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Department of Energy

Oak Ridge Operations Office
P.O. Box 2001
Oak Ridge, Tennessee 37831—

Hon. George R. Westfall
St. Louis County Executive
County Government Center
7900 Forsyth Blvd.
Clayton, MO 63105

Dear Mr. Westfall:

HAZELWOOD INTERIM STORAGE SITE – ENVIRONMENTAL SURVEILLANCE REPORT

Enclosed for your information is a copy of the 1996 Environmental Surveillance Report for the U.S. Department of Energy's Hazelwood Interim Storage Site. This report is prepared and published for distribution to key stakeholders, including local, state, and federal officials and members of the public.

If you have any questions on the content of this report or desire additional information, please contact me directly at 524-4083.

Sincerely,

Stephen H. McCracken
St. Louis Site Manager

Enclosure

1.2 Unit Conversions

The following tables list the units of measurement and appropriate abbreviations used in this document. Conventional units for radioactivity are used because the regulatory guidelines are generally provided in these terms; Système Internationale (SI) units of measurement are used in the discussion of all other parameters. Unit conversions will be provided in the text for water level information only.

Units of Measurement and Conversion Factors - Radioactivity

Parameter	Conventional Units	SI Units	Conversion Factor
Dose	millirem (mrem)	milliSievert (mSv)	1 mrem = 0.01 mSv
Activity	picocurie (pCi)	becquerel (Bq)	1 pCi = 0.037 Bq

Units of Measurement and Conversion Factors - Mass, Length, Area, and Volume

Parameter	SI Units	English Units	Conversion Factor
Mass	gram (g)	ounce (oz)	1 g = 0.035 oz
	kilogram (kg)	pound (lb)	1 kg = 2.2046 lb
Length	centimeter (cm)	inch (in.)	1 cm = 0.394 in.
	meter (m)	foot (ft)	1 m = 3.281 ft
	kilometer (km)	mile (mi)	1 km = 0.621 mi
Area	hectare (ha)	acre	1 ha = 2.47 acres
Volume	milliliter (mL)	fluid ounce (fl. oz.)	1 mL = 0.0338 fl. oz.
	liter (L)	gallon (gal)	1 L = 0.264 gal
	cubic meter (m^3)	cubic yard (yd^3)	1 m^3 = 1.307 yd^3

2.0 REGULATORY GUIDELINES

The primary regulatory guidelines that affect activities at FUSRAP sites are found in DOE Orders, federal statutes, and federal regulations as identified in the FUSRAP Standards/Requirements Identification Document (S/RID) (DOE 1996) and state and local regulations. S/RID requirements are generally applicable to all sites, while the applicability of other regulations varies from site to site. The State of Missouri has adopted federal standards applicable to contaminants in the media being monitored at HISS. Regulatory criteria that were used to evaluate the results of the 1996 environmental surveillance program at HISS are summarized below, categorized by media and parameters.

<u>External Gamma Radiation and Air (Radon Gas and Airborne Particulates)</u>

Regulatory criteria for evaluating the calculated maximum doses from external gamma radiation and inhalation of radioactive particulates and the measured concentrations of radon gas are as follows:

- Clean Air Act

  Section 112 of the Clean Air Act authorized the Environmental Protection Agency (EPA) to promulgate the National Emission Standards for Hazardous Air Pollutants (NESHAPs), which is applicable at HISS under Subpart H (for non-radon, radioactive constituents) and Subpart Q (for radon emissions). Compliance with Subpart H is verified by applying the EPA-approved CAP88-PC model (EPA 1992a). Compliance with Subpart Q is verified by annual monitoring of the piles for radon-222 flux.

- DOE Order 5400.5

  - Dose limits for members of the public are presented in this DOE Order. The primary dose limit is expressed as an effective dose equivalent of 100 mrem above background in a year from all sources (excluding radon). External gamma radiation dose and the calculated doses from airborne particulate releases are included in the calculation of the effective dose equivalent total.

  - DOE limits for radon concentrations in air are also presented in this Order. The limits for radon-220 and radon-222 concentrations in air are both 3.0 pCi/L above background concentrations. Based on known site contaminants and their relative abundance, radon-220 is not a contaminant of concern at HISS.

Summary of Radiological Standards and Guidelines
- External Gamma Radiation and Air -

Parameter	DOE Order 5400.5 [a]	Other Federal Standard or Guideline
Radon-222 flux	20 pCi/m^2/s	20 pCi/m^2/s [b]
Radon-222	3.0 pCi/L	4 pCi/L [c]
Radionuclide emissions (airborne particulates and radioactive gases excluding radon-222 and radon-220)	10 mrem/yr	10 mrem/yr [b]
Effective dose equivalent (total contribution from all sources [d])	100 mrem/yr	100 mrem/yr [e]

[a] *Guidelines provided in the DOE Order are above-background concentrations or exposure rates.*

[b] *Federal (EPA) Standard from 40 CFR, Part 61, subparts H (radionuclide emissions) and Q (radon-222 flux).*

[c] *EPA action level for radon concentration in homes (EPA 400-R-92-011).*

[d] *Contributing sources at HISS consist of external gamma radiation exposure, radionuclide emissions listed above, and ingested radionuclides in water and soil/sediment (listed in the following table).*

[e] *Federal (Nuclear Regulatory Commission) Standard 10 CFR 20 and proposed (EPA) Radiation Protection Guidance for Exposure of the General Public (FR 59:66414, December 23, 1994).*

FUSRAP TECHNICAL MEMORANDUM

To: Jason Darby, Environmental Scientist - FSRD
From: Michael E. Redmon, Engineering, Science, and Technology Manager - FUSRAP
Subject: Environmental Surveillance Results for 1996 for the Hazelwood Interim Storage Site

Prepared By	ES Team Lead	Project Engineer	Project Manager
			5/19/97

SUMMARY

This memorandum presents and interprets analytical results and measurements obtained as part of the 1996 environmental surveillance program for the Hazelwood Interim Storage Site (HISS) under the U.S. Department of Energy (DOE) Formerly Utilized Sites Remedial Action Program (FUSRAP). In the early history of the site, uranium ore and uranium- and radium-bearing process residues were stored on the property, resulting in low-level radioactive contamination of soil. The environmental surveillance program for HISS includes sampling of air, surface water, stormwater runoff, groundwater, and streambed sediment to aid in evaluating potential effects on the offsite population from these materials. The discussion below provides a comparative analysis of average historical background conditions and regulatory criteria to the 1996 results reported for external gamma radiation and for samples from the media investigated. Data tables and figures referenced in the text are included at the end of this document.

Results from the 1996 environmental surveillance program at HISS indicate that, except for thorium-230 in streambed sediment, no measured parameter exceeded applicable DOE guidelines, and no dose calculated for potentially exposed members of the general public exceeded DOE limits.

1.0 INTRODUCTION

HISS occupies the eastern half of the property located at 9170 to 9200 Latty Avenue in northern St. Louis County, within the city limits of Hazelwood, Missouri. The western half of the property is occupied by Futura Coatings, a private company. Hazelwood is approximately 25 km northwest of downtown St. Louis and 1.6 km north of the Lambert-St. Louis International Airport (Figure 1). HISS is situated on approximately 2.2 ha and currently includes access roads, two interim storage piles, a utility building, a vehicle decontamination facility, three office trailers, and two mobile laboratory trailers (BNI 1996a).

On the HISS/Futura property, radioactively contaminated materials are present in below-grade soils (at depths to 1.8 m below ground surface) and in two interim storage piles: the main

storage pile and the secondary storage pile (Figure 2). The primary radioactive contaminant associated with this material is thorium-230, with lower concentrations of radium-226 and uranium (in natural isotopic abundance, neither depleted nor enriched) (DOE 1994). Onsite thorium-230 ranges from 0.8 to 790 pCi/g, radium-226 ranges from 0.5 to 700 pCi/g, and uranium-238 ranges from approximately 3 to 800 pCi/g (DOE 1993a). The total estimated volume of radioactively contaminated materials in the two storage piles is 24,000 m^3, and in situ (in place) volume of contaminated materials on the HISS/Futura property is 38,000 m^3 (BNI 1997a).

The main storage pile was formed in 1977 when the property owner prepared the western half of the property for commercial use. Approximately 9,900 m^3 of contaminated material was generated during these activities and placed in the main storage pile (Figure 2). Approximately 11,000 m^3 of additional contaminated soil from cleanup of the northern end of HISS and the western end of Latty Avenue in 1985 was incorporated into this pile (BNI 1991).

The secondary pile at HISS was created in 1986 as a result of an offsite drainage improvement project conducted by the city of Berkeley. Approximately 3,500 m^3 of radioactively contaminated soil was excavated during this project and placed at HISS, north of the main storage pile (DOE 1994), creating the secondary pile (Figure 2).

1.1 Measured Parameters

The key elements of the 1996 environmental surveillance program at HISS were

- measurement of external gamma radiation;
- measurement of radon gas concentrations in air (combined contributions from radon-220 and radon-222);
- monitoring of radon-222 flux (rate of radon-222 emission from the storage piles);
- sampling and analysis of surface water and streambed sediment for total uranium, radium-226, radium-228, thorium-230, and thorium-232 (referred to collectively as radioactive constituents);
- sampling and analysis of groundwater for radioactive constituents and water quality parameters; and
- monitoring of stormwater discharge quality in accordance with National Pollutant Discharge Elimination System (NPDES) permit requirements as issued by the Missouri Department of Natural Resources.

Surface Water, Sediment, and Groundwater - Radioactive Constituents

Regulatory criteria for evaluating the measured concentrations of radionuclides in sediment, surface water, and groundwater at HISS are as follows:

- DOE Order 5400.5

  This Order provides applicable limits for radioactive constituents in water and soil at DOE-owned and DOE-operated facilities.

  The environmental surveillance program does not include analysis of onsite soils; however, because there are no standards for sediment, the DOE residual soil cleanup criteria specified in DOE Order 5400.5 are used as a basis for evaluating the analytical results in sediment.

  DOE Order 5400.5 states that the guideline for residual concentrations of radium-226, radium-228, thorium-230, and thorium-232 in surface soil is 5 pCi/g above background for an individual isotope, averaged over the first 15 cm of soil below the surface. For subsequent 15-cm depth intervals (subsurface soils), the specified limit is 15 pCi/g. Because surveillance sediment samples are collected from the first 15 cm of sediment, only the surface soil criteria are used.

  The site-specific soil cleanup criterion for the St. Louis Sites for uranium-238 (50 pCi/g, DOE 1990) is used to evaluate analytical results for uranium in sediment. Because the uranium is present in natural isotopic abundance, uranium-238 represents approximately one-half of the radioactivity of total uranium (the other half of the activity results from uranium-234 and a very small percentage of uranium-235). Consequently, the total uranium concentration is approximately double the uranium-238 concentration, and an equivalent soil guideline for total uranium is double the uranium-238 guideline, or 100 pCi/g. Sediment samples are analyzed for total uranium, and they are subsequently compared with this 100 pCi/g guideline.

  For mixtures of radionuclides, the Order prescribes that the data be evaluated by the sum-of-the-ratios method. By this method, the above-background concentration of each of the radioisotopes (radium-226 or thorium-230, whichever is greater; thorium-232 or radium-228, whichever is greater; and total uranium) is divided by its respective criterion, and the ratios are summed. If the result is greater than 1, the mixture of radionuclides fails the sum-of-the-ratios test and is considered to exceed the soil guidelines.

  DOE derived concentration guides (DCGs) for water are also presented in this Order and were used to evaluate historical and current analytical data at HISS. The DCG for each

radionuclide represents the concentration that would result in a dose of 100 mrem during a year, conservatively calculated for continuous exposure conditions.

