater than 1 m (4 ft) deep. If confined spaces are to be entered as part of the work operations, a hazardous work permit (filled out for confined space entry) must be obtained from Industrial Safety and Fire Protection.

The identified remedial investigation activities on the B Plant AAMS should not require confined space entry. Nevertheless, the hazards associated with confined spaces are of such severity that all employees should be familiar with the safe work discussed in the following paragraphs.

No employee shall enter any test pit or trench deeper than 1 m (4 ft) unless the sides are shored or laid back to a stable slope as specified in OSHA 29 CFR 1926.652 or equivalent state occupational health and safety regulations.

When an employee is required to enter a pit or trench 1 m (4 ft) deep or more, an adequate means of access and egress, such as a slope of at least 2:1 to the bottom of the pit or a secure ladder or steps shall be provided.

Before entering any confined space, <u>including any test pit</u>, the atmosphere will be tested for flammable gases, oxygen deficiency, and organic vapors. If other specific contamination, such as radioactive materials or other gases and vapors may be present, additional testing for those substances shall be conducted. Depending on the situation, the space may require ventilation and retesting before entry.

An employee entering a confined or partially confined space must be equipped with an appropriate level of respiratory protection in keeping with the monitoring procedures discussed previously and the action levels for airborne contaminants (see "Warnings and Action Levels" in HWOP).

No employee shall enter any test pit requiring the use of level B protection, unless a backup person also equipped with a pressure-demand self-contained breathing apparatus (SCBA) is present. No backup person shall attempt any emergency rescue unless a second backup person equipped with an SCBA is present, or the appropriate emergency response authorities have been notified and additional help is on the way.

3.0 SITE BACKGROUND

Specific details on the B Plant AAMS background and known and suspected contamination are described in Sections 2.0 through 10.0 of the plan. The B Plant Aggregate Area is situated within the 200 East Area of the U.S. Department of Energy's (DOE) Hanford Site, in the south-central portion of the state of Washington. The 200 East Area is located in Benton County in the central portion of the Hanford Site. It is adjacent to the 200 West Area, located roughly 5 km (3 mi) to the east.

The B Plant Aggregate Area at the Hanford Site was used by the U.S. Government as a chemical separations area in the process to produce plutonium for nuclear weapons. These operations resulted in the release of chemical and radioactive wastes into the soil, air, and water of the area. Each waste site in the aggregate area is described separately in this document. Close relationships between waste units, such as overflow from one to another, are also discussed.

4.0 SCOPE OF WORK AND POTENTIAL HAZARDS

While the information presented in Sections 2.0 through 10.0 of the plan are believed to be representative of the constituents and quantities of wastes at the time of discharge, the present chemical nature, location, extent, and ultimate fate of these wastes in and around the liquid disposal facilities are largely unknown. The emphasis of the investigation in the B Plant AAMS will be to characterize the nature and extent of contamination in the vadose (unsaturated subsurface soil) zone.

4.1 WORK TASKS

Work tasks are described in Section 5.0 of the plan.

4.2 POTENTIAL HAZARDS

Onsite tasks will involve noninvasive surface sampling procedures and invasive soil sampling either directly in or immediately adjacent to areas known or suspected to contain potentially hazardous chemical substances, toxic metals, and radioactive materials.

Surface radiological contamination and fugitive dust will be the potential hazards of primary concern during noninvasive mapping and sampling activities.

Existing data indicate that hazardous substances may be encountered during invasive sampling; these include radionuclides, heavy metals, and corrosives. In addition, volatile organics may also be associated with certain facilities such as the solvent storage buildings or underground storage tanks.

Potential hazards include the following:

- External radiation (gamma and to a lesser extract, beta) from radioactive materials in the soil
- Internal radiation resulting from radionuclides present in contaminated soil entering the body by ingestion or through open cuts and scratches
- Internal radiation resulting from inhalation of particulate (dust) contaminated with radioactive materials
- Inhalation of toxic vapors or gases such as volatile organics or ammonia
- Inhalation or ingestion of particulate (dust) contaminated with inorganic or organic chemicals, and toxic metals
- Dermal exposure to soil or groundwater contaminated with radionuclides
- Dermal exposure to soil or groundwater contaminated with inorganic or organic chemicals, and toxic metals
- Physical hazards such as noise, heat stress, and cold stress
- Slips, trips, falls, bumps, cuts, pinch points, falling objects, other overhead hazards, crushing injuries, and other hazards typical of a construction-related job site
- Unknown or unexpected underground utilities
- Biological hazards; snakes, spiders, etc.

4.3 ASSESSMENT AND MITIGATION OF POTENTIAL HAZARDS

The likelihood of significant exposure (100 mR/h or greater) to external radiation is remote and can be readily monitored and controlled by limiting exposure time, increasing distance, and employing shielding as required.

Internal radiation by inhalation or inadvertent ingestion of contaminated dust is a realistic concern and must be continuously evaluated by the health physics technician. Appropriate respiratory protection, protective clothing, and decontamination procedures will be implemented as necessary to reduce potential inhalation, ingestion, and dermal exposure to acceptable levels.

Dermal exposure to toxic chemical substances is not expected to pose a significant problem for the identified tasks given the use of the designated protective clothing. The appropriate level of personal protective clothing and respiratory protection will vary from work site to work site.

5.0 ENVIRONMENTAL AND PERSONAL MONITORING

The site safety officer or authorized delegate shall be present at all times during work activities which require an HWOP, and shall be in charge of all environmental/personal monitoring equipment. Industrial Hygiene and Safety shall review all activities involving or potentially involving radiological exposure or contamination control and shall prescribe the appropriate level of technical support and/or monitoring requirements. Other equipment deemed necessary by the site safety officer or Industrial Hygiene and Safety shall be obtained at their direction; work will be initiated or continued until such equipment is in place. These instruments are to be used only by persons who are trained in their usage and who understand their limitations. No work shall be done unless instrumentation is available and in proper working order.

Air sampling may be required downwind of the referenced waste sites to monitor particulates and vapors before job startup. Siting of such sampling devices will be determined by Health Physics, the site safety officer, and HEHF, if appropriate. Any time personnel exposure monitoring, other than radiological, is required to determine exposure levels, it must be done by HEHF. Discrete sampling of ambient air within the work zone and breathing zones will be conducted using a direct-reading instrument, as specified in the site-specific safety document, and other methods as deemed appropriate (e.g., pumps with tubes, O_2 meters). The following standards will be used in determining critical levels:

- "Radionuclide Concentrations in Air," in Chapter XI, DOE Order 5480.1B (DOE 1986)

- "Air Contaminants - Permissible Exposure Limits," in 29 CFR 1910.1000

- *Threshold Limit Values and Biological Exposure Indices for 1990-1991* (ACGIH 1991)

- *Occupational Safety and Health Standards*, 29 CFR 1910.1000

- *Pocket Guide to Chemical Hazards* (NIOSH 1991), which provides National Institute for Occupational Safety and Health (NIOSH)-recommended exposure limits for substances that do not have either a threshold limit value or a permissible exposure limit.

5.1 AIRBORNE RADIOACTIVE AND RADIATION MONITORING

An onsite health physics technician will monitor airborne radioactive contamination levels and external radiation levels. Action levels will be consistent with derived air concentrations and applicable guidelines as specified in the radiation protection manual WHC-CM-4-10 (WHC 1988).

Appropriate respiratory protection shall be required when conditions are such that the airborne contamination levels may exceed an 8-hour derived air concentration (e.g., the presence of high levels of uncontained, loose contamination on exposed surfaces or operations that may raise excessive levels of dust contaminated with airborne radioactive materials, such as excavation or drilling under extremely dry conditions).

Specific conditions requiring the use of respiratory protection because of radioactive materials in air will be incorporated into the RWP. If, in the judgment of the health physics technician, any of these conditions arise, work shall cease until appropriate respiratory protection is provided.

6.0 PERSONAL PROTECTIVE EQUIPMENT

The level of personal protective equipment required initially at a site will be specified in the site-specific safety document for each task or group of tasks. Personal protective clothing and respiratory protection shall be selected to limit exposure to anticipated chemical and radiological hazards. Work practices and engineering controls may be used to control exposure.

7.0 SITE CONTROL

The field team leader, site safety officer, and health physics technician are designated to coordinate access control and security on the site. Special site control measures will be necessary to restrict public access. The zones will be clearly marked with rope and/or appropriate signs. The size and shape of the control zone will be dictated by the types of hazards expected, the climatic conditions, and specific operations required.

Control zone boundaries may be increased or decreased based on results of field monitoring, environmental changes, or work technique changes. The site RWP and the contractor's standard operating procedures for radiation protection may also dictate the boundary size and shape. All team members must be surveyed for radioactive contamination when leaving the controlled zone if in a radiation zone.

The onsite command post and staging area will be established near the upwind side of the control zone as determined by an onsite windsock. Exact location for the command post is to be determined just before start of work. Vehicle access, availability of utilities (power and telephone), wind direction, and proximity to sample locations should be considered in establishing a command post location.

8.0 DECONTAMINATION PROCEDURES

Remedial investigation activities will require entry into areas of known chemical and radiological contamination. Consequently, it is possible that personnel and equipment could be contaminated with hazardous chemical and radiological substances.

During site activities, potential sources of contamination may include airborne vapors, gases, dust, mists, and aerosols; splashes and spills; walking through contaminated areas; and handling contaminated equipment. Personnel who enter the exclusion zone will be required to go through the appropriate decontamination procedures on leaving the zone. Decontamination procedures shall be consistent with EII 5.4, "Field Decontamination of

Drilling, Well Development, and Sampling Equipment," and EII 5.5, "Decontamination of Equipment for RCRA/CERCLA Sampling" (WHC 1991), or other approved decontamination procedures.

9.0 CONTINGENCY AND EMERGENCY RESPONSE PLANS

As a general rule, in the event of an unanticipated, potentially hazardous situation indicated by instrument readings, visible contamination, unusual or excessive odors, or other indications, team members shall temporarily cease operations and move upwind to a predesignated safe area as specified in the site-specific safety documentation.