- Safe Drinking Water Act (SDWA)

  SDWA is the primary federal law applicable to the operation of a public water system and the development of drinking water quality standards [*EPA Drinking Water Regulations and Health Advisories* (EPA 1996)]. The regulations in 40 CFR Part 141 set maximum permissible levels of organic, inorganic, and microbial contaminants in drinking water by specifying the maximum contaminant level (MCL) for each. MCLs have been promulgated for combined concentrations of radium-226 and radium-228 and for gross alpha (including radium but excluding uranium and radon). Although stormwater and groundwater at HISS are not a public drinking water supply, the MCLs for drinking water are considered relevant and appropriate and are therefore used as a conservative basis for evaluating analytical results.

Summary of Radiological Standards and Guidelines - Water and Sediment

Parameter	DOE DCG [a] for Water [b]	Other Federal Standards	DOE Authorized Limit for Residual Radioactivity in Surface Soil [c,d]
Thorium-230	300 pCi/L	--	5 pCi/g
Thorium-232	50 pCi/L	--	5 pCi/g
Uranium-238	600 pCi/L	--	50 pCi/g
Total uranium	600 pCi/L [e]	--	100 pCi/g [f]
Radium-226	100 pCi/L	5 pCi/L [g]	5 pCi/g
Radium-228	100 pCi/L		5 pCi/g
Gross Alpha	--	15 pCi/L [g]	--

[a] *DOE derived concentration guide (DOE Order 5400.5).*

[b] *Surface water and groundwater (non-drinking water) values represent concentrations above background. In addition, if a mixture of radionuclides is present, the sum of the ratios of each isotope to its respective DCG must be less than one.*

[c] *Above-background concentration in soil, averaged over the topmost 15 cm of soil.*

[d] *In the absence of standards for sediment, the DOE residual cleanup criteria for radium and thorium in surface soil and the site-specific criterion for uranium (DOE 1990) are used as a basis for evaluating analytical results for sediment. If a mixture of the radionuclides is present in soil, then the sum of the ratios of the concentration of each isotope (radium-226 or thorium-230, whichever is greater; radium-228 or thorium-232, whichever is greater; and uranium) to the allowable limit must be less than one.*

[e] *This guideline applies to total uranium in natural isotopic abundance.*

[f] *Total uranium concentration is estimated as two times the uranium-238 concentration when uranium is in natural isotopic abundance; consequently, the approximate soil guideline for total uranium is two times the guideline for uranium-238.*

[g] *Current SDWA MCL for the combined concentration of radium-226 and radium-228 and for gross alpha (excluding uranium and radon) in drinking water. Stormwater and groundwater at HISS are not a drinking water source.*

– *No existing (promulgated) standard.*

Groundwater - Chemical Parameters

Although the groundwater near HISS is not used as a public drinking water supply, federal drinking water regulatory criteria were applied as a basis of comparison for chemical (groundwater quality) analytical data at HISS.

- SDWA

  As indicated previously, SDWA is the primary federal law applicable to the operation of a public water system and the development of drinking water quality standards (EPA 1996). The regulations set MCLs for organic, inorganic, and microbial contaminants in drinking water. In some cases, secondary maximum contaminant levels (SMCLs), which are not federally enforceable (40 CFR 143.1), are provided as guidelines for the states.

Stormwater - Chemical and Radioactive Constituents

- Clean Water Act - National Pollutant Discharge Elimination System and Missouri Code of State Regulations (10 CSR 20-6.200)

  Effective April 28, 1995, the Missouri Department of Natural Resources, under its state-implemented National Pollutant Discharge Elimination System (NPDES) program, issued to DOE a renewed and revised stormwater permit for HISS that stipulates requirements for stormwater monitoring, effluent limitations, and sampling and reporting frequencies. The renewed permit is essentially the same as the previous version, requiring daily monitoring of flow and rainfall, monthly sampling of stormwater runoff for settleable solids, and quarterly sampling of runoff for radioactive constituents, total organic halides, and total organic carbon. Quarterly sampling at the two HISS outfalls, as specified in the renewed permit, is to be conducted in the months of March, June, September, and December. Samples were not collected during months lacking adequate rainfall to produce flow through either of the outfalls (May, August, December).

  DOE evaluates stormwater quality by comparing sampling results with DOE DCGs for radioactive constituents and with permit effluent limits for settleable solids (1.5 mL/L/h daily maximum and 1.0 mL/L/h monthly average) and pH (6.0 to 9.0).

3.0 SAMPLING LOCATIONS AND RATIONALE

At HISS, radioactive constituents are present at concentrations exceeding DOE guidelines in below-grade soils and in the two interim storage piles. Exposure of members of the public to this radioactively contaminated material at HISS is unlikely because of site access restrictions (e.g., fences) and engineering controls (e.g., pile covers); however, potential pathways include direct exposure to external gamma radiation; inhalation of air containing radon or radioactively contaminated particulates; and contact with, or ingestion of, contaminated surface water, streambed sediments, groundwater, or stormwater. The environmental surveillance program at HISS has been developed to provide surveillance of these potential exposure routes through periodic sampling and analysis of selected media for radioactive and chemical constituents.

Table 1 summarizes the 1996 environmental surveillance program at HISS for external gamma radiation, radon gas, surface water, sediment, groundwater, and stormwater.

Measurement of external gamma radiation is conducted at fenceline locations surrounding HISS (Figure 2) to assess the maximum hypothetical exposure to the public. Measurement of radon concentrations in air is conducted at the same fenceline locations. Two offsite locations are used to determine the background external gamma radiation and radon concentration (Figure 2). Radon-222 flux results are obtained at discrete grid intersections on the surface of the main and secondary storage piles (Figure 3) to determine the rate at which radon is emitted from specific areas of the pile surface.

Surface water and streambed sediment samples are collected semiannually at sampling locations upstream and downstream of the site (Figure 4) and are analyzed for radioactive constituents.

Water level measurements and groundwater samples obtained from monitoring wells allow the assessment of groundwater flow patterns as well as groundwater quality in the immediate vicinity of the site. Groundwater monitoring wells are located inside the property boundary, along the fenceline, and at offsite locations north of Latty Avenue and south of Banshee Road (Figure 2). Water level data are collected from all 19 monitoring wells. Groundwater samples are obtained annually from five monitoring wells surrounding the area of contamination on the HISS/Futura property and from one offsite background well. Samples are analyzed for radioactive constituents and water quality parameters.

Stormwater outfall sampling locations (Figure 2) are located on the northern and southern portions of HISS and aid in evaluating point source surface runoff. Samples are analyzed for chemical and radioactive constituents in accordance with NPDES permit # MO-0111252.

4.0 SURVEILLANCE METHODOLOGY

Under the HISS environmental surveillance program, standard analytical methods approved and published by EPA and the American Society for Testing and Materials (ASTM) are used for chemical (i.e., all nonradiogical) analyses. The laboratories conducting the radiological analyses adhere to EPA-approved methods and to procedures developed by the Environmental Measurements Laboratory (EML) and ASTM. A detailed listing of the specific procedures and the data quality objectives for the surveillance program is provided in the FUSRAP *Environmental Surveillance Plan* (BNI 1996a).

All 1996 environmental surveillance activities at HISS were conducted in accordance with the FUSRAP *Environmental Surveillance Plan* (BNI 1996a) and the instruction guides (IGs) and work instruction (WI) listed in the following table. The instructions are based on guidelines provided in

RCRA Ground Water Monitoring: Draft Technical Guidance (EPA 1992b); *Test Methods for Evaluating Solid Waste, Physical/Chemical Methods* (SW-846, EPA 1992c); and *A Compendium of Superfund Field Operations Methods* (EPA 1987).

FUSRAP Instructions Used for Environmental Surveillance Activities

Document Number	Document Title
191-IG-007	Groundwater Level and Meteorological Measurements (BNI 1996b)
191-IG-011	Decontamination of Field Sampling Equipment at FUSRAP Sites (BNI 1996c)
191-IG-028	Surface Water and Sediment Sampling Activities (BNI 1993a)
191-IG-029	Radon/Thoron and TETLD Exchange (BNI 1993b)
191-IG-033	Groundwater Sampling Activities (BNI 1993c)
WI-96-105	Routine FUSRAP Stormwater Monitoring Activities at HISS (BNI 1996d)

5.0 ANALYTICAL DATA AND INTERPRETATION OF RESULTS

This section presents the data and interpretation of results for the environmental surveillance program at HISS. Data for 1996 are presented in Tables 2 through 11.

In data tables containing analyses for radioactive constituents, some results may be expressed as negative numbers. This phenomenon occurs if the average background activity of the laboratory counting instrument exceeds the measured sample activity. In such cases, when this instrument background activity is subtracted from the sample activity, a negative number results. For the purposes of interpretation, all values below the baseline minimum detectable activity (MDA) are interpreted as having an unknown value between zero and the MDA. Such a value is referred to as a nondetect in the text discussion.

For direct comparison of analytical results with the DOE soil authorized limits and the DCGs, average background radioactivity in surface water, sediment, and groundwater is subtracted from the 1996 results. The reported results and the background-corrected results are both presented in the data tables; however, for simplicity, discussion in the text presents the analytical result (with background not subtracted) and specifies the above-background concentration only if the measured concentration is near the DOE limit. All figures displaying results present actual analytical data only.

The average historical background concentration for each radioactive analyte is determined from environmental surveillance background sampling results from 1992 to 1996, unless otherwise noted (BNI 1997b). Subtracting the calculated average background from the sampling results for 1996 gives an estimate of the above-background concentration of the measured constituent at

each location. Subtracting background from the sampling result may yield a negative number, just as a negative value may be obtained when the laboratory subtracts instrument background from a sample measurement. Negative numbers are considered indistinguishable from background.

The most precise analytical method for analysis of total uranium yields results in µg/L and µg/g for water and sediment samples, respectively. To allow direct comparison of results with the DCGs and soil guidelines, the data must be converted to pCi/L and pCi/g, as appropriate. The specific activity for total uranium in its natural isotopic abundance (uranium that is neither depleted nor enriched) is 0.677 pCi/µg (BNI 1995), which is the factor used to convert the data to pCi/L or pCi/g. Only the converted data are provided in the tables and text of this document.

5.1 External Gamma Radiation

External gamma radiation dose rates are measured using non-personnel tissue-equivalent thermoluminescent dosimeters (TETLDs) in place at HISS continuously throughout the year. Each TETLD measures a cumulative dose over the period of exposure (approximately one year). When corrected for shelter/absorption and background and normalized to exactly one year's exposure, these detectors provide a measurement of the annual external gamma radiation dose at that location. TETLD results for the 1996 external gamma dose (both raw data and corrected data) are summarized in Table 2. TETLD surveillance locations are shown in Figure 2.

The corrected data are used to calculate the annual external gamma radiation dose to a hypothetical maximally exposed individual. Identification of this individual is a function of the fenceline dose, the distance of the individual from the fenceline, and the amount of time that individual spends at that location. The data from the side of the site that has the nearest potential receptor and has the highest radiation readings (i.e., locations 2 and 7) are averaged, and the external gamma dose rates at the distances to individuals at the nearest residence or commercial/industrial facility are then determined. In 1996, the annual dose was calculated for the hypothetical maximally exposed individual working outside 40 hours per week and 50 weeks per year (23 percent occupancy) at Futura Coatings to the west of the site, with an average distance of approximately 46 m between the fenceline and the individual. Results of this calculation are expressed as a maximum dose rate to the individual in mrem/yr.

Although the potential dose at location 2 is indicated in Table 2 to exceed 100 mrem/yr, this represents a condition of 100 percent occupancy (24 hours per day for 365 days per year) at this fenceline location and clearly does not represent a plausible exposure to any actual individual. Based on a more realistic scenario and the 1996 external gamma radiation results, the dose to the most plausible hypothetical maximally exposed individual, a worker 46 m west of the fenceline, would be 0.216 mrem/yr (BNI 1997c). This value is consistent with the calculated dose rate for 1995 (0.13 mrem/yr; BNI 1996e).

5.2 Radon Gas

Average radon concentrations for 1996 are presented in Table 3; the corresponding surveillance locations are shown in Figure 2. Concentrations of radon gas are measured using RadTrack® detectors, which are designed to measure alpha particle emissions from both isotopes of radon (radon-220 and radon-222) and to collect passive, integrated data throughout the period of exposure. Every six months starting in January, the exposed detectors were replaced with unexposed detectors so that the cumulative concentration of radon gas in air at the site was measured continuously throughout the year. Based on knowledge of the contaminants at HISS, radon-220 is not a contaminant of concern.

Results of the 1996 radon surveillance program indicated that radon gas concentrations at HISS were consistently low and indistinguishable from background, ranging from 0.2 pCi/L (detection limit) to 0.5 pCi/L. Approximately 50 percent of the results were at or below the detection limit, consistent with results obtained in previous years (BNI 1996e). All 1996 radon concentrations at HISS were well below the DOE limit of 3.0 pCi/L. These results suggest that radon gas concentrations measured in air at the HISS perimeter represent ambient concentrations.

5.3 Radon-222 Flux

Measurement of radon-222 flux provides an indication of the rate of radon-222 emission from a surface. Radon-222 flux results and monitoring locations for 1996 are presented in Table 4 and Figure 3, respectively. Radon-222 flux at HISS is measured using activated charcoal canisters placed at 7.6-m intervals across the surface of each pile for a 24-h exposure period. Measurements from the secondary pile ranged from nondetect to 0.22 $pCi/m^2/s$. All but one of the measurements from the main storage pile were less than or equal to 1.20 $pCi/m^2/s$. A single elevated flux reading of 14.49 $pCi/m^2/s$ was measured at location 8 on the northwestern end of the pile. All measurements from surrounding locations were very low, indicating that the flux at location 8 represents a very small area of the pile or measurement anomaly. In 1996, as in all previous years of monitoring the piles, average radon-222 flux was well below the 20 $pCi/m^2/s$ standard specified in 40 CFR Part 61, Subpart Q of NESHAPs.

5.4 Airborne Particulate Dose

To determine the dose from airborne particulates potentially released from HISS during 1996, airborne particulate release rates are calculated using historical data for site soil contamination and a limited reservoir surface wind erosion model (EPA 1985). Total airborne particulate release rates are then entered into the CAP88-PC computer model (EPA 1992a) to perform two calculations (BNI 1997d):

1. The first calculation estimates the resultant hypothetical doses from airborne particulates to individuals at the distances from the center of the site to the nearest residences and to the nearest commercial/industrial facility. Hypothetical doses are then corrected for residential occupancy (conservatively assumed to be 24 hours/day) and commercial/industrial facility occupancy (40 hour/week for 50 weeks/year). The hypothetical individual receiving the highest of these calculated doses is then identified as the individual maximally exposed to airborne particulate dose. Because this dose is based in part on wind direction and not simply on distance from the site, this hypothetical maximally exposed individual may not be the same as the one identified in the dose calculation for external gamma radiation dose (Section 5.1).

2. The second calculation estimates the hypothetical airborne particulate collective dose to the population within 80 km of the site using a population file (generated from county population densities) to determine the number of people in circular grid sections fanning out to 80 km from the center of the site.

The first calculation indicates that the 1996 airborne particulate dose to the hypothetical maximally exposed individual, a worker at the nearest commercial/industrial facility 50 m west of the site, was essentially zero (0.00027 mrem/yr, or 2.7×10^{-4} mrem/yr). This value is well below the 10 mrem/yr standard specified in 40 CFR, Part 61, Subpart H. The second calculation indicates that the hypothetical airborne particulate collective dose to the population within 80 km of the site was 3.6×10^{-5} person-rem/yr (BNI 1997d).

5.5 Surface Water and Sediment

In 1996 during April and October, surface water and sediment samples were collected at six offsite locations (Figure 4), including one upstream (background) location. Samples are collected upstream at SWSD002 (4 km southwest of HISS in Coldwater Creek on the far side of the St. Louis International Airport); immediately upstream of HISS but downstream of vicinity properties at SWSD006; downstream at SWSD005, just offsite in a Coldwater Creek tributary; at SWSD004 in Coldwater Creek, downstream of the St. Louis Airport Site (SLAPS) but just upstream of the confluence with the tributary containing location SWSD005; downstream at SWSD003 in Coldwater Creek just north of HISS; and at SWSD007 in Coldwater Creek, approximately 900 m downstream of SWSD003 (Figure 4).

Surface water and sediment samples were analyzed for thorium-230, thorium-232, radium-226, radium-228, and total uranium.

5.5.1 Surface Water

Consistent with results from previous years (BNI 1996e), sample results in 1996 for all analyzed radionuclides in surface water were well below the DOE DCGs (Table 5). Analytical results for 1996 are discussed below.

- The downstream total uranium results ranged from 1.09 pCi/L at SWSD005 near the site outfall to 8.88 pCi/L at SWSD004, upstream of HISS in Coldwater Creek. Maximum downstream Coldwater Creek concentrations at SWSD003 and SWSD007 were 6.21 and 7.07 pCi/L, respectively. These results are slightly above background, but because concentrations in April and October at SWSD005 (immediately downstream from the site and upstream of SWSD003 and SWSD007) are comparable to the average historical background (0.83 pCi/L), there is not conclusive evidence of a contribution from HISS activities to total uranium concentrations in offsite surface waters. All detected total uranium concentrations were less than 2 percent of the DOE DCG of 600 pCi/L.

- Measured thorium-230, thorium-232, and radium-226 surface water concentrations in 1996 were generally indistinguishable from background.

- Radium-228 was detected in surface water at trace concentrations only, with a maximum result of 0.43 pCi/L at SWSD005 (immediately downstream from the site). All results were less than 1 percent of the DOE DCG for radium-228 (100 pCi/L above background).

5.5.2 Sediment

Because there are no standards for concentrations of radioactive constituents in streambed sediment, the DOE authorized limits for surface soil, 5 pCi/g above background for radium and thorium isotopes and 100 pCi/g for total uranium, are used as a basis for evaluating sediment analytical results. Analytical results (with background not subtracted) for each radioactive constituent are provided in Table 6 and described in greater detail below, generally progressing from upstream locations to downstream:

- At location SWSD006, which is downstream of vicinity properties but upstream of HISS, concentrations of radium-226, radium-228, thorium-232, and total uranium in sediment were comparable to background concentrations measured in 1996 at location SWSD002. Thorium-230 concentrations were slightly elevated, with a maximum of 3.48 pCi/g, but all concentrations were less than the DOE authorized limits. In addition, the mixture of radionuclides was less than the criterion for mixtures (sum of the ratios).

- At location SWSD004, which is downstream of SLAPS but upstream of HISS, concentrations of radium-226, radium-228, thorium-232, and total uranium in sediment were comparable to background concentrations measured in 1996 at location SWSD002. Thorium-230 concentrations were slightly elevated, with a maximum of 3.61 pCi/g, but all concentrations were less than the DOE authorized limits. The mixture of radionuclides was less than the criterion for mixtures (sum of the ratios).

  At location SWSD005, the nearest sampling location downstream from HISS, elevated concentrations of radium-226 (2.72 to 5.66 pCi/g), thorium-230 (7.23 to 229.70 pCi/g), and total uranium (1.86 to 7.87 pCi/g) were detected. Consistent with historical results (BNI 1996e), some isotopes exceeded the DOE authorized limits for surface soil, and the mixture of radionuclides exceeded the sum-of-the-ratios criterion. Thorium-230 results from the October sampling event are higher than concentrations previously detected in the environmental surveillance program (Figure 5). However, characterizations of Coldwater Creek in 1987, 1989, and 1995 identified localized areas with concentrations of thorium-230 in excess of the DOE surface soil cleanup guideline (DOE 1989; DOE 1993b; and DOE 1994) and comparable to the maximum thorium-230 environmental surveillance result in 1996. Location SWSD005 is in an industrialized area and is relatively inaccessible to the general public; therefore, the elevated concentration of thorium-230 is not likely to pose a health risk. The estimated radiological risk for a Coldwater Creek recreational user calculated previously is within the EPA target risk range of 1×10^{-6} to 1×10^{-4} (DOE 1993a).

  No major activities were conducted at HISS during this period, and it is therefore doubtful that the elevated thorium concentration at SWSD005 represents a recent release from the site. More likely, the results at SWSD005 indicate that existing, isolated areas of contamination were redistributed by irregular patterns of rainfall. For example, on April 28, after the first sediment sampling event, an unusually heavy storm deposited 11.3 cm of rain in a 24-h period in the St. Louis area (NOAA 1996). Localized thorium contamination is known to exist in Coldwater Creek and its tributaries (DOE 1993b), and fluctuations occur from one sampling period to another, which is consistent with the localized nature of the contamination (Figure 5). No specific trend is apparent.

- At SWSD003, downstream from HISS and SLAPS, concentrations of thorium-230 in 1996 were above background concentrations but were below the DOE authorized limit (5 pCi/g above background), consistent with results from previous years (BNI 1996e). The mixture of radionuclides at this location was also less than the DOE sum-of-the-ratios criterion.

- At SWSD007, concentrations of thorium-230 (5.64 to 32.38 pCi/g) and total uranium (2.19 to 3.41 pCi/g) were above background concentrations, but only the October result for thorium-230 (32.38 pCi/g) exceeded the DOE authorized limit for that isotope. The October sample also exceeded the DOE criterion for mixtures, but the April result was below that

criterion. As shown in Figure 5, concentrations of thorium-230 historically have exceeded the DOE authorized limit at this location; the 1996 measured concentrations for all isotopes were well within historical range.

5.6 Groundwater

The locations of groundwater monitoring wells at HISS are shown in Figure 2. Background information, descriptions of activities performed under the groundwater surveillance program, and surveillance results are discussed below.

5.6.1 Groundwater Flow System

Natural System

The overburden at HISS consists of topsoil and fill material generally less than 1.8 m (6 ft) thick. The topsoil and fill overlie loess material, which consists of yellowish-brown silty clay and clayey silt and extends to a depth of approximately 6.1 m to 7.6 m (20 to 25 ft) below ground surface across the site. Greenish to olive-gray clayey silt and silty clay lacustrine deposits underlie the loess material. The monitoring wells used for water level measurement for HISS/Futura are screened at depths ranging from 4.6 to 9.2 m (15 to 30 ft) below ground surface primarily in the loess layer (BNI 1994).

Hydraulic conductivity tests conducted in monitoring wells in 1992 indicate that the average hydraulic conductivity of the upper zone [extending from approximately 1.8 to 7.6 m (6 to 20 ft) below ground surface] is 4.85×10^{-4} cm/s (1.59×10^{-5} ft/s).

Water Level Measurements

A total of 19 groundwater monitoring wells are included in the groundwater surveillance program for HISS/Futura (Figure 2). There are 15 wells on the HISS/Futura property and 4 wells offsite. During 1996, groundwater levels were measured quarterly in all of these wells. Wells HISS13, HISS15, HISS16, HISS17S, HISS20S, and B53W20S (background) were used for groundwater sampling and analyses.

Depths to groundwater ranged from approximately 0.60 to 4.0 m (2 to 13 ft) below ground surface. Groundwater elevations ranged from approximately 154 m (HISS19S) to 158 m (HISS01) above mean sea level (505 to 517 ft above mean sea level).