10.0 REFERENCES

ACGIH, 1991, *Threshold Limit Values and Biological Exposure Indices for 1990-1991*, American Conference of Governmental Industrial Hygienists, Cincinnati, Ohio.

DOE, 1986, *Environment, Safety & Health Program for DOE Operations*, DOE Order 5480.1B, U.S. Department of Energy, Washington, D.C.

NIOSH, 1991, *Pocket Guide to Chemical Hazards, National Institute for Occupational Safety and Health*, U.S. Department of Health and Human Services, Public Health Service, Centers for Disease Control, Washington, D.C.

WHC, 1988, *Radiation Protection*, WHC-CM-4-10, Westinghouse Hanford Company, Richland, Washington.

WHC, 1991, *Environmental Investigations and Site Characterization Manual*, WHC-CM-7-7, Westinghouse Hanford Company, Richland, Washington.

WHC, 1992, *Health and Safety for Hazardous Waste Field Operations*, WHC-CM-4-3 Vol. 4, Westinghouse Hanford Company, Richland, Washington.

APPENDIX C

PROJECT MANAGEMENT PLAN

CONTENTS

CONTENTS (cont.)

Page

FIGURES:

TABLE:

ACRONYMS AND ABBREVIATIONS

CERCLA	Comprehensive Environmental Response, Compensation, and Liability Act of 1980
DOE	U.S. Department of Energy
Ecology	Washington State Department of Ecology
EPA	U.S. Environmental Protection Agency
FS	feasibility study
MCS	Management Control System
PMP	Project Management Plan
PNL	Pacific Northwest Laboratory
RCRA	Resource Conservation and Recovery Act
RI	remedial investigation
Tri-Party Agreement	Hanford Federal Facility Agreement and Consent Order

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1.0 INTRODUCTION

This Project Management Plan (PMP) defines the administrative and institutional tasks necessary to support the B Plant Aggregate Area investigations at the Hanford Site. Also, this PMP defines the responsibilities of the various participants, the organizational structure, and the project tracking and reporting procedures. This PMP is in accordance with the provisions of the *Hanford Federal Facility Agreement and Consent Order* (Tri-Party Agreement) dated August 1990 (Ecology et al. 1990). Any revisions to the Tri-Party Agreement that would result in changes to the project management requirements would supersede the provisions of this chapter.

2.0 PROJECT ORGANIZATION AND RESPONSIBILITIES

2.1 INTERFACE OF REGULATORY AUTHORITIES AND THE U.S. DEPARTMENT OF ENERGY

The B Plant Aggregate Area consists of active and inactive waste management units to be remedied under either the Resource Conservation and Recovery Act (RCRA) or the Comprehensive Environmental Response, Compensation, and Liability Act of 1980 (CERCLA). The U.S. Department of Ecology (Ecology) has been designated as the lead regulatory agency, as defined in the Tri-Party Agreement. Accordingly, Ecology is responsible for overseeing remedial action activity at this aggregate area and ensuring that the applicable authorities of both the U.S. Environmental Protection Agency (EPA) and the U.S. Department of Energy (DOE) are applied. The specific responsibilities of EPA, Ecology, and DOE are detailed in the Tri-Party Agreement.

2.2 PROJECT ORGANIZATION AND RESPONSIBILITIES

The project organization for implementing remedial activities at the B Plant Aggregate Area is shown in Figure C-1. The following sections describe the responsibilities of the individuals shown in Figure C-1.

2.2.1 Project Managers

The EPA, DOE, and Ecology have each designated one individual as project manager for remedial activities at the Hanford Site. These project managers will serve as the primary point of contact for all activities to be carried out under the Tri-Party Agreement. The responsibilities of the project managers are given in Section 4.1 of the Tri-Party Agreement.

2.2.2 Unit Managers

As shown in Figure C-1, EPA, DOE, and Ecology will each designate an individual as a unit manager for the B Plant Aggregate Area.

The unit manager from Ecology will serve as the lead unit manager. The Ecology unit manager will be responsible for regulatory oversight of all activities required for the B Plant Aggregate Area.

The unit manager from EPA will be responsible for making decisions related to issues for which the supporting regulatory agency maintains authority. All such decisions will be made in consideration of recommendations made by the Ecology unit manager.

The unit manager from DOE will be responsible for maintaining and controlling the schedule and budget and keeping the EPA and Ecology unit managers informed as to the status of the activities at the B Plant Aggregate Area, particularly the status of agreements and commitments.

2.2.3 Quality Assurance Lead

The quality assurance lead will be a designated person within the Westinghouse Hanford Quality Assurance Organization. This designated person will be responsible for monitoring overall environmental restoration activities for this project. The designated personnel shall have the necessary organizational independence and authority to identify conditions adverse to quality and to systematically seek corrective action.

This individual is responsible for the preplanned survellance and audit activities for this project. A quality assurance report shall be provided to the technical lead, annually as a minimum, for inclusion in the project final report generated by the technical organization. The quality assurance report shall summarize the surveillance and audit activities as well as associated corrective actions that may have been taken during the interval.

2.2.4 Health and Safety Officer (Environmental Division/Environmental Field Services)

The health and safety officer is responsible for monitoring all potential health and safety hazards, including those associated with radioactive, volatile, and/or toxic compounds during sample handling and sampling decontamination activities. The health and safety officer has the responsibility and authority to halt field activities resulting from unacceptable health and safety hazards.

2.2.5 Technical Lead

The technical lead will be a designated person within the Westinghouse Hanford Environmental Engineering Group. The responsibilities of the technical lead will be to plan, authorize, and control work so that it can be completed on schedule and within budget, and to ensure that all planning and work performance activities are technically sound.

2.2.6 Remedial Investigation/Feasibility Study Coordinators

The remedial investigation (RI) and feasibility study (FS) coordinators will be responsible for coordinating all activities related to the RI and FS, respectively, including data collection, analysis, and reporting. The RI and FS coordinators will be responsible for keeping the technical lead informed as to the RI and FS work status and any problems that may arise.

2.2.7 Resource Conservation and Recovery Act Facility Investigation/Corrective Measures Study Contractor

Figure C-1 shows the organizational relationship of an offsite contractor. Assuming a contractor is used to perform the RI/FS for the B Plant Aggregate Area, the contractor would assume responsibilities of the RI and FS coordinators, as described above. In this instance, the contractor will be directly responsible for planning data collection activities and for analyzing and reporting the results of the data-gathering in the RI and FS reports. However, the Westinghouse Hanford coordinator would retain the responsibility for securing and managing the field sampling efforts of the Hanford Site technical resource teams, described below. Figure C-2 shows a sample organizational structure for an RI/FS contractor team.

2.2.8 Hanford Site Technical Resources

The various technical resources available on the Hanford Site for performing the field studies are shown in Table C-1. These resources will be responsible for performing data collection activities and analyses, and for reporting the results of specific technical activities. Figures C-3 through C-6 show the detailed organizational structure of specific technical teams. Internal and external work orders and subcontractor task orders will be written by the Westinghouse Hanford technical lead to use these technical resources, which are under the control of the technical lead. Statements of work will be provided to the technical teams and will include a discussion of authority and responsibility, a schedule with clearly defined milestones, and a task description including specific requirements. Each technical team will keep the coordinator informed of the work status performed by that group and any problems that may arise.

3.0 DOCUMENTATION AND RECORDS

All plans and reports will be categorized as either primary or secondary documents as described by Section 9.1 of the Tri-Party Agreement. The process for document review and comment will be as described in Section 9.2 of the Tri-Party Agreement. Revisions, should they become necessary after finalization of any document, will be in accordance with Section 9.3 of the Tri-Party Agreement. Changes in the work schedule, as well as minor field changes, can be made without having to process a formal revision. The process for making these changes will be as stated in Section 12.0 of the Tri-Party Agreement. Administrative records, which must be maintained to support the Hanford Site activities, will be in accordance with Section 9.4 of the Tri-Party Agreement.

4.0 FINANCIAL AND PROJECT TRACKING REQUIREMENTS

4.1 MANAGEMENT CONTROL

Westinghouse Hanford will have the overall responsibility for planning and controlling the investigation activities, and providing effective technical, cost, and schedule baseline management. If a contractor is used, the contractor will assume the direct day-to-day responsibilities for these management functions. The management control system used for this project must meet the requirements of DOE Order 4700.1, Project Management System and DOE Order 2250.1C, Cost and Schedule Control Systems Criteria. The Westinghouse Hanford Management Control System (MCS) meets these requirements. The primary goals of the Westinghouse Hanford MCS are to provide methods for planning, authorizing, and controlling work so that it can be completed on schedule and within budget, and to ensure that all planning and work performance activities are technically sound and in conformance with management and quality requirements.

The schedule developed for the B Plant Aggregate Area will be updated at least annually, to expand the new current fiscal year and the follow-on year. In addition, any approved schedule changes (see Section 12.0 of the Tri-Party Agreement for the formal change control system) would be incorporated at this time, if not previously incorporated. This update will be performed in the fourth quarter of the previous fiscal year (e.g., July to September) for the upcoming current fiscal year. The work schedule can be revised at any time during the year if the need arises, but the changes would be restricted to major changes that would not be suitable for the change control process.

4.2 MEETINGS AND PROGRESS REPORTS

Both project and unit managers must meet periodically to discuss progress, review plans, and address any issues that have arisen. The project managers' meeting will take place at least quarterly, and is discussed in Section 8.1 of the Tri-Party Agreement.

Unit managers shall meet monthly to discuss progress, address issues, and review near-term plans pertaining to their respective operable units and/or treatment, storage, and disposal groups/units. The meetings shall be technical in nature, with emphasis on technical issues and work progress. The assigned DOE unit manager for the B Plant Aggregate Area will be responsible for preparing revisions to the aggregate area schedule prior to the meeting. The schedule shall address all ongoing activities associated with the B Plant Aggregate Area, including actions on specific source units (e.g., sampling). This schedule will be provided to all parties and reviewed at the meeting. Any agreements and commitments (within the unit manager's level of authority) resulting from the meeting will be prepared and signed by all parties as soon as possible after the meeting. Meeting minutes will be issued by the DOE unit manager and will summarize the discussion at the meeting, with information copies given to the project managers. The minutes will be issued within five working days following the meeting. The minutes will include, at a minimum, the following information:

- Status of previous agreements and commitments

- Any new agreements and commitments

- Schedules (with current status noted)

- Any approved changes signed off at the meeting in accordance with Section 12.1 of the Tri-Party Agreement.