The potentiometric surface map for the January 29, 1996, water level measurements is plotted in Figure 6. The general groundwater flow pattern was radial, moving away from the site, and the hydraulic gradient was approximately 0.01, consistent with monitoring events of previous years (BNI 1996e). The radial flow pattern is most likely the result of preferential recharge through the shallow drainage ditch along the western portion of the southern storage pile combined with

the presence of surface water courses located to the west (Coldwater Creek), north, and south of the site (BNI 1994). Assuming a porosity of 0.2, the average linear groundwater velocity is approximately 0.2 m/day (0.07 ft/day). This velocity is not necessarily the rate of contaminant migration, because contaminant-dependent transport factors such as retardation (caused by physical interactions such as contaminants binding to clay particles) significantly slow the rate of transport.

5.6.2 Groundwater Quality

Field Parameters

Table 7 presents a summary of field parameters measured during 1996 environmental surveillance at HISS: temperature, pH, oxidation/reduction potential (Eh), specific conductance, dissolved oxygen, and turbidity.

Water Quality Data

Groundwater samples from a representative set of monitoring wells (HISS13, HISS15, and HISS17S and background well B53W20S) were analyzed for standard water quality parameters to assess water quality in the groundwater formation underlying the site. These parameters include sodium, potassium, calcium, magnesium, carbonate, bicarbonate, alkalinity, sulfate, total phosphate, chloride, nitrate, and total dissolved solids (TDS). In the sampled wells, only nitrate exceeded federal drinking water limits. Water quality data for 1996 are presented in Table 8 and discussed below.

- Concentrations of nitrate in wells HISS13 (878 mg/L) and HISS17S (53 mg/L) exceeded the federal SDWA limit (10 mg/L) and are nearly identical to concentrations measured in these wells in 1995 (BNI 1996e). Groundwater in the vicinity is not a drinking water source. The presence of nitrate, a common fertilizer ingredient, in groundwater does not present a hazard to the public.

- TDS results for the site perimeter wells ranged from 716 to 7320 mg/L. There is no drinking water limit for this analyte; however, the SDWA does provide a SMCL (500 mg/L) for TDS as a non-enforceable regulatory guideline. The TDS concentration in background well B53W20S was very close to the SMCL at 495 mg/L. These results are generally consistent with previous years: in all wells sampled in 1995, including the background well, TDS exceeded 500 mg/L, indicating that high TDS is an ambient condition in that groundwater zone and is not directly related to site activities (BNI 1996e).

5.6.3 Groundwater - Radioactive Constituents

Groundwater samples analyzed for radioactive constituents were collected from five wells arranged radially about the area of contamination at the site and from offsite background monitoring well B53W20S (Table 9). Results were consistent with those of previous years (BNI 1996e). Historical background concentrations for the analytes were determined from data from well B53W20S over the period of record for that well (1993 to 1996).

All groundwater results were well below the DCGs.

- Total uranium concentrations at HISS ranged from 1.92 pCi/L (HISS15) to 25.62 pCi/L (HISS16). Historical average background from well B53W20S is 1.58 pCi/L. All detected total uranium concentrations in groundwater were less than 5 percent of the DOE DCG (600 pCi/L). A comparison of historical analytical results for total uranium (with background not subtracted) in each well sampled in 1996 is presented in Figure 7. This figure shows that well HISS16, immediately north of the site, has consistently exhibited concentrations of total uranium that are elevated but have always been less than 35 pCi/L and significantly less than the DOE DCG. In addition, the figure shows that at all other sampled wells, total uranium concentrations have been less than or equal to 10 pCi/L since 1992. Groundwater underlying the site is not a drinking water source.

- Radium-226 concentrations at HISS ranged from 0.25 (HISS17S) to 1.93 pCi/L (HISS16). The historical background concentration is 0.15 pCi/L. All sample concentrations were less than 2 percent of the radium-226 DOE DCG (100 pCi/L). Radium-228 was not detected in any HISS well (MDA of 0.38 pCi/L or less). All measured concentrations were well below the SDWA MCL of 5 pCi/L for combined concentrations of radium-226 and radium-228.

- Thorium-230 concentrations were less than or equal to 0.55 pCi/L (HISS20S). The average historical thorium-230 concentration is 0.15 pCi/L. All detected thorium-230 concentrations were well below the DOE DCG of 300 pCi/L. Thorium-232 was not detected in any HISS well (MDA of 0.32 pCi/L or less).

5.7 Stormwater

Except for the storage piles, topography at the site is relatively flat; therefore, precipitation often ponds in a few isolated low areas onsite but eventually infiltrates into the ground or drains offsite by way of overland flow. At outfall 001, the overland flow from the northern two-thirds of HISS is directed to the underground storm sewer system located to the north along Latty Avenue. At outfall 002 the runoff from the remaining one-third of HISS is directed to a ditch located to the south; both runoff paths drain into Coldwater Creek (Figures 2 and 4).

Stormwater samples were collected and submitted for analysis for radioactive and chemical constituents in accordance with the renewed site NPDES permit issued on April 28, 1995. During March, June, and September, samples were collected for analysis for radioactive constituents, total organic halides (TOX), and total organic carbon (TOC), and field measurements for pH and specific conductivity were collected; insufficient runoff was generated during December to perform the fourth quarter sampling. To identify the causative agent for detectable TOX results, samples were also analyzed for volatile and semivolatile organic compounds. Samples for settleable solids analysis were analyzed every month, except in May, August, and December, when insufficient runoff was generated for sampling.

Consistent with all previous years, all sampled discharges were in compliance with permit-specified effluent limitations for chemical parameters (Table 10):

- At both outfalls, all settleable solids results were less than the detection limit (0.5 mL/L/h) and were therefore well below the monthly average limit (1.0 mL/L/h) and the daily average limit (1.5 mL/L/h) specified in the permit.

- At both outfalls, all pH measurements were within the permit-specified range.

- According to the permit, "if a positive result for TOX is detected, the permittee shall identify the compound." To comply with this permit requirement, samples were also analyzed for volatile and semivolatile constituents. In September, the semivolatile analysis tentatively identified the compound Bromacil at an approximate concentration of 40 µg/L at outfall 001 and 70 µg/L at outfall 002. Bromacil (5-bromo-3-sec-butyl-6-methyl-uracil) is the active ingredient in Hyvar®, a commonly available herbicide used for periodic weed control at HISS. There are no state or federal limits for this compound. Except for this herbicide, halogenated organic compounds have not been used at HISS in the past, nor are they currently in use.

  TOX samples were collected at each outfall as a flow-weighted average providing an estimate of the average concentration in stormwater from the sampled storm event. The volatile and semivolatile samples were collected as a first-flush grab sample to capture the highest potential concentrations of these constituents for a strong qualitative identification. At outfall 001, the approximate Bromacil concentration of 40 µg/L accounts for nearly all the TOX (51.1 µg/L); at outfall 002, the approximate Bromacil concentration of 70 µg/L exceeds the TOX measurement of 38.7 µg/L. There is strong evidence that Bromacil, a compound for which there are no regulatory limits, is the cause of the positive result for TOX.

Results for radioactive constituents were consistent with results from previous years. Detected concentrations are evaluated against DOE DCGs (Table 11) and MCLs.

- Radium-226 concentrations in stormwater, ranging from nondetect to 4.15 pCi/L, were less than 5 percent of the DOE DCG of 100 pCi/L. Radium-228 was detected in only one sample, at a trace concentration of 0.66 pCi/L, which is well below the DOE DCG of 100 pCi/L. Although stormwater discharge is not a drinking water source, the combined concentrations of the two radium isotopes were below the federal drinking water limit of 5 pCi/L for combined concentrations of radium-226 and radium-228.

- Thorium-230 concentrations ranged from 2.90 to 16.76 pCi/L and were less than 6 percent of the DOE DCG of 300 pCi/L. Thorium-232 was not detected (detection limit less than or equal to 0.56 pCi/L).

- Total uranium concentrations in stormwater ranged from 1.27 to 15.24 pCi/L and were significantly less than the DOE DCG of 600 pCi/L.

- Lead-210 concentrations ranged from 1.70 to 3.20 pCi/L. All concentrations were below the DOE DCG of 30 pCi/L.

- Measured gross alpha concentrations ranged from 5.14 to 16.23 pCi/L at outfall 001 and from 16.64 to 25.39 pCi/L. Stormwater discharge from HISS is not drinking water; however, because there are no DCGs for gross alpha, the SDWA MCL is used as a conservative standard of comparison. The MCL for gross alpha is 15 pCi/L excluding uranium and radon. Subtracting the uranium concentration and conservatively assuming radon in the water to be zero, only one gross alpha result exceeded the MCL (outfall 002 on September 26, 1996).

6.0 CONCLUSIONS

A. External Gamma Radiation

The 1996 dose from direct gamma exposure at HISS to a hypothetical maximally exposed individual (worker) 46 m west of the fenceline would be 0.216 mrem/yr above background. This value is consistent with the 1995 calculated maximum dose of 0.13 mrem/yr above background.

B. Radon Gas

Results of the 1996 radon surveillance program indicate that the combined radon-220 and radon-222 concentrations at the site were consistently low (0.2 pCi/L to 0.5 pCi/L throughout the year). Based on knowledge of site contaminants and their relative abundance, radon-220 is not a contaminant of concern at the site. All radon concentrations at HISS were well below the DOE limit for radon-222 of 3.0 pCi/L above background.

C. Radon-222 Flux

Radon-222 flux results at HISS in 1996 ranged from nondetect to 14.49 pCi/m^2/s (all but one of the measurements were below 1.2 pCi/m^2/s) at the main storage pile and nondetect to 0.22 pCi/m^2/s at the secondary pile. All 1996 results were well below the standard of 20 pCi/m^2/s as specified in 40 CFR Part 61, Subpart Q of the National Emission Standards for Hazardous Air Pollutants (NESHAPs).

D. Airborne Particulate Dose

The 1996 hypothetical dose from inhalation of radioactively contaminated airborne particulates to a worker situated 50 m west of the center of the site is 0.00027 mrem/yr. This value is negligible compared to the 10 mrem/yr standard specified in 40 CFR, Part 61, Subpart H of NESHAPs. The hypothetical airborne particulate collective dose to the population within 80 km of the site was 0.036 person-mrem/yr.

E. Cumulative Dose from External Gamma Radiation and Airborne Particulates

The maximum cumulative dose from external gamma radiation and airborne particulates to a hypothetical individual is 0.216 mrem/yr. This value is below the 100-mrem/yr standard (from all sources excluding radon).

F. Surface Water

All 1996 surface water results for radium-226, radium-228, thorium-230, thorium-232, and total uranium were less than 2 percent of DOE DCGs. Radium-226 ranged from 0.15 to 0.54 pCi/L; radium-228 concentrations were mostly nondetect with a maximum detected result of 0.43 pCi/L; thorium-230 concentrations ranged from nondetect to a maximum of 0.92 pCi/L; thorium-232 concentrations were all nondetects, with a maximum MDA of 0.31 pCi/L; and total uranium results ranged from 1.09 pCi/L to 8.88 pCi/L, with the maximum concentration occurring upstream of HISS.

G. Sediment

Because there are no standards for concentrations of radioactive constituents in sediment, the DOE authorized limits for surface soil were used as a basis for evaluating sediment analytical results.