Project coordinators for each operable unit also will meet on a monthly basis to share information and to discuss progress and problems.

The DOE shall issue a quarterly progress report for the Hanford Site within 45 days following the end of each quarter. Quarters end on March 31, June 30, September 30, and December 31. The quarterly progress reports will be placed in the public information repositories as discussed in Section 10.2 of the Tri-Party Agreement. The report shall include the following:

- Highlights of significant progress and problems.

- Technical progress with supporting information, as appropriate.

- Problem areas with recommended solutions. This will include any anticipated delays in meeting schedules, the reason(s) for the potential delay, and actions to prevent or minimize the delay.

- Significant activities planned for the next quarter.

- Work schedules (with current status noted).

5.0 REFERENCES

Ecology, EPA, and DOE, 1990, *Hanford Federal Facility Agreement and Consent Order*, (First Amendment), 89-10, Rev.1, Olympia, Washington.

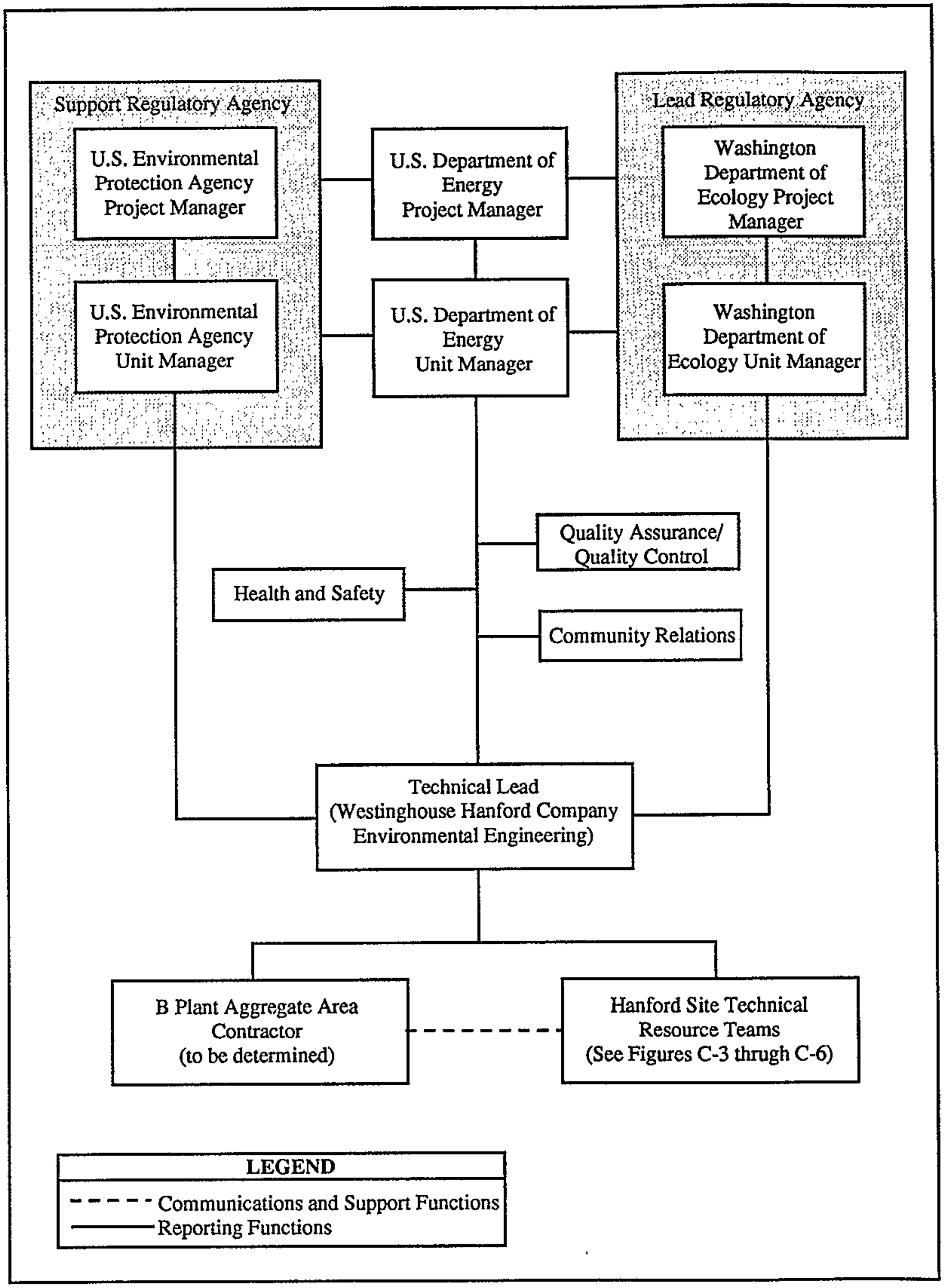

Figure C-1. Project Organization for the B Plant Aggregate Area Project.

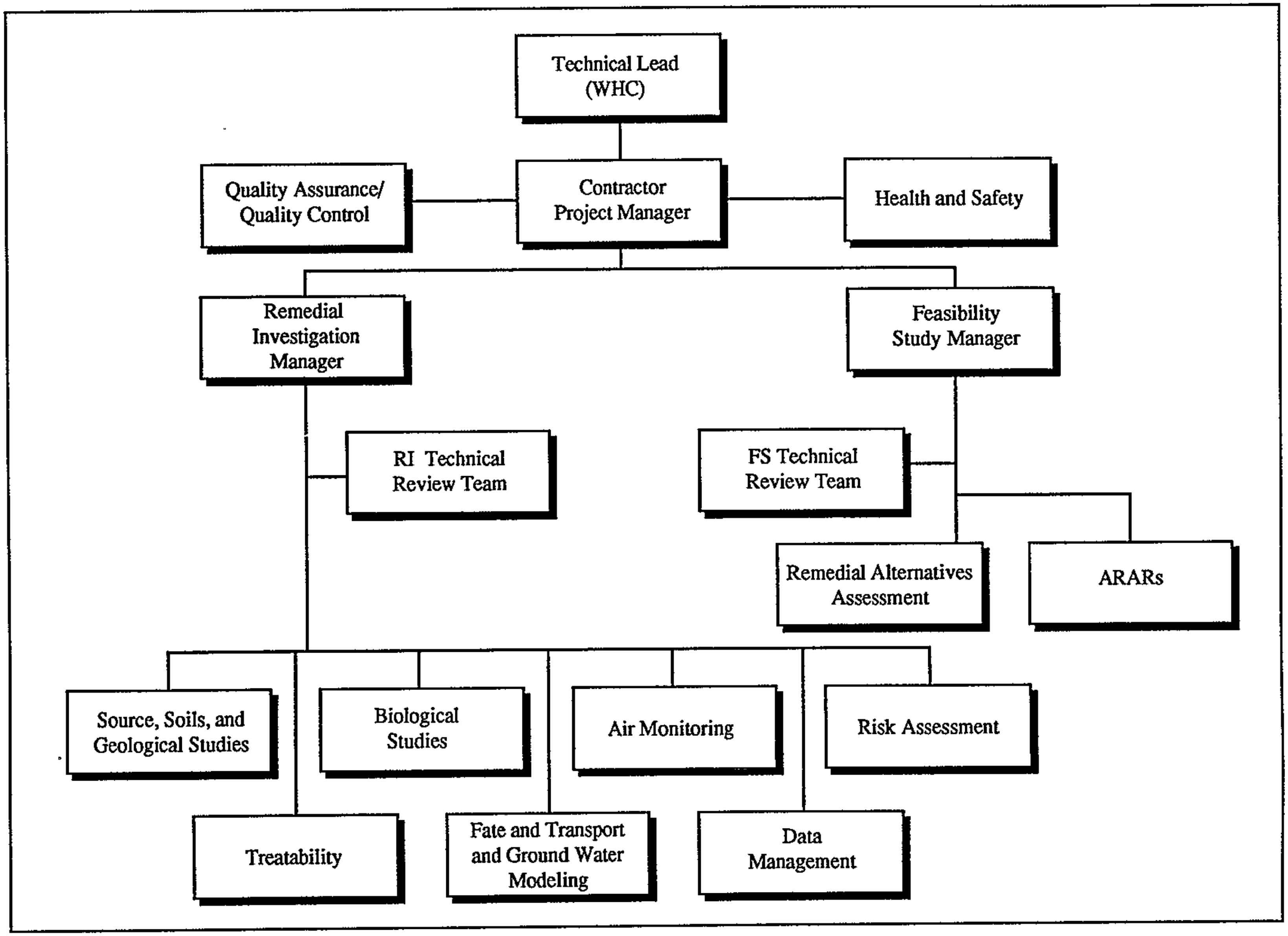

Figure C-2. Example Project Organization for the B Plant Aggregate Area

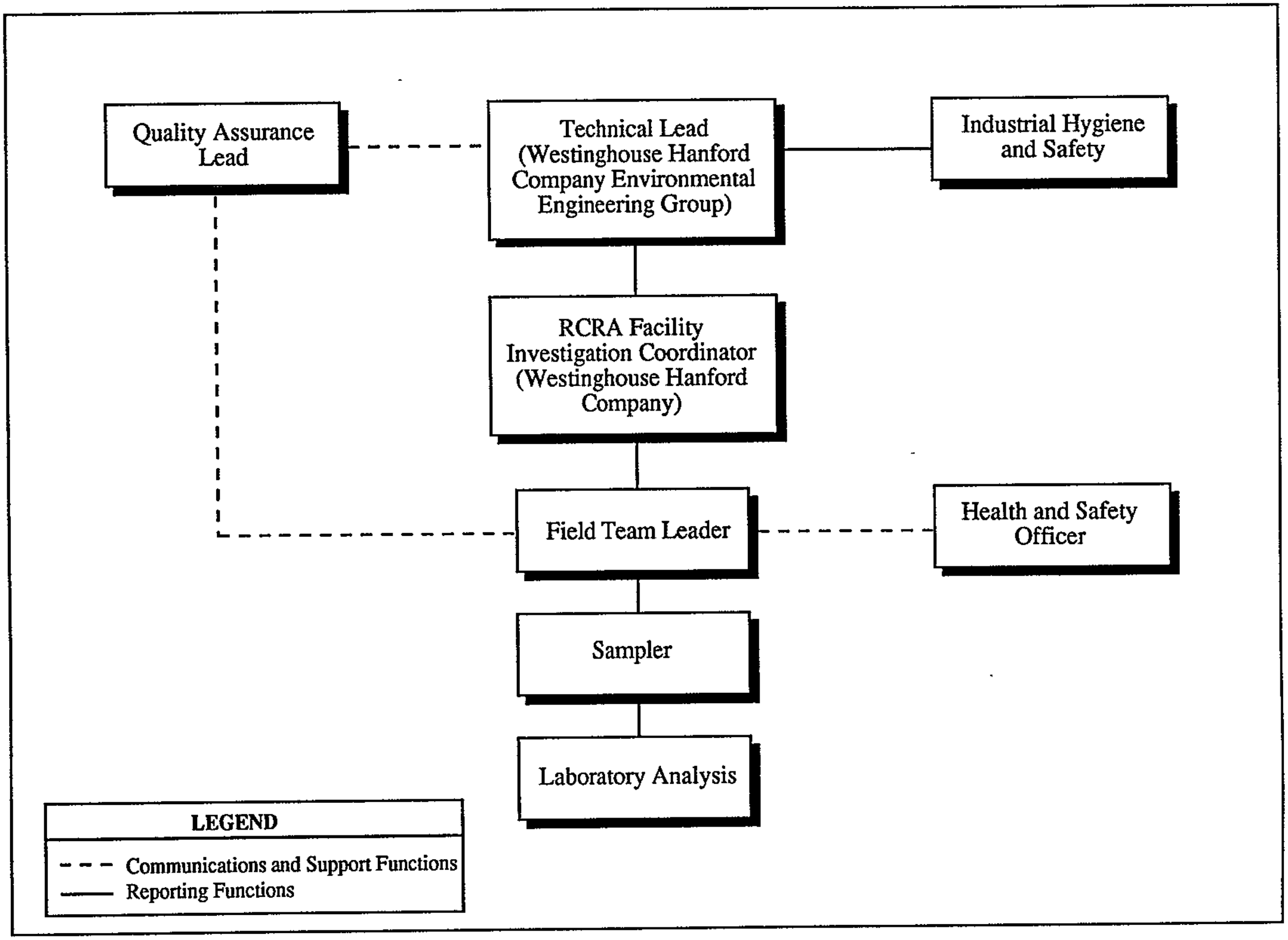

Figure C-3. The Hanford Site Soil Sampling Team.

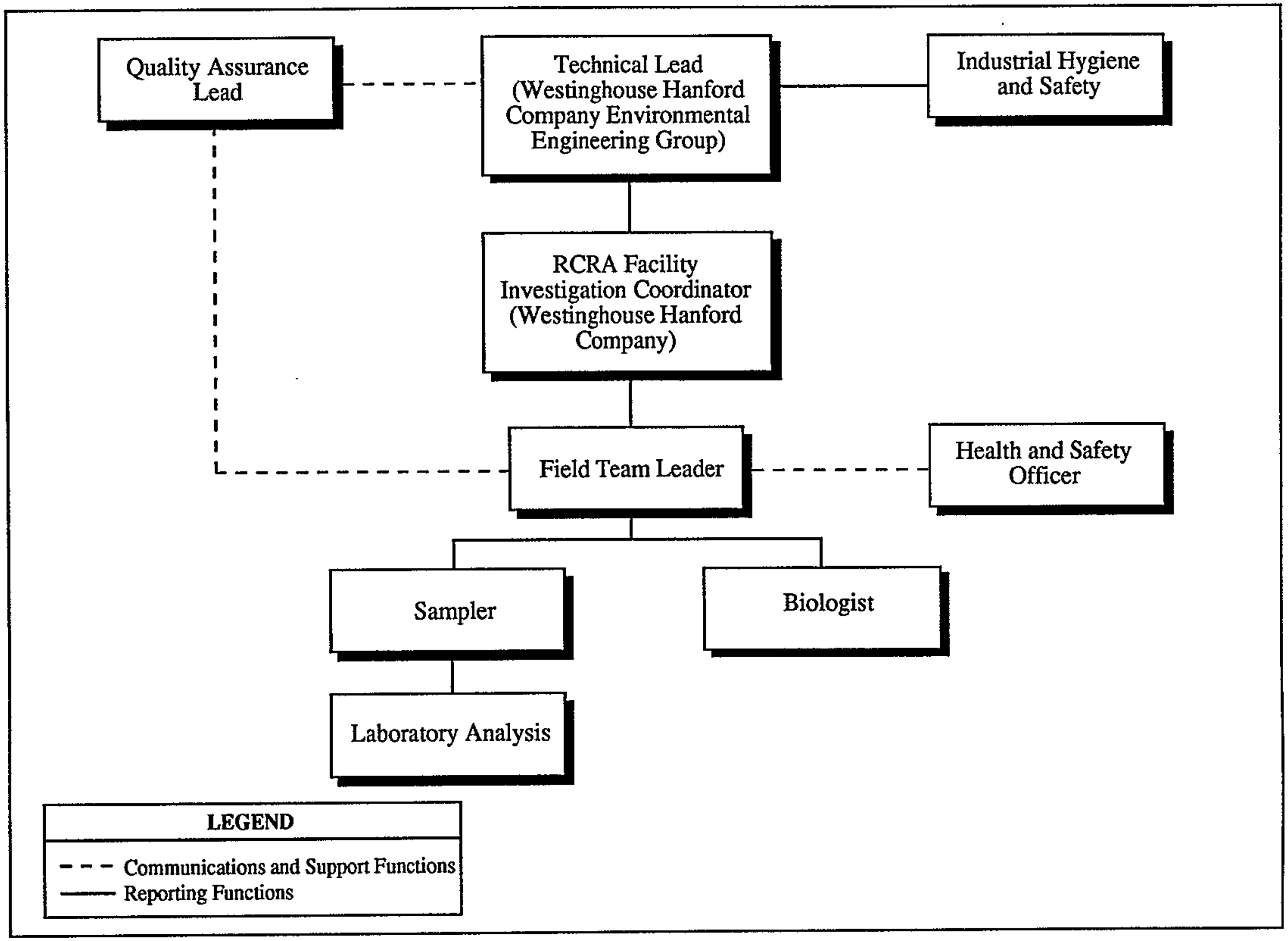

Figure C-4. The Hanford Site Biological Sampling Team.

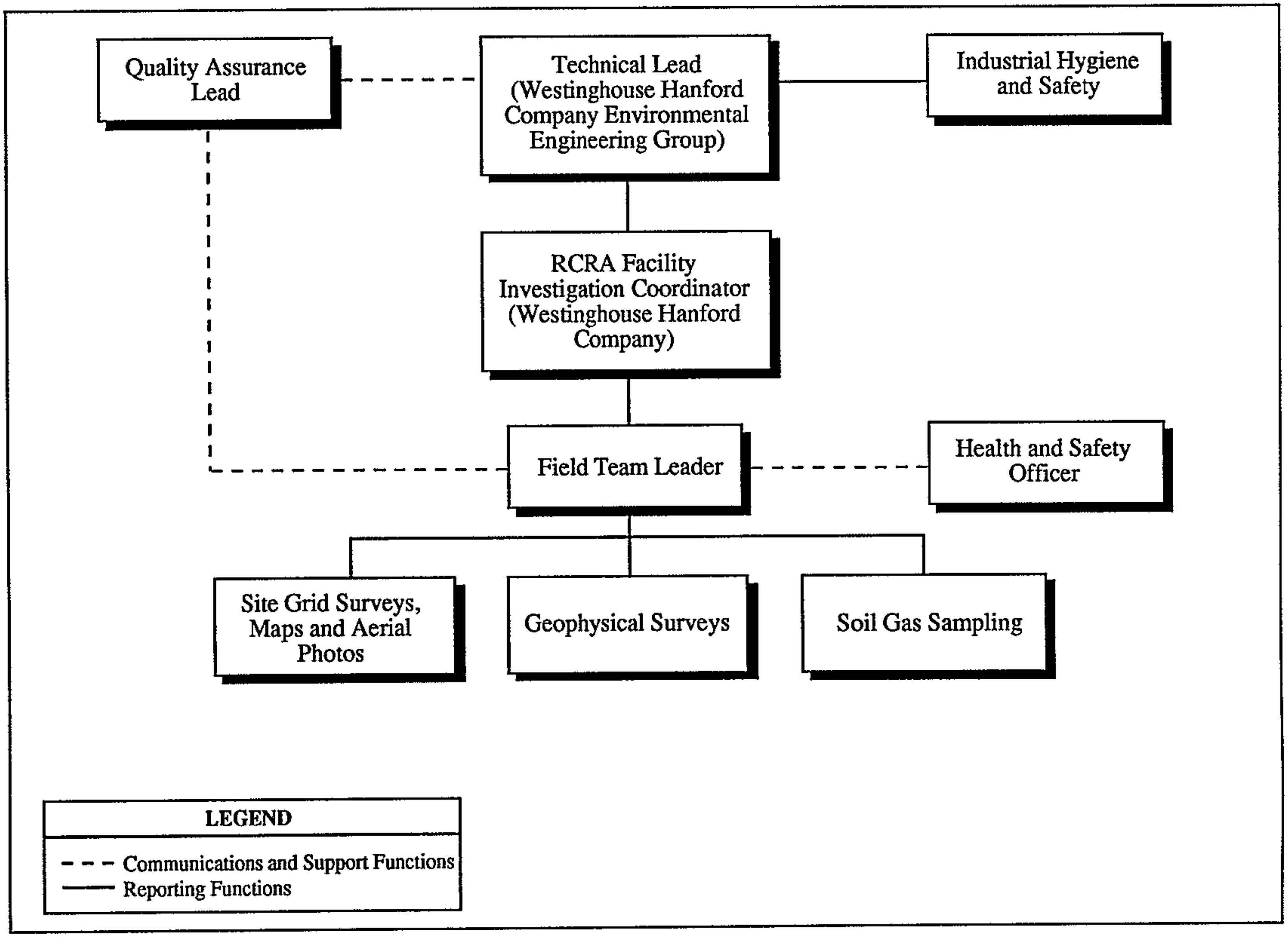

Figure C-5. The Hanford Site Physical and Geophysical Survey Team.