All radium-226, radium-228, thorium-232, and total uranium concentrations were less than the surface soil limits. The 1996 results for one constituent, thorium-230, exceeded the DOE surface soil criteria at two sampling locations downstream of HISS. The highest thorium-230 concentration, 229.70 pCi/g, was found immediately downstream at sampling location SWSD005. Although this concentration is higher than has been previously detected in the surveillance program, it is consistent with streambed characterization results obtained in previous years and confirms the presence of localized areas of contamination. Sampling location SWSD005 is in an industrialized area and is

relatively inaccessible to the general public; therefore, the elevated concentration of thorium-230 is not likely to pose an immediate health risk.

H. Groundwater

All 1996 results of groundwater analyses for radioactive constituents were less than 5 percent of the DOE DCGs and were below SDWA MCLs. Consistent with previous years, well HISS16 exhibited elevated concentrations of total uranium, at 25.62 pCi/L.

I. Stormwater

All 1996 analytical results for stormwater were in compliance with permit-specified limits: all concentrations of settleable solids were well below the NPDES permit criterion of 1.5 mL/L/h (daily maximum) or 1.0 mL/L/h (monthly average); all pH measurements were within the permit-specified range of 6.0 to 9.0. Bromacil, the active ingredient in a commercially available herbicide used periodically at the site, is a halogenated organic compound that was detected in the stormwater discharge from the site; there are no regulatory limits for this compound.

All concentrations of radioactive constituents were well below DOE DCGs. Radium concentrations were below the SDWA MCL, and all gross alpha results were less than the MCL except for one (outfall 002, September 26, 1996).

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Environmental Surveillance Results for 1996

Hazelwood Interim Storage Site

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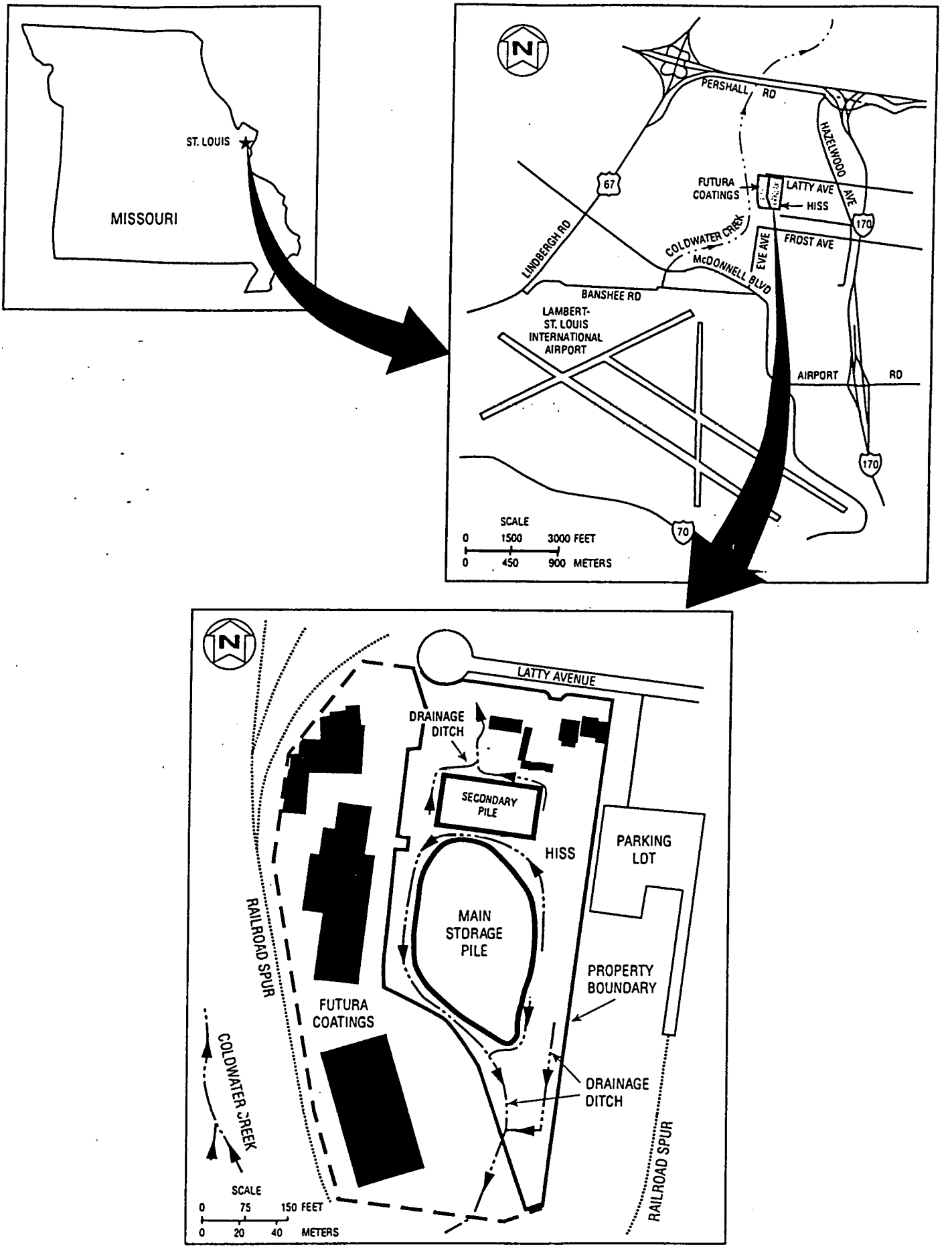
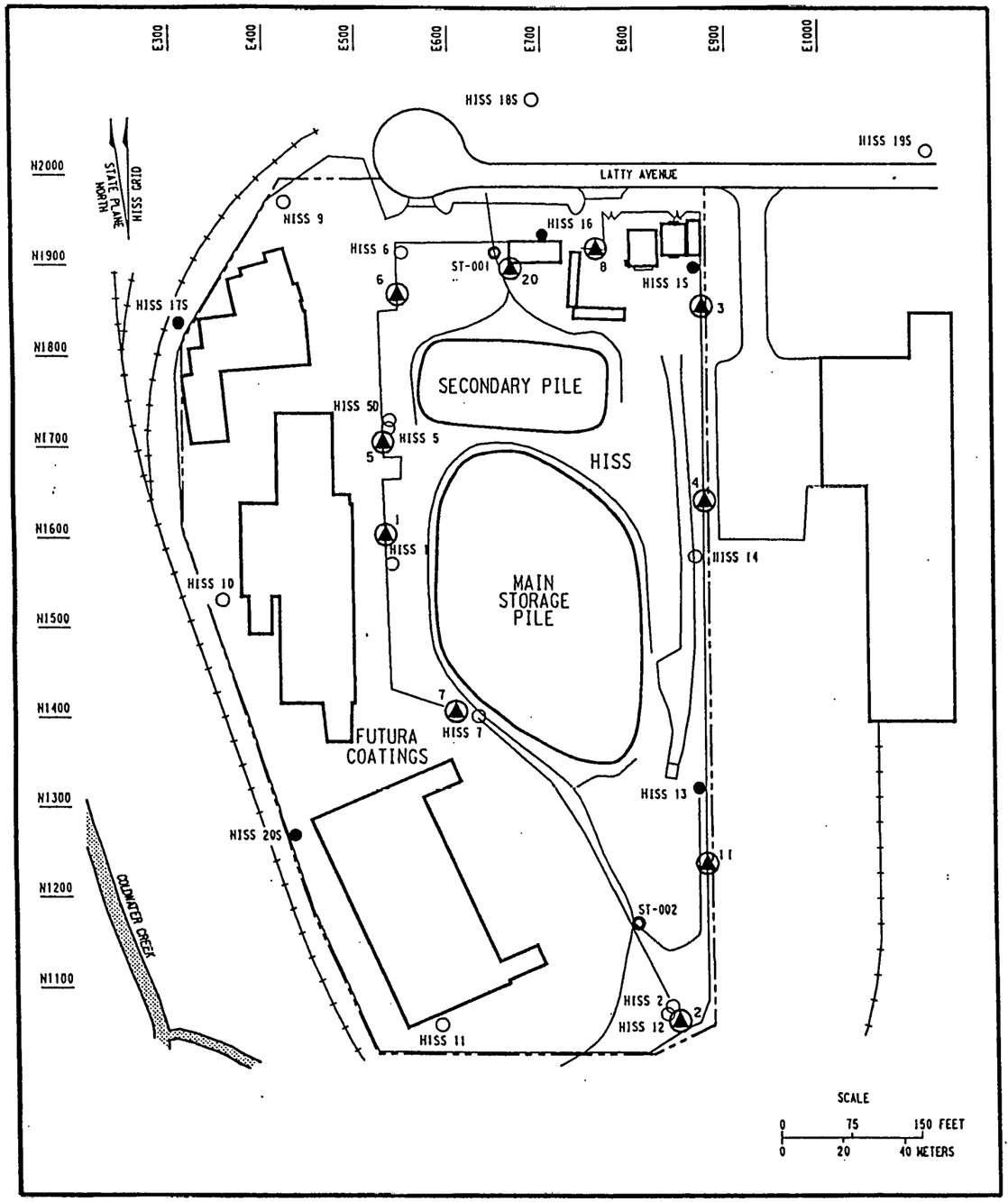
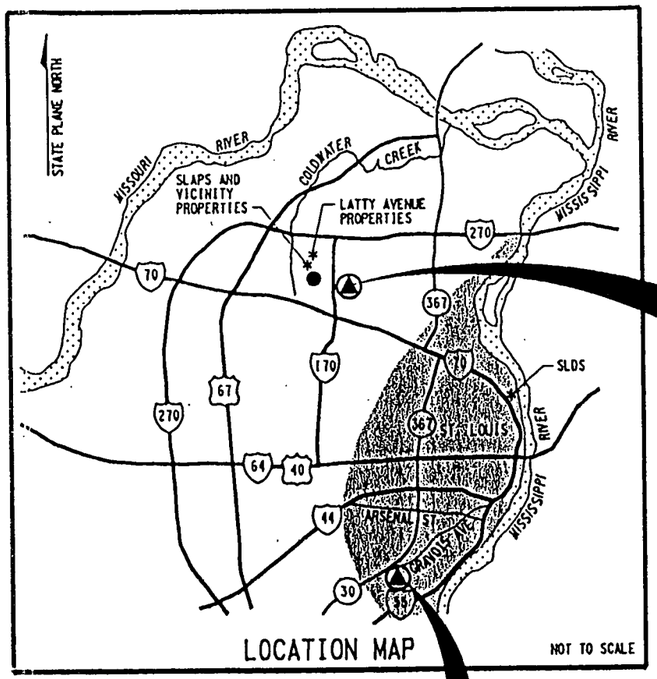
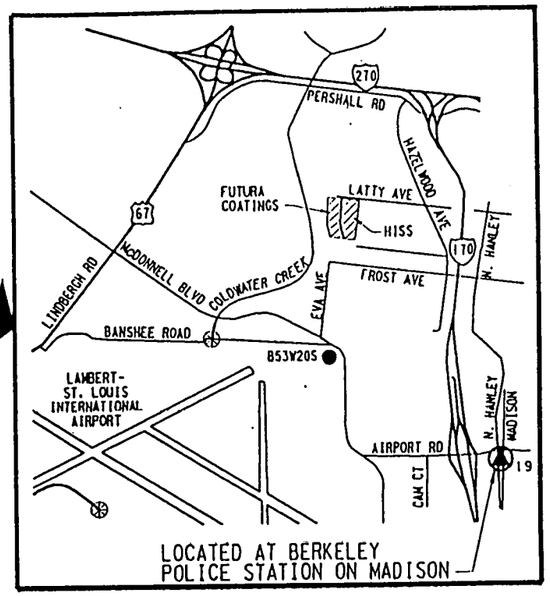
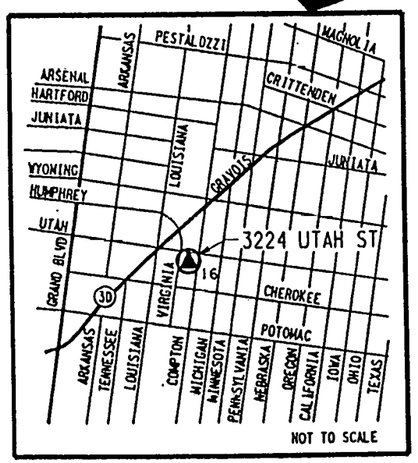