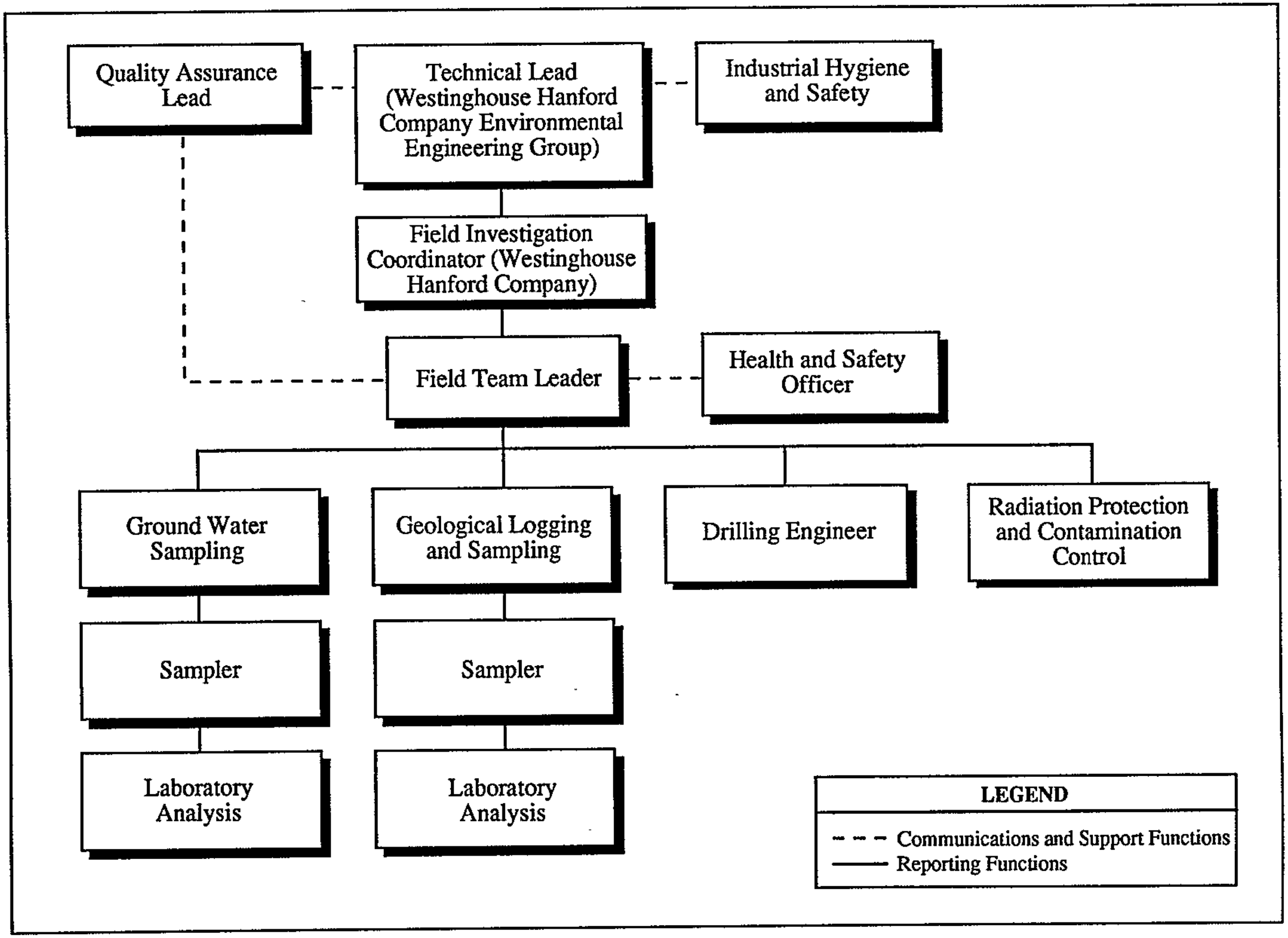

Figure C-6. Drilling, Sampling, and Well-Development Team.

Table C-1. Hanford Site RI/FS Technical Resources. Page 1 of 2

Subject/Activity	Technical Resources: RI	Technical Resources: FS
Hydrology and geology	Westinghouse Hanford/Geosciences PNL/Earth and Environmental Sciences Center	Westinghouse Hanford/Geosciences
Toxicology and risk/endangerment assessment	Westinghouse Hanford/Environmental Technology PNL/Earth and Environmental Sciences Center PNL/Life Sciences Center	Westinghouse Hanford/ Environmental Technology
Environmental chemistry	Westinghouse Hanford/Geosciences PNL/Earth and Environmental Sciences Center	Westinghouse Hanford/Geosciences
Geotechnical and civil engineering	Westinghouse Hanford/Geosciences (Planning) Environmental Field Services	NA
Geotechnical and civil engineering	NA	Westinghouse Hanford/ Environmental Engineering PNL/Waste Technology Center
Groundwater treatment engineering	NA	Westinghouse Hanford/ Environmental Engineering PNL/Waste Technology Center
Waste stabilization and treatment	NA	Westinghouse Hanford/ Environmental Engineering PNL/Waste Technology Center
Surveying	Kaiser Engineers Hanford	NA

Table C-1. Hanford Site RI/FS Technical Resources. Page 2 of 2

	Technical Resources	
Subject/Activity	RI	FS
Soil and water sampling and analysis	Westinghouse Hanford/Environmental Engineering Westinghouse Office of Sampling Management PNL/Earth and Environmental Sciences Center PNL/Materials and Chemical Sciences Center	NA
Drilling and well installation	Westinghouse Hanford/Geosciences Environmental Field Services Kaiser Engineers	NA
Radiation monitoring	Westinghouse Hanford/Operational Health Physics	NA

NA = Not applicable.

APPENDIX D

INFORMATION MANAGEMENT OVERVIEW

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CONTENTS

CONTENTS (cont.)

ACRONYMS AND ABBREVIATIONS

AR	administrative record
CERCLA	Comprehensive Environmental Response, Compensation and Liability Act of 1980
CMS	Corrective Measures Study
DOE	U.S. Department of Energy
DOE/RL	U.S. Department of Energy, Richland Operations Office
Ecology	Washington Department of Ecology
EDMC	Environmental Data Management Center
EHPSS	Environmental Health and Pesticide Services Section
EII	Environmental Investigations Instructions
EIMP	Environmental Information Management Plan
EPA	U.S. Environmental Protection Agency
ER	environmental restoration
ERRA	Environmental Restoration Remedial Action
FOMP	Field Office Management Plan
FS	feasibility study
GIS	geographic information system
HEHF	Hanford Environmental Health Foundation
HEIS	Hanford Environmental Information System
HLAN	Hanford Local Area Network
HMS	Hanford Meteorological Station
IMO	Information Management Overview
KEH	Kaiser Engineers Hanford
OSM	Office of Sample Management
PNL	Pacific Northwest Laboratory
QA	quality assurance
QAPP	Quality Assurance Project Plan
QC	quality control
RFI	RCRA Facility Investigation
RI	remedial investigation
ROD	record of decision
TR	training records
Tri-Party Agreement	Hanford Federal Facility Agreement and Consent Order
TSD	treatment, storage, and disposal
Westinghouse Hanford	Westinghouse Hanford Company

DEFINITIONS OF TERMS

Action Plan. Action plan for implementation of the *Hanford Federal Facility Agreement and Consent Order* (Ecology et al. 1990). A negotiation between the U.S. Environmental Protection (EPA), the U.S. Department of Energy (DOE), and the State of Washington Department of Ecology (Ecology). The Action Plan defines the methods and processes by which hazardous waste permits will be obtained, and by which closure and post-closure actions under the Resource Conservation and Recovery Act of 1976 (RCRA) and by which remedial actions under the Comprehensive Environmental Response, Compensation, and Liability Act of 1980 (CERCLA) will be conducted on the Hanford Site.

Administrative Record (AR). In CERCLA, the official file that contains all information that was considered or relied on by the regulatory agency in arriving at a final remedial action decision, as well as all documentation of public participation throughout the process. In RCRA, the official file that contains all documents to support a final RCRA permit determination.

Administrative Record File. The assemblage of documents compiled and maintained by an agency pertaining to a proposed project of administrative action and designated as AR or that are candidates for inclusion in the AR once a record of decision (ROD) is attained.

Data Management. The planning and control of activities affecting data.

Data Quality. The totality of features and characteristics of data that bears on its ability to satisfy a given purpose. The characteristics of major importance are accuracy, precision, completeness, representativeness, and comparability.

Data Validation. The process whereby data are accepted or rejected based on a set of criteria. This aspect of quality assurance involves establishing specified criteria for data validation. The quality assurance project plan (QAPP) must indicate the specified criteria that will be used for data validation.

ENCORE. The name given to the combination of hardware, software, and administrative subsystems that serve to integrate the management of the Hanford Site environmental data.

Environmental Data Management Center (EDMC). The central facility and services that provide a files management system for processing environmental information.

Environmental Information. Data related to the protection or improvement of the Hanford Site environment, including data required to satisfy environmental statutes, applicable DOE orders, or the Tri-Party Agreement.

Field File Custodian. An individual who is responsible for receipt, validation, storage, maintenance, control, and disposition of information or other records generated in support of Environmental Division activities.

Hanford Environmental Information System (HEIS). A computer-based information system under development as a resource for the storage, analysis, and display of investigative data collected for use in site characterization and remediation activities. Subject areas currently being developed include geophysics/soil gas, vadose zone soil (geologic), atmospherics, and biota.

Information System. Collection of components relate to the management of data and reporting of information. Information systems typically include computer hardware, computer software, operating systems, utilities, procedures, and data.

Lead Agency. The regulatory agency (EPA or Ecology) that is assigned the primary administrative and technical responsibility with respect to actions at a particular operable unit.

Nonrecord Material. Copies of material that are maintained for information, reference, and operating convenience and for which another office has primary responsibility.

Operable Unit. An operable unit at the Hanford Site is a group of land disposal and groundwater sites placed together for the purposes of doing a remedial investigation/ feasibility study. The primary criteria for placement of a site into an operable unit are geographic proximity, similarity of waste characteristics and site types, and the possibility for economies of scale.

Primary Document. A document that contains information on which key decisions are made with respect to the remedial action or permitting process. Primary documents are subject to dispute resolution and are part of the administrative record file.

Project Manager. The individual responsible for implementing the terms and conditions of the Action Plan on behalf of his respective party. The EPA, DOE, and Ecology will each designate one project manager.

Quality Affecting Record. Information contained on any media, including but not limited to, hard copy, sample material, photo copy, and electronic systems, that is complete in terms of appropriate content and that furnishes evidence of the quality of items and/or activities affecting quality.

Quality Assurance. The systematic actions necessary to provide adequate confidence that a material, component, system, process, or facility performs satisfactorily or as planned in service.

Quality Assured Data. Data developed under an integrated program for assurance of the reliability of data.

Raw Data. Unprocessed or unanalyzed information.

Record Validation. A review to determine that records are complete, legible, and meet records requirements. Documents are considered valid records only after the validation process has been completed.

Retention Period. The length of time records must be held before they can be disposed of. The time is usually expressed in years from the date of the record, but may also be expressed as contingent on the occurrence of an event.

Secondary Document. A document providing information that does not, in itself, reflect or support key decisions. A secondary document is subject to review by the regulatory agencies and may be part of the administrative record field. It is not subject to dispute resolution.

Validated Data. Data that meet criteria contained in an approved company procedure.

Verified Data. Data that have been checked for accuracy and consistency following a transfer action (e.g., from manual log to computer, or from distributed database to centralized data repository).

1.0 INTRODUCTION AND OBJECTIVES

1.1 INTRODUCTION

An extensive amount of data will be generated over the next several years in connection with the activities planned for the B Plant Aggregate Area. The quality of these data are extremely important to the full remediation of the aggregate area as agreed on by the U.S. Department of Energy (DOE), the U.S. Environmental Protection Agency (EPA) the Washington Department of Ecology (Ecology), and interested parties.

The Information Management Overview (IMO) provides an overview of the data management activities at the operable unit level. It identifies the type and quantity of data to be collected and references the procedures which control the collection and handling of data. It provides guidance for the data collector, aggregate area investigator, project manager, and reviewer to fulfill their respective roles.

This IMO addresses handling of data generated from activities associated with the aggregate area activities. All data collected will be in accordance with the Environmental Investigations Instructions (EII) contained in the Westinghouse Hanford Company's (Westinghouse Hanford) *Environmental Investigations and Site Characterization Manual* (WHC 1991a).

Development of a comprehensive plan for the management of all environmental data generated at the Hanford Site is under way. The *Environmental Information Management Plan* (EIMP) (Steward et al. 1989), released in March 1989, described activities in the Environmental Data Management Center (EDMC) and long-range goals for management of scientific and technical data. The scientific and technical data part of the EIMP was reviewed, revised, and expanded in fiscal year 1990 (Michael et al. 1990). An *Environmental Restoration Remedial Action Program Records Management Plan* (WHC 1991b) issued in July 1991, enables the program office to identify, control, and maintain the quality assurance (QA), decisional, or regulatory prescribed records generated and used in support of the Environmental Restoration Remedial Action (ERRA) Program.

1.2 OBJECTIVES

This IMO describes the process for the collection and control procedures for validated data, records, documents, correspondence, and other information associated with this aggregate area. This IMO addresses the following:

- Types of data to be collected

- Plans for managing data
- Organizations controlling data
- Databases used to store the data
- EIMP
- Hanford Environmental Information System (HEIS).

2.0 TYPES OF DATA

2.1 TYPES OF DATA

The general types of technical data to be collected and the associated controlling procedures are as follows:

Type of data	Procedure
Historical reports	EII 1.6
Aerial photos	EII 1.6
Chart recordings	EII 1.6
Technical memos	EII 1.6
Validated samples analyses	EII 1.6
Reports	EII 1.6
Logbooks	EII 1.5
Chain-of-custody forms	EII 5.1
Sample quality assurance/ quality control (QA/QC)	Office of Sample Management (OSM)

All such data are submitted to the EDMC for entry into the administrative record (AR).

General types of related administrative data is shown in Table D-1, which is organized in terms of general types of personnel and compliance/regulatory data. Table D-1 references the appropriate procedures and the record custodians. Data associated with aggregate area investigations will be submitted to the EDMC for entry into the AR, as appropriate.

2.2 DATA COLLECTION

Data will be collected according to the aggregate area sampling and analysis plans and the Quality Assurance Project Plan (QAPP). Section 2.1 listed the controlling procedures for data collection and handling before turnover to the organization responsible for data storage.

All procedures for data collection shall be approved in compliance with the Westinghouse Hanford *Environmental Investigations and Site Characterization Manual* (WHC 1991a).

2.3 DATA STORAGE AND ACCESS

Data will be handled and stored according to procedures approved in compliance with applicable Westinghouse Hanford procedures (WHC 1988). The EDMC is the central files manager and process facility. All data entering the EDMC will be indexed, recorded, and placed into safe and secure storage. Data designated for placement into the AR will be copied, placed into the Hanford Site AR file, and distributed by the EDMC to the user community. The hard copy files are the primary sources of information; the various electronic data bases are secondary sources.

Normal access to data is through EDMC which is responsible for the AR. The Administrative Record Public Access Room is located in the 345 Hills Street Facility in Richland, Washington. This facility includes AR file documents (including identified guidance documents and technical literature).

Project participants may access data that are not in the AR by requesting it at the monthly unit managers' meeting for the operable unit of concern. As the project moves to completion, it is expected that all of the relevant data will be contained in the AR and the need to access data will be minimal.

The following types of data will be accessed from and reside in locations other than the EDMC:

Data Type	Data location
• QA/QC laboratory data	OSM (Westinghouse Hanford)
• Sample status	OSM (Westinghouse Hanford)
• Archived samples	Laboratory performing analyses
• Training records	Technical Training Support Section (Westinghouse Hanford)
• Meteorological data	Hanford Meteorological Station (HMS) (Pacific Northwest Laboratory [PNL])

• Health and safety records	Hanford Environmental Health Foundation (HEHF)
• Personal protective fitting	Environmental Health and Pesticide Services Section (Westinghouse Hanford)
• Radiological exposure	Pacific Northwest Laboratory.

2.4 DATA QUANTITY

Data quantities for the investigative activities will be estimated based on the sampling and analysis plans developed for investigation of sites within the aggregate area.

3.0 DATA MANAGEMENT

3.1 OBJECTIVE

A considerable amount of data will be generated through the implementation of the aggregate area sampling and analysis plans. The QAPP will provide the specific procedural direction and control for obtaining and analyzing samples in conformance with requirements to ensure quality data results. The sampling and analysis plans will provide the basis for selecting the location, depth, frequency of collection, etc., of media to be sampled and methods to be employed to obtain samples of selected media for cataloging, shipment, and analysis. Figure D-1 displays the general data management model for data generated through work plan activities.

3.2 ORGANIZATIONS CONTROLLING DATA

This section addresses the organizations that will receive data generated from aggregate area activities.

3.2.1 Environmental Engineering Group

The Westinghouse Hanford Environmental Engineering Group provides the operable unit technical coordinator. The technical coordinator is responsible for maintaining and transmitting data to the designated storage facility.

3.2.2 Office of Sample Management

The Westinghouse Hanford OSM will validate all analytical data packages received from the laboratory. Validated summary data (sample results and copies of chain-of-custody forms) will be forwarded to the technical coordinator. Nonvalidated data will be forwarded to the technical coordinator on request. Preliminary data will be clearly labeled as such. The OSM will maintain raw sample data, QA/QC laboratory data, and the archived sample index.

3.2.3 Environmental Data Management Center

The EDMC is the Westinghouse Hanford Environmental Division's central facility and service that provides a file management system for processing environmental information. The EDMC manages and controls the AR and Administrative Record Public Access Room at the Hanford Site. Part 1 of the EIMP (Michael et al. 1990) describes the central file system and services provided by the EDMC. The following procedures address data transmittal to the EDMC:

- EII 1.6, Records Management (WHC 1991a)
- EII 1.11, Technical Data Management (WHC 1991a)
- TPA-MP-02, Information Transmittals and Receipt Controls (DOE/RL 1990)
- TPA-MP-07, Administrative Record Collection and Management (DOE/RL 1990)

3.2.4 Information Resource Management

Information Resource Management is the designated records custodian (permanent storage) for Westinghouse Hanford. The procedural link from the EDMC to the Information Resource Management is currently under development.

3.2.5 Hanford Environmental Health Foundation

The HEHF performs the analyses on the nonradiological health and exposure data (Section 3.3.2) and forwards summary reports to the Fire and Protection Group and the Environmental Health and Pesticide Services Section within the Westinghouse Hanford Environmental Division. Nonradiological and health exposure data are maintained also for other Hanford Site contractors (PNL and Kaiser Engineers Hanford [KEH]) associated with aggregate area activities. The HEHF provides summary data to the appropriate site contractor. EII 2.1, Preparation of Hazardous Waste Operations Permits, and EII 2.2, Occupational Health Monitoring (WHC 1991a) address the preparation of health and safety plans and occupational health monitoring, respectively.

3.2.6 Environmental Health and Pesticide Services Section

The Westinghouse Hanford Environmental Health and Pesticide Services Section maintains personal protective equipment fitting records and maintains nonradiological health field exposure and exposure summary reports provided by HEHF for Westinghouse Hanford Environmental Division and subcontractor personnel.