Figure 1
Hazelwood Interim Storage Site, Site Location and Site Map









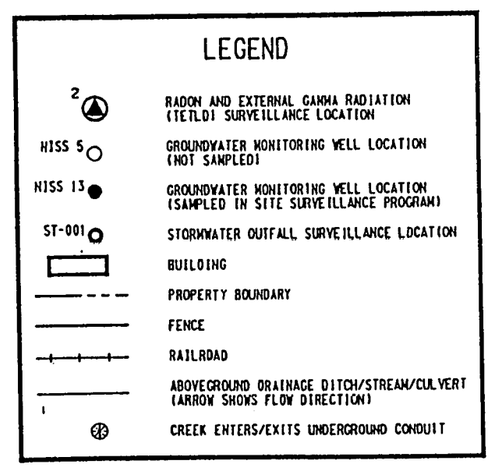


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Figure 2
Hazelwood Interim Storage Site Environmental Surveillance Locations
External Gamma Radiation, Radon Gas, Groundwater, and Stormwater

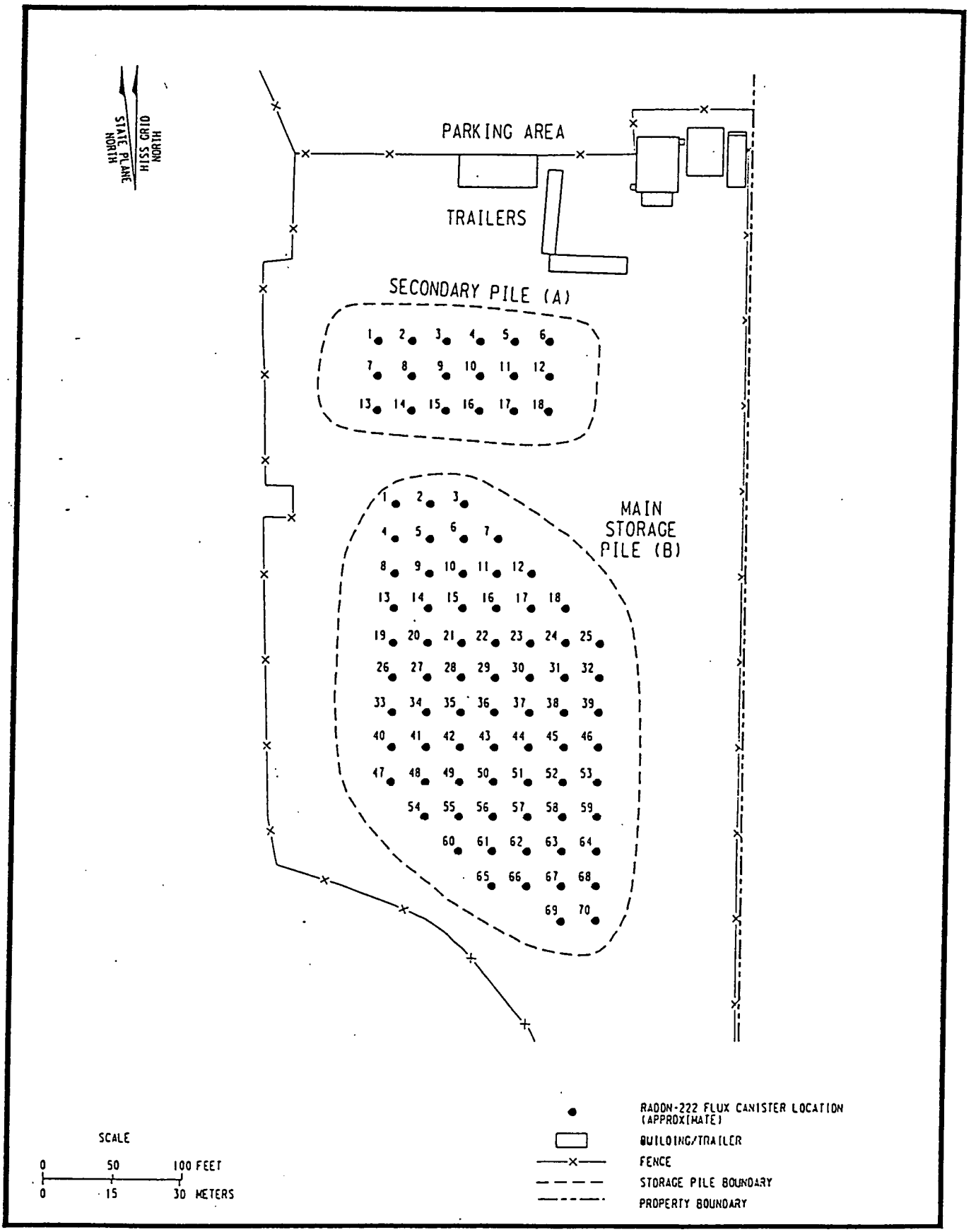

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Figure 3
Hazelwood Interim Storage Site
Approximate Radon-222 Flux Monitoring Locations

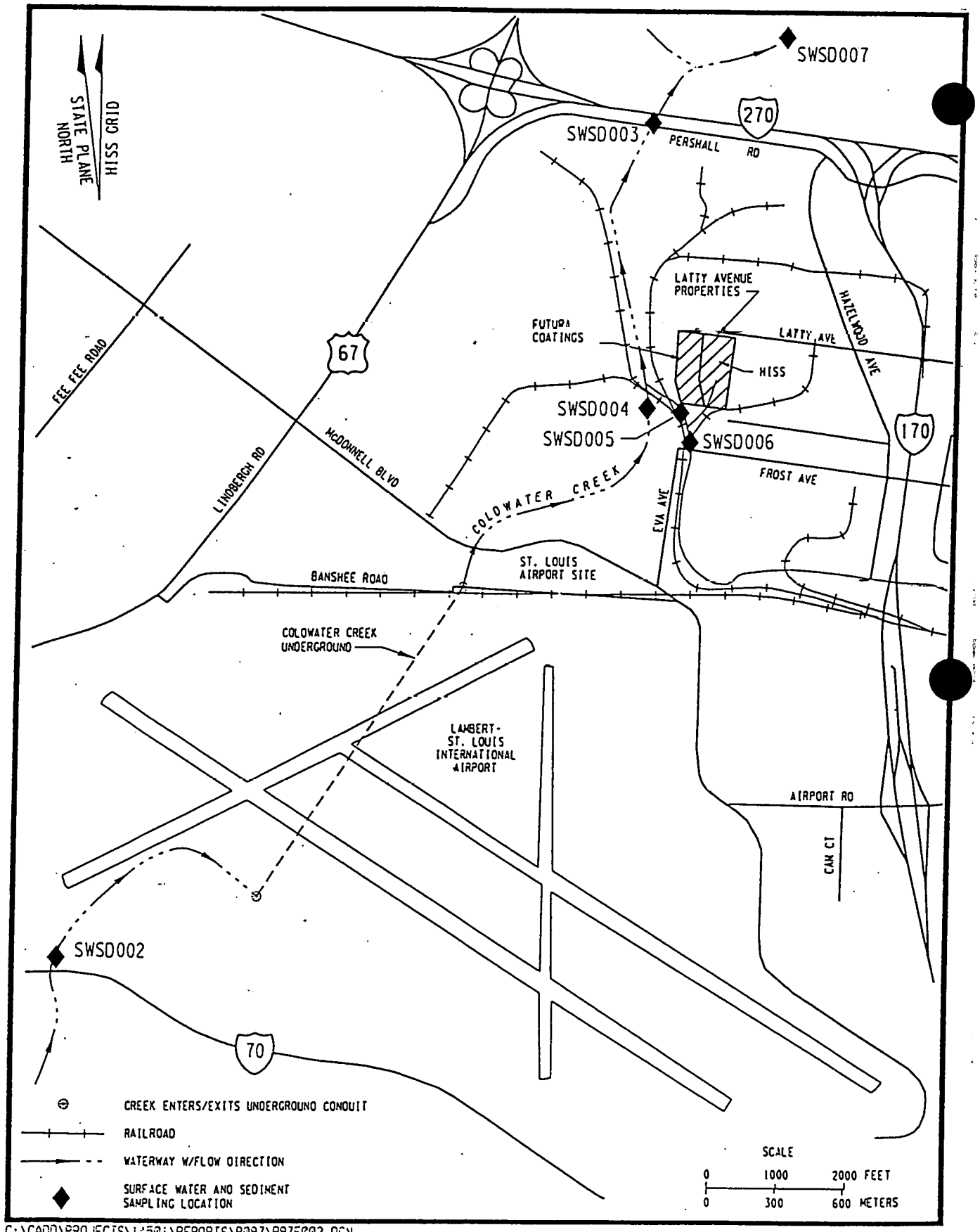

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Figure 4
Surface Water and Sediment Sampling Locations
in the Vicinity of Hazelwood Interim Storage Site

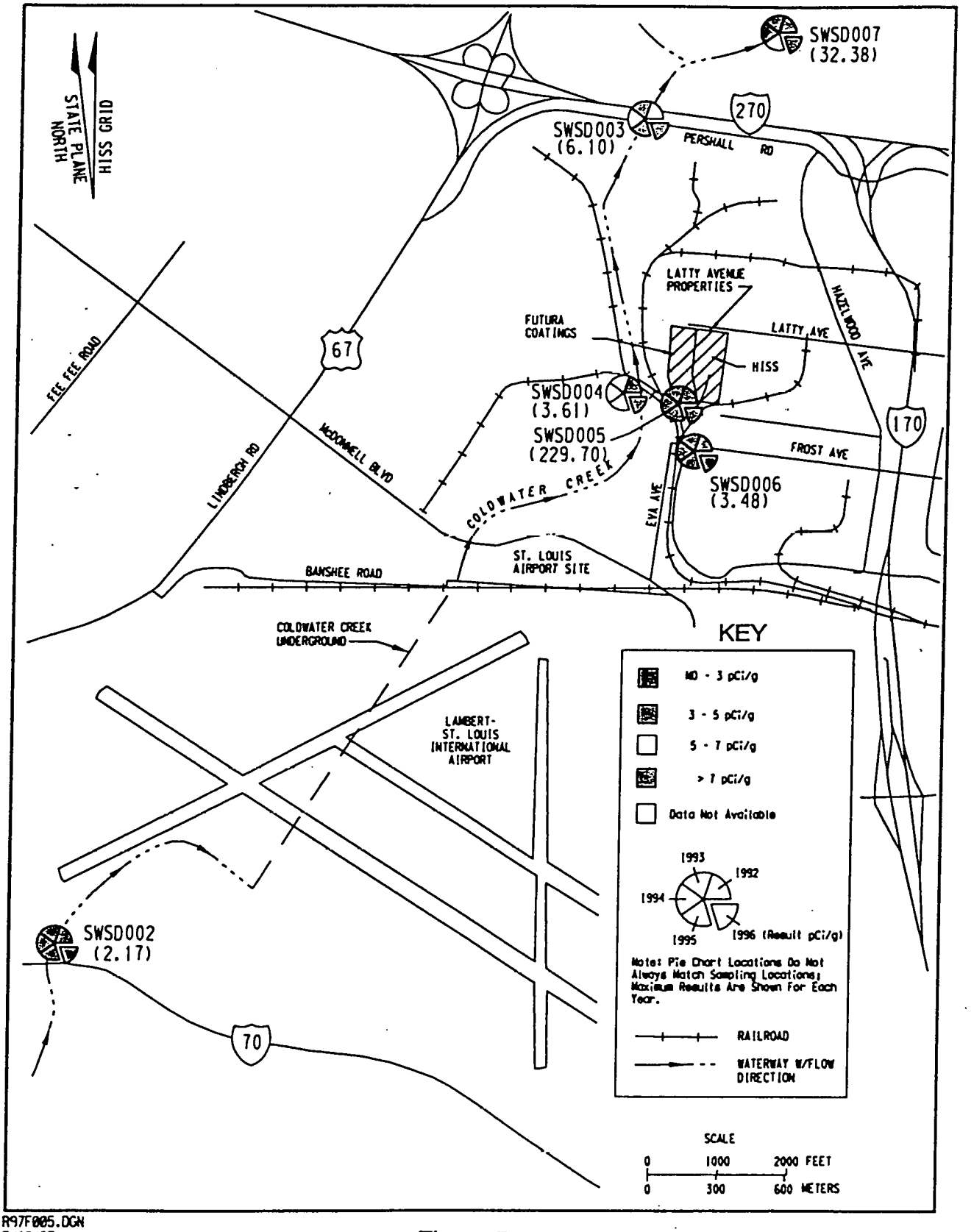

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Figure 5
Hazelwood Interim Storage Site
Thorium-230 Trend Results in Streambed Sediments