3.2.7 Technical Training Records and Scheduling Section

The Westinghouse Hanford Technical Training Records and Scheduling Section provides training and maintains training records (Section 3.3.4).

3.2.8 Pacific Northwest Laboratory

The PNL operates the HMS and collects and maintains meteorological data (Section 3.3.1). Data management is discussed in Andrews (1988).

The PNL collects and maintains radiation exposure data (Section 3.3.3).

3.3 DATABASES

This section addresses databases that will receive data generated from the aggregate area activities. These and other databases are described in the EIMP (Michael et al. 1990). All of these databases exist independently of this aggregate area and serve other site functions. Data pertinent to the operable unit, housed in these databases, will be submitted to the AR.

3.3.1 Meteorological Data

The HMS collects and maintains meteorological data. Their database contains meteorological data from 1943 to the present, and Andrews (1988) is the document containing meteorological data management information.

3.3.2 Nonradiological Exposure and Medical Records

The HEHF collects and maintains data for all nonradiological exposure records and medical records.

3.3.3 Radiological Exposure Records

The PNL collects and maintains data on occupational radiation exposure. This database contains respiratory personal protective equipment fitting records, work restrictions, and radiation exposure information.

3.3.4 Training Records

Training records for Westinghouse Hanford and subcontractor personnel are managed by the Westinghouse Hanford Technical Training Support Section. Other Hanford Site contractors (PNL and KEH) maintain their own personnel training records. Training records for non-Westinghouse personnel are entered into the Westinghouse (soft reporting) database to document compliance.

Training records include:

- Initial 40-h hazardous waste worker training
- Annual 8-h hazardous waste worker training update
- Hazardous waste generator training
- Hazardous waste site specific training
- Radiation safety training
- Cardiopulmonary resuscitation
- Scott air pack
- Fire extinguisher
- Noise control
- Mask fit.

3.3.5 Environmental Information/Administrative Record

Environmental information and the AR are managed by Westinghouse Hanford EDMC personnel. They provide an index and key information on all data transmitted to the EDMC. This database is used to assist in data retrieval and to produce index lists as required.

3.3.6 Sample Status Tracking

The OSM maintains the sample status tracking database. This database contains information about each sample. Information maintained includes sample number, ship date, receipt date, and laboratory identification.

4.0 ENVIRONMENTAL INFORMATION AND RECORDS MANAGEMENT PLAN

This section briefly discusses the EIMP (Michael et al. 1990) that was developed to provide an overview of an integrated approach to managing Hanford Site environmental data, and the *Environmental Restoration Remedial Action Program Records Management Plan* (WHC 1991b).

4.1 ENVIRONMENTAL INFORMATION MANAGEMENT PLAN

The EIMP provides an overview of how information is managed throughout the lifetime of Hanford Site environmental programs.

The Environmental Division of Westinghouse Hanford is responsible for the protection and improvement of the Hanford Site environment. To fulfill responsibility, the Environmental Division has assumed a management role with respect to Hanford Site environmental information. This management role includes (1) establishing standards for how data are validated and controlled, (2) developing and maintaining a supporting computer-based environment, and (3) sustaining a centralized file management system.

Hanford Site environmental information is defined as data related to the protection or improvement of the Hanford Site environment, including data required to satisfy environmental statutes, applicable DOE orders, or the *Hanford Federal Facility Agreement and Consent Order* (Ecology et al. 1990), (Tri-Party Agreement).

Environmental information falls into several overlapping categories, such as administrative versus technical and electronic versus manual or hard copy. A considerable amount of data are recorded in documents, which are governed by company-wide document and records control practices. Other data are collected or generated by computer and, therefore, exist in electronic form. The name ENCORE has been given to the combination of administrative, hardware, and software systems that serve to integrate the management of this electronic data.

Administrative information (e.g., budgets and schedules) is subject to accounting and other standard business practices. Scientific and technical data are subject to a different set of legal, classification, release, and engineering requirements.

Superimposed over these categories is the files management system for environmental information. This management system, has been developed to meet a number of Environmental Division needs, including requirements for compilation of AR files. The AR files are compilations of all material related to environmental restoration and remedial action records of decision (ROD) for each operable unit and treatment, storage, and disposal (TSD) group described in the Tri-Party Agreement.

Data in electronic form flows from information systems in the ENCORE realm to both scientific/technical and administrative documents. Environmental documents distributed within the Hanford Site and from regulatory agencies are received by the EDMC for storage and future processing.

Part I of the EIMP describes the overall Westinghouse Hanford systems that are generally applied to documents and records. Part I also describes, in greater detail, the files management system developed to manage the AR file information. The EDMC compiles the AR files and provides controlled distribution of specified information to the AR files held by DOE, Ecology, and the EPA. The EDMC also provides controlled distribution of specified community relations information to regional information repositories.

Part II addresses computer-based information, with an emphasis on scientific and technical data. The long-term nature of environmental programs and the complex interrelationships of environmental data require that the data be preserved, retrievable, traceable, and sufficient for future use. To ensure data availability for response to regulatory and agency requirements, the plan is directed toward optimizing the use of automated techniques for managing data. The current processing environment and the proposed ENCORE realm are described, and the plans for implementation of ENCORE are addressed.

4.2 ENVIRONMENTAL RESTORATION REMEDIAL ACTION PROGRAM RECORDS MANAGEMENT PLAN

The ERRA Program records management plan was developed to fulfill the requirements of the U.S. Department of Energy, Richland Operations Office (DOE/RL) *Environmental Restoration Field Office Management Plan* (FOMP) (DOE/RL 1989). The FOMP describes the plans, organization, and control systems to be used for management of the Hanford Site ERRA Program. The Westinghouse Hanford ERRA Program Office has developed this ERRA Program records management plan to fulfill the requirements of the FOMP. This records management plan will enable the program office to identify, control, and maintain the quality assurance, decisional, or regulatory prescribed records generated and used in support of the ERRA Program.

The ERRA Program records management plan describes how the applicable records management requirements will be implemented for the ERRA Program. The plan also develops the criteria for identifying the appropriate requirements for each individual piece of information related to ERRA work activities.

This records management plan applies to all ERRA Program records and documents generated, used, or maintained in support of ERRA-funded work activities on the Hanford Site. The terms, information, documents, nonrecord material, records, record material, and QA records used throughout the ERRA records management plan are interpreted as ERRA information, ERRA documents, ERRA nonrecord material, ERRA records, ERRA record material, and ERRA QA records.

5.0 HANFORD ENVIRONMENTAL INFORMATION SYSTEM

5.1 OBJECTIVE

The Hanford Environmental Information System (HEIS) has been developed by PNL for Westinghouse Hanford as a primary resource for computerized storage, retrieval, and analysis of quality-assured technical data associated with Comprehensive Environmental Response, Compensation and Liability Act of 1980 (CERCLA) remedial investigation/ feasibility study (RI/FS) activities and RCRA Facility Investigation/Corrective Measures Study (RFI/CMS) activities being undertaken at the Hanford Site. The HEIS will provide a means of interactive access to data sets extracted from other databases relevant to implementation of the Tri-Party Agreement (Ecology et al. 1990). The HEIS will support graphics analysis, including a geographic information system. Implementation of HEIS will serve to ensure that data consistency, quality, traceability, and security are achieved through incorporation of all environmental data within a single controlled database.

The following is a list of data subjects proposed to be entered into HEIS:

- Geologic
- Geophysics
- Atmospheric
- Biotic
- Site characterization
- Soil gas

- Waste site information
- Surface monitoring
- Groundwater.

5.2 STATUS OF THE HANFORD ENVIRONMENTAL INFORMATION SYSTEM

The HEIS, a computerized database containing technical data and information used to support the Hanford environmental restoration (ER) activities, is operational. The data for the Hanford groundwater wells and groundwater samples is currently accessible via the Hanford Local Area Network (HLAN) to local users and to offsite users via a modem link to the HEIS database computer. Additional data, including geologic, biota, and other pertinent environmental sample results, are being entered into the HEIS database.

The *Hanford Environmental Information System (HEIS) User's Manual* (WHC 1990) was issued in October 1990. An operator manual is being prepared and is expected to be issued in 1992.

The HEIS geographic information system (GIS) will display detailed maps for the Hanford restoration sites including data from the HEIS database. Such spatially related data will be used to support analysis of waste site technical issues and restoration options. The combination of the HEIS for data and the GIS spatial displays offers some powerful tools for many users to analyze and collectively evaluate the environmental data from the ER and site-wide monitoring programs.