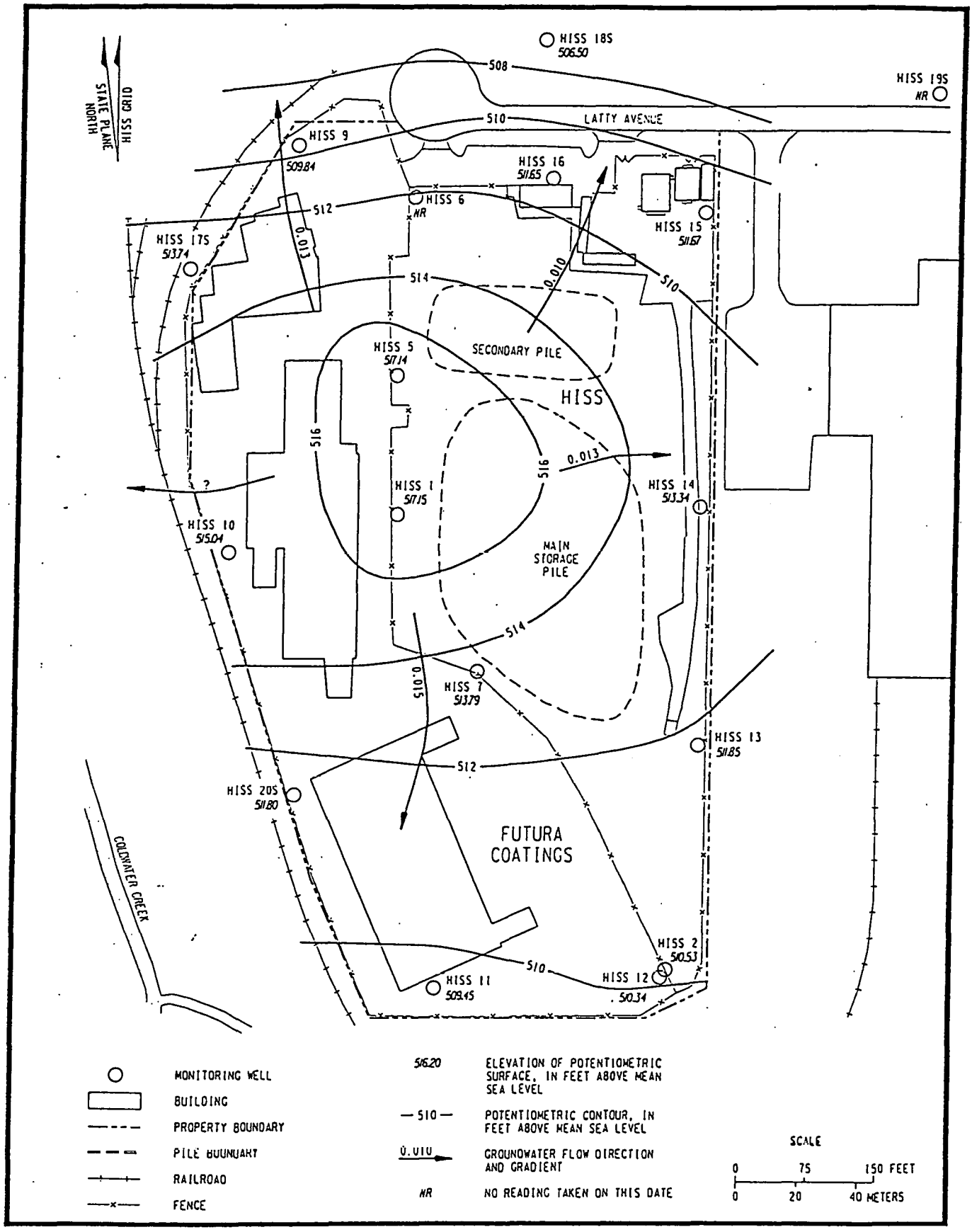

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Figure 6
Hazelwood Interim Storage Site
Potentiometric Surface Map (January 29, 1996)

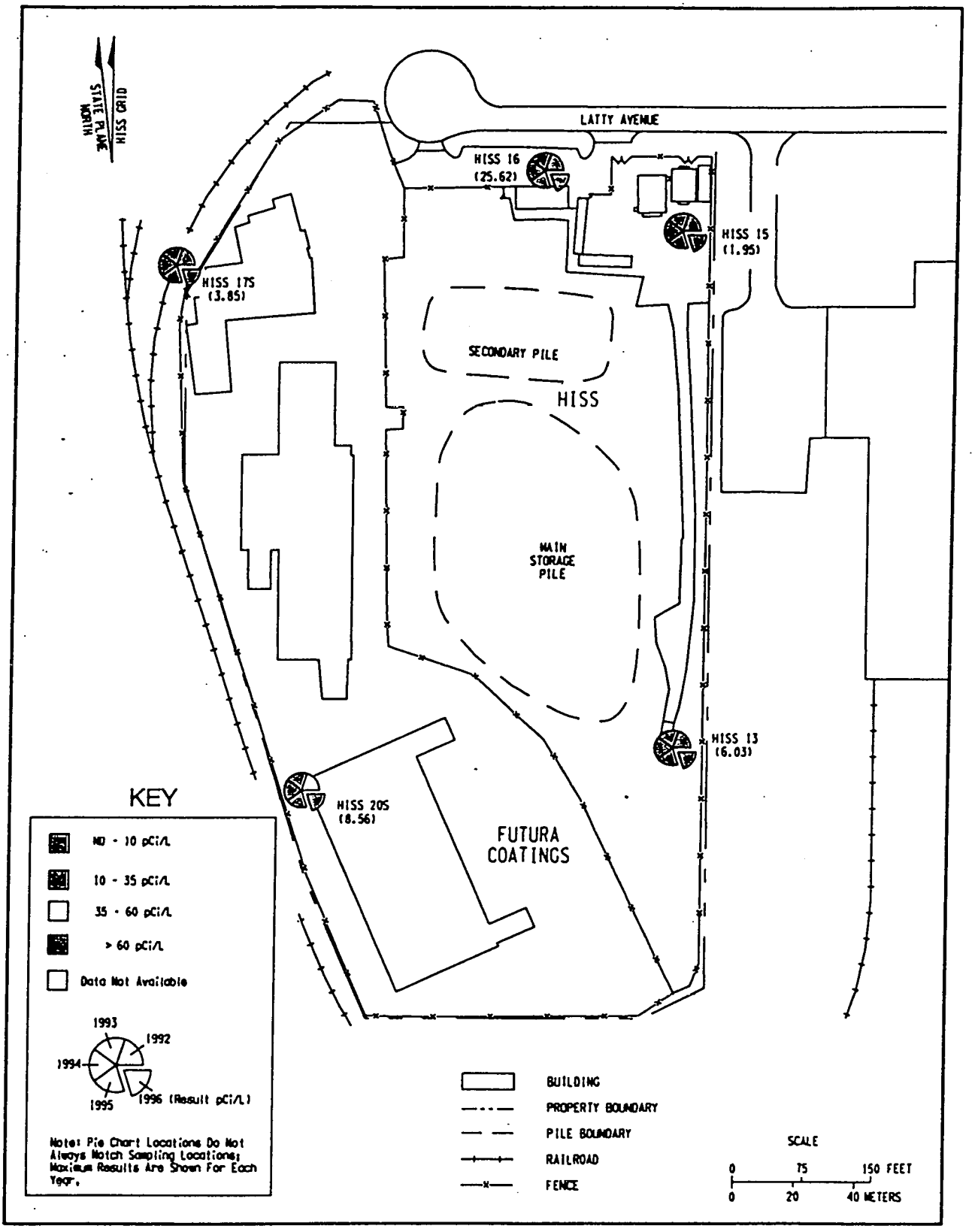

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Figure 7
Hazelwood Interim Storage Site
Total Uranium Trend Results in Groundwater

Environmental Surveillance Results for 1996

Hazelwood Interim Storage Site

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Table 1
1996 Environmental Surveillance Summary
External Gamma Radiation, Radon Gas, and Radon-222 Flux
Hazelwood Interim Storage Site

Measured Parameter	Station Identification	Number of Analyses or Measurements																								Total Analyses per Year
		No. of Sample Locations				Sample Duplicate				Ship Blank				Contingency Sample				Matrix Spike				Matrix Spike Duplicate				
		CY Quarter				CY Quarter				CY Quarter				CY Quarter				CY Quarter				CY Quarter				
		1	2	3	4	1	2	3	4	1	2	3	4	1	2	3	4	1	2	3	4	1	2	3	4	
LABORATORY MEASUREMENTS																										
External gamma radiation (TETLDs)[a]	1, 2, 3, 4, 5, 6, 7,	11		11						1		1		12		12										48
Radon gas	8, 11, 16, 19, 20[b]	12		12		1		1																		26
Radon-222 flux				88																						88

a. TETLD = Tissue-equivalent thermoluminescent dosimeter (non-personnel).

b. Location 20 is used for radon gas measurement only.

Table 1
1996 Environmental Surveillance Summary
Groundwater
Hazelwood Interim Storage Site

Measured Parameter	Station Identification	Number of Analyses or Measurements																								Total Analyses per Year
		No. of Sample Locations				Rinsate Blank				Trip Blank				Sample Duplicate				Matrix Spike				Matrix Spike Duplicate				
		CY Quarter				CY Quarter				CY Quarter				CY Quarter				CY Quarter				CY Quarter				
		1	2	3	4	1	2	3	4	1	2	3	4	1	2	3	4	1	2	3	4	1	2	3	4	
FIELD MEASUREMENTS																										
Chemical/Physical																										
Dissolved oxygen	HISS13		6																							6
Eh	HISS15		6																							6
Turbidity	HISS16		6																							6
Temperature	HISS17S		6																							6
Specific conductivity	HISS20S		6																							6
pH	B53W20S		6																							6
LABORATORY MEASUREMENTS																										
Radiological																										
Total uranium	HISS13		6				3								1											10
Thorium-232	HISS15, HISS16		6				3								1											10
Thorium-230	HISS17S		6				3								1											10
Radium-226	HISS20S		6				3								1											10
Radium-228	B53W20S		6				3								1											10
Chemical																										
Water Quality[c]	HISS13, HISS15, HISS17S, B53W20S		4				2								1				1				1			7

c. See Table 8 for a comprehensive list of analytes for water quality.