6.0 REFERENCES

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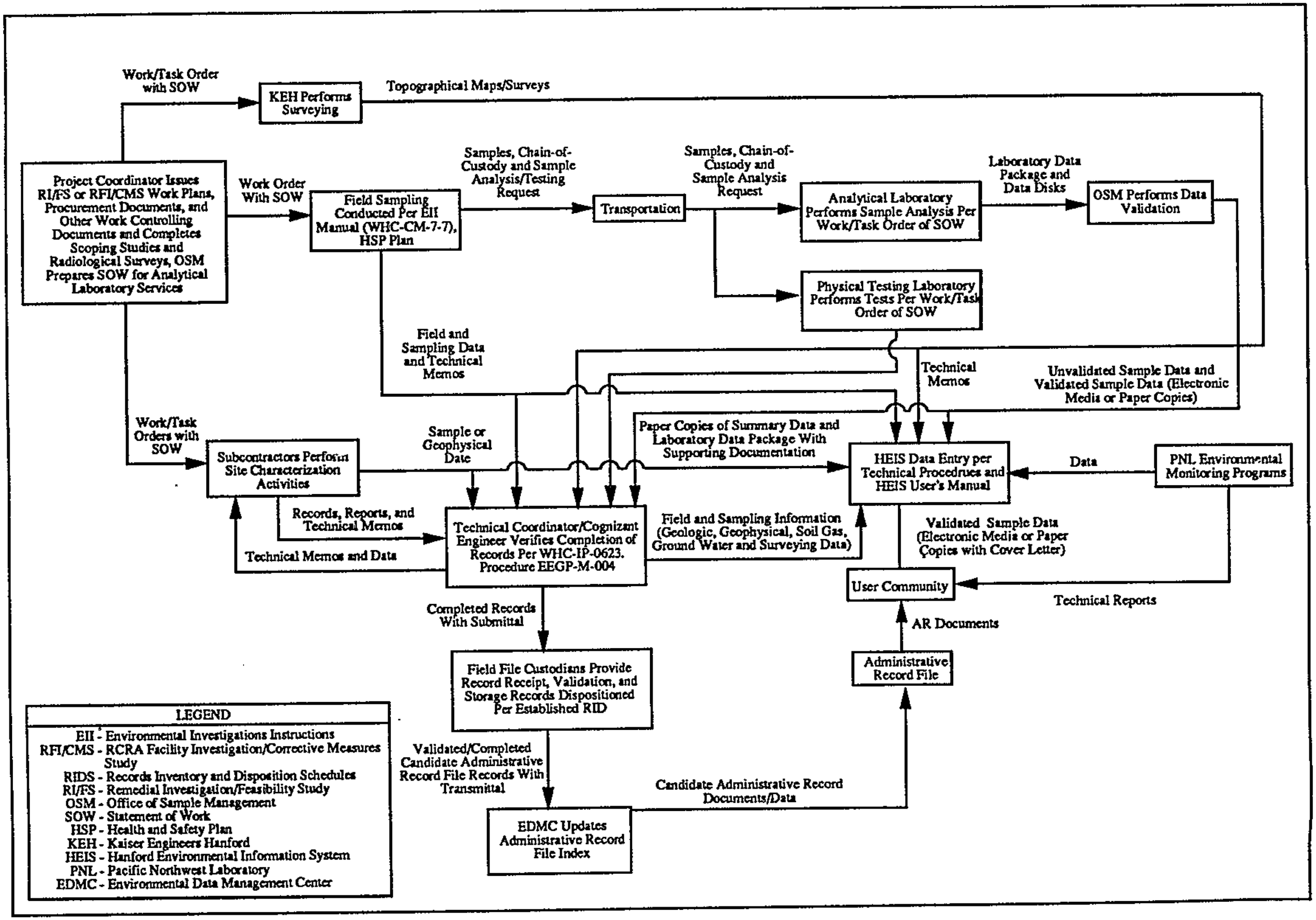
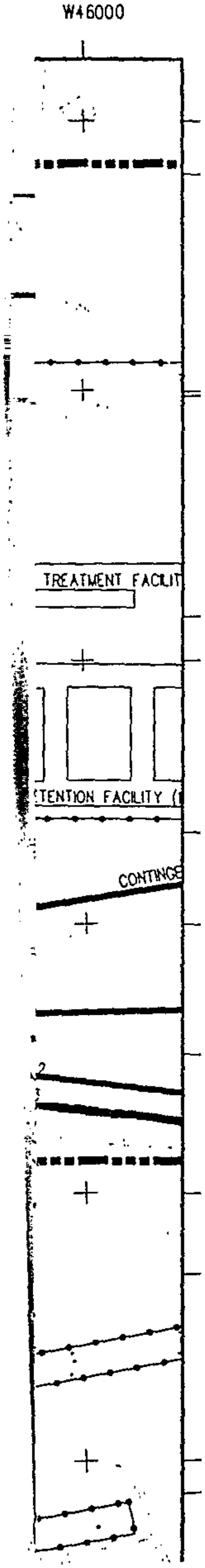


Figure D-1. Environmental Engineering, Technology and Permitting Data Management Model.

Table D-1. Types of Related Administrative Data.

Type of Data	Controlling document/procedure	Record Custodians: TR	HEHF	PNL	EDMC	EHPSS
Personnel						
Personnel training and qualifications	EII 1.7[a]	X				
Occupational exposure records (nonradiological)	EII 2.2[a]		X			X
Radiological exposure records				X		
Respiratory protection fitting						X
Personnel health and safety records	EII 2.1[a]		X			X
Compliance/regulatory						
Action-specific requirements/screening levels	EII 1.6[a]				X	
Guidance document tracking	EII 1.6[a]				X	
Compliance issues	EII 1.6[a]				X	
Problem resolution	EII 1.6[a]				X	
Administrative record	TPA-MP-11[b]				X	

[a] WHC 1991a, *Environmental Investigations and Site Characterization Manual.*
[b] DOE/RL 1990, *Hanford Federal Facility Agreement and Consent Order (Tri-Party Agreement) Handbook.*
EDMC = Environmental Data Management Center (Westinghouse Hanford Company).
EHPSS = Environmental Health and Pesticide Services Section (Westinghouse Hanford Company).
EII = Environmental Investigations Instructions.
HEHF = Hanford Environmental Health Foundation.
TR = training records (Westinghouse Hanford Company, Pacific Northwest Laboratory [PNL], Kaiser Engineers Hanford [KEH]).



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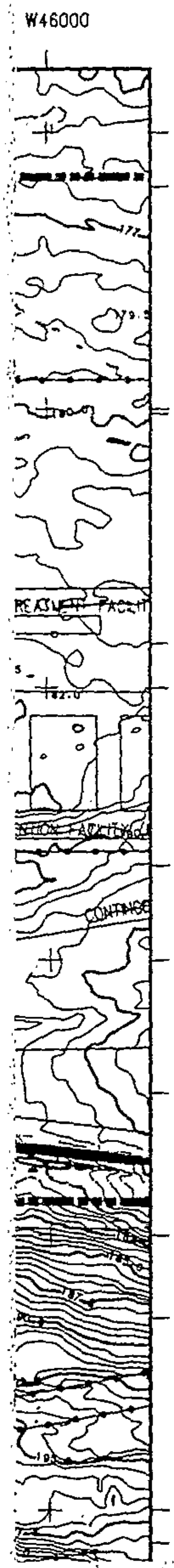
B PLANT AGGREGATE AREA (West of Purex)
PLATE 1 - Facilities, Sites, & Unplanned Releases

LEGEND

- Aggregate Area Boundary
- Security Systems/Fences
- Perimeter Boundary
- Buildings
- Waste Management Units
- Unplanned Releases
- Other Waste Mgmt Units



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B PLANT AGGREGATE AREA (West of Purex)
PLATE 2 – Topography

LEGEND

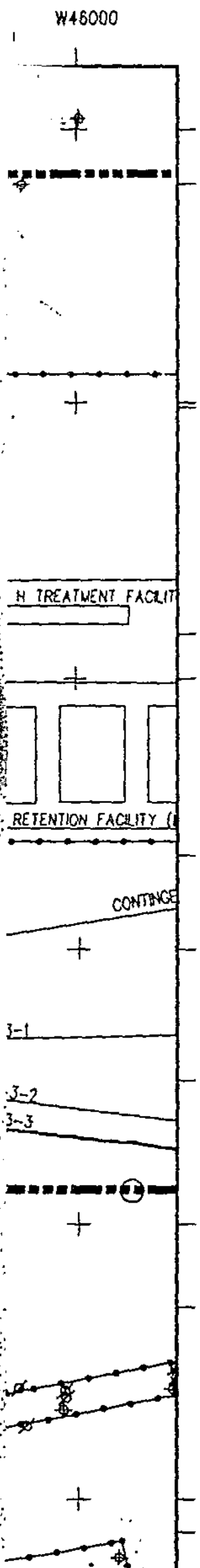
Aggregate Area Boundary

Security Systems/Fences

Perimeter Boundary

Buildings

Contour Interval .5 Meter



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B PLANT AGGREGATE AREA (West of Purex)
PLATE 3 - Monitor Wells & Sample Locations

LEGEND

- Aggregate Area Boundary
- Security Systems/Fences
- Perimeter Boundary
- Buildings
- Monitor Wells
- Other Wells

SAMPLING LOCATIONS (Approximate)

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B PLANT AGGREGATE AREA (East of Purex)
PLATE 4 - Facilities, Sites, & Unplanned Releases

LEGEND

Aggregate Area Boundary
Security Systems/Fences
Perimeter Boundary
Buildings
Waste Management Units
Unplanned Releases
Other Waste Mgmt Units

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B PLANT AGGREGATE AREA (East of Purex)
PLATE 5 - Topography

LEGEND

Aggregate Area Boundary
Security Systems/Fences
Perimeter Boundary
Buildings

Contour Interval .5 Meter

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B PLANT AGGREGATE AREA (East of Purex)
PLATE 6 - Monitor Wells & Sample Locations

LEGEND

Aggregate Area Boundary

Security Systems/Fences

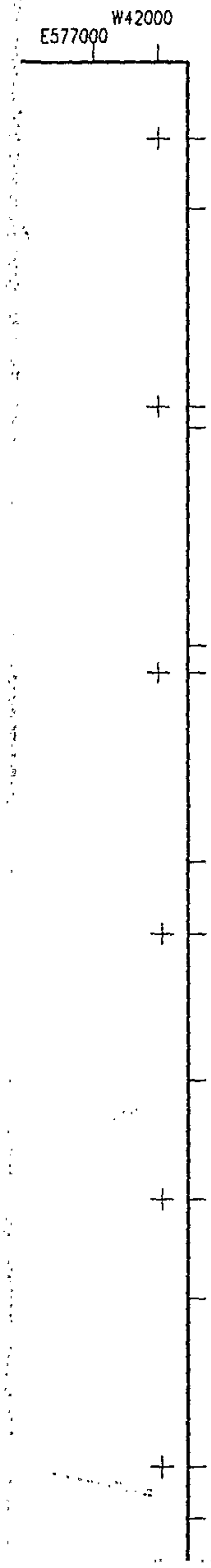
Perimeter Boundary

Buildings

Monitor Wells

Other Wells

SAMPLING LOCATIONS (Approximate)



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B PLANT AGGREGATE AREA (North of Purex)
PLATE 7 - Facilities, Sites, Unplanned Releases, Topography, Monitor Wells & Sample Locations

LEGEND

Aggregate Area Boundary

Buildings

Waste Management Units

Unplanned Releases

Monitor Wells

SAMPLING LOCATIONS (Approximate)

Soil Sampling Locations