Table 1
1996 Environmental Surveillance Summary
Stormwater
Hazelwood Interim Storage Site

Measured Parameter	Station Identification	Number of Analyses or Measurements																								Total Analyses per Year
		No. of Sample Locations				Rinsate Blank				Trip Blank				Sample Duplicate				Matrix Spike				Matrix Spike Duplicat				
		CY Quarter				CY Quarter				CY Quarter				CY Quarter				CY Quarter				CY Quarter				
		1	2	3	4	1	2	3	4	1	2	3	4	1	2	3	4	1	2	3	4	1	2	3	4	
FIELD MEASUREMENTS																										
Chemical/Physical																										
Specific conductivity	STW001 STW002	2	2	2	2																					8
pH		2	2	2	2																					8
Continuous flow		2	2	2	2																					N/A
LABORATORY MEASUREMENTS																										
Radiological																										
Total uranium	STW001 STW002	2	2	2	2																					8
Thorium-230		2	2	2	2																					8
Thorium-232		2	2	2	2																					8
Radium-226		2	2	2	2																					8
Radium-228		2	2	2	2																					8
Lead-210		2	2	2	2																					8
Gross alpha		2	2	2	2																					8
Gross beta		2	2	2	2																					8
Chemical																										
Total organic carbon		2	2	2	2																					8
Total organic halides[d]		2	2	2	2																					8
Settleable solids (monthly)		2	2	2	2																					24

d. In accordance with NPDES permit # MO-0111252, if a positive result (i.e., 2 times the detection limit) is reported for TOX, the permittee must identify the specific compound.

Table 1
1996 Environmental Surveillance Summary
Surface Water and Sediment
Hazelwood Interim Storage Site

Measured Parameter	Station Identification	Number of Analyses or Measurements																								Total Analyses per Year
		No. of Sample Locations				Rinsate Blank				Trip Blank				Sample Duplicate				Matrix Spike				Matrix Spike Duplicate				
		CY Quarter				CY Quarter				CY Quarter				CY Quarter				CY Quarter				CY Quarter				
		1	2	3	4	1	2	3	4	1	2	3	4	1	2	3	4	1	2	3	4	1	2	3	4	
FIELD MEASUREMENTS																										
Chemical/Physical																										
Dissolved oxygen	SWSD002		6		6																					12
Eh	SWSD003		6		6																					12
Turbidity	SWSD004		6		6																					12
Temperature	SWSD005		6		6																					12
Specific conductivity	SWSD006		6		6																					12
pH	SWSD007		6		6																					12
LABORATORY MEASUREMENTS																										
Surface Water																										
Total uranium	SWSD002 SWSD003 SWSD004		6		6										1		1									14
Thorium-232			6		6										1		1									14
Thorium-230			6		6										1		1									14
Radium-226			6		6										1		1									14
Radium-228			6		6										1		1									14
Sediment	SWSD005 SWSD006 SWSD007																									
Total uranium			6		6		1		1						1		1									16
Thorium-232			6		6		1		1						1		1									16
Thorium-230			6		6		1		1						1		1									16
Radium-226			6		6		1		1						1		1									16
Radium-228			6		6		1		1						1		1									16

Table 2
1996 External Gamma Radiation Dose Rates
Hazelwood Interim Storage Site

Monitoring [b] Location		TETLD [a] Readings (mrem/yr)	TETLD [a] Corrected [c] (mrem/yr)
HISS perimeter	1	78.0	-13.1
		80.4	-10.5
	2	204.0	122.4
		197.8	115.7
	3	55.0	-37.8
		58.2	-34.3
	4	138.4	51.9
		144.4	58.3
	5	74.2	-17.1
		78.2	-12.8
	6	69.8	-21.9
		71.6	-19.9
	7	118.0	29.9
		118.0	29.9
	8	46.8	-46.6
		45.8	-47.7
	11	135.6	48.9
		136.4	49.7
Background	16	84.6	
		81.0	
	19	96.8	
		98.2	

a. TETLD = Tissue-equivalent thermoluminescent dosimeter (non-personnel). There are two TETLDs per station, each containing five chips. Reported values are an average chip reading per TETLD.

b. Monitoring locations are shown in Figure 2.

c. All TETLD readings are corrected for shelter/absorption factor (s/a = 1.075) and are normalized to exactly one year's exposure. Corrected background is then subtracted from all other readings. TETLD dose rates for 1996 are calculated in FUSRAP committed calculation 140-CV-032 (BNI 1997b).

Table 3
1996 Radon Gas Concentrations [a]
Hazelwood Interim Storage Site

Monitoring Location [b]		Average Daily Concentration (pCi/L) 01/22/96 08/05/96 [c]	Average Daily Concentration (pCi/L) 08/05/96 01/22/97 [c]
HISS perimeter	1	0.20*	0.30
	2	0.20	0.30
	3	0.20*	0.20
	4	0.20	0.50
	5	0.20*	0.20
	6	0.20*	0.30
Duplicate [d]	6	0.20*	0.20
	7	0.20*	0.20
	8	0.20*	0.20*
	11	0.20*	0.30
Trailer interior	20	0.20*	0.20*
Background	16	0.40	0.30
	19	0.20*	0.30

a. Radon gas concentrations in 1996 were measured with RadTrack® detectors. These detectors measure the combined concentration of radon-220 and radon-222 in air. Historically, radon-220 has not been detected at HISS.
b. Monitoring locations are shown in Figure 2.
c. Detectors were installed and removed on the dates listed.
d. A quality control duplicate is collected at the same time and location and is analyzed by the same method for evaluating precision in sampling and analysis.

Note: The DOE limit for radon-222 is 3.0 pCi/L.
The sum of the ratios of the concentration of each isotope to its limit must also be less than 1.

(*) Indicates detection limit is reported. Actual result is less than this value.
1 pCi = 0.037 becquerel

Table 4
1996 Radon-222 Flux Monitoring Results
Hazelwood Interim Storage Site

Sample ID	Radon-222 Flux pCi/m²/s
Main Pile	
01B	0.64 ± 0.27
01B [a]	0.23 ± 0.31
02B	0.04 ± 0.26
03B	0.02 ± 0.26
04B	0.69 ± 0.27
05B	-0.06 ± 0.26
06B	0.00 ± 0.26
06B [b]	0.07 ± 0.26
07B	0.12 ± 0.26
08B	14.49 ± 0.44
09B	0.31 ± 0.26
10B	-0.01 ± 0.00
11B	0.09 ± 0.26
12B	0.60 ± 0.27
13B	0.54 ± 0.27
14B	1.20 ± 0.28
15B	-0.04 ± 0.26
16B	0.20 ± 0.26
16B [b]	0.37 ± 0.27
17B	0.34 ± 0.31
18B	0.00 ± 0.00
19B	0.88 ± 0.30
20B	0.89 ± 0.30
21B	0.10 ± 0.29
22B	0.05 ± 0.29
22B [a]	-0.11 ± 0.30
23B	-0.03 ± 0.29
24B	-0.03 ± 0.29
25B	-0.13 ± 0.29
26B	0.09 ± 0.29
26B [b]	-0.16 ± 0.29
27B	0.00 ± 0.00
28B	0.25 ± 0.29
29B	0.09 ± 0.29
30B	0.11 ± 0.29

Sample ID	Radon-222 Flux pCi/m²/s
Main Pile	
31B	-0.02 ± 0.29
32B	-0.22 ± 0.29
33B	0.17 ± 0.29
34B	0.55 ± 0.30
35B	-0.04 ± 0.29
36B	0.13 ± 0.30
36B [b]	0.05 ± 0.30
37B	-0.08 ± 0.29
38B	-0.09 ± 0.29
39B	-0.09 ± 0.29
40B	1.08 ± 0.31
41B	0.33 ± 0.30
42B	-0.06 ± 0.30
43B	-0.08 ± 0.30
44B	-0.01 ± 0.30
45B	-0.19 ± 0.29
46B	-0.24 ± 0.29
46B [b]	-0.26 ± 0.29
47B	1.03 ± 2.17
47B [a]	0.03 ± 0.31
48B	0.09 ± 0.30
49B	0.00 ± 0.30
50B	-0.11 ± 0.30
51B	-0.18 ± 0.30
52B	-0.29 ± 0.30
53B	-0.21 ± 0.30
54B	-0.14 ± 0.30
55B	-0.18 ± 0.30
56B	0.14 ± 0.30
56B [b]	0.07 ± 0.30
57B	-0.11 ± 0.30
58B	-0.09 ± 0.30
59B	-0.32 ± 0.30
60B	-0.18 ± 0.30
61B	-0.09 ± 0.30

Sample ID	Radon-222 Flux pCi/m²/s
Main Pile	
62B	-0.28 ± 0.30
63B	-0.09 ± 0.30
64B	0.03 ± 0.30
65B	-0.10 ± 0.30
66B	0.13 ± 0.30
66B [b]	-0.02 ± 0.30
67B	-0.18 ± 0.30
68B	0.11 ± 0.30
69B	-0.23 ± 0.30
70B	0.09 ± 0.30
70B [a]	0.07 ± 0.31
70B [b]	-0.16 ± 0.30
Secondary Pile	
01A	-0.02 ± 0.25
02A	-0.04 ± 0.25
03A	-0.15 ± 0.25
04A	-0.08 ± 0.25
05A	-0.06 ± 0.25
05A [b]	0.22 ± 0.26
06A	0.17 ± 0.26
07A	-0.11 ± 0.25
08A	-0.02 ± 0.25
09A	0.07 ± 0.26
10A	-0.10 ± 0.25
11A	-0.35 ± 0.25
12A	-0.25 ± 0.25
13A	-0.05 ± 0.25
14A	0.05 ± 0.26
14A [a]	-0.10 ± 0.26
15A	-0.24 ± 0.25
15A [b]	-0.07 ± 0.25
16A	-0.18 ± 0.25
17A	-0.03 ± 0.26
18A	-0.10 ± 0.25

a. A quality control duplicate is collected at the same time and location and is analyzed by the same method for evaluating precision in sampling and analysis.

b. The canisters are counted twice in the laboratory as quality control duplicates to evaluate analytical precision.

Note: The EPA standard for radon-222 flux is 20 pCi/m²/s.

Table 5
1996 Surface Water Analytical Results - Radioactive Constituents
Hazelwood Interim Storage Site

Sampling Location	Date Collected	Analyte	Result [a] (pCi/L)	BNI Flag [b]	MDA [c] (pCi/L)	Result Above Background [d] (pCi/L)	DCG [e] (pCi/L)
SWSD002	04/25/96	Radium-226	0.35 ± 0.25		0.20	0.04 ± 0.26	100
Background	10/30/96	Radium-226	0.28 ± 0.20		0.19	-0.03 ± 0.22	100
	04/25/96	Radium-228	0.05 ± 0.09	UJ	0.35	-0.02 ± 0.12	100
	10/30/96	Radium-228	0.09 ± 0.12	UJ	0.35	0.02 ± 0.14	100
	04/25/96	Thorium-230	0.18 ± 0.18	UJ	0.33	0.00 ± 0.19	300
	10/30/96	Thorium-230	0.56 ± 0.33		0.20	0.38 ± 0.34	300
	04/25/96	Thorium-232	0.04 ± 0.09	UJ	0.31	-0.03 ± 0.10	50
	10/30/96	Thorium-232	0.22 ± 0.20	UJ	0.23	0.15 ± 0.20	50
	04/25/96	Total uranium	1.23 ± 0.03		0.02	0.40 ± 0.04	600
	10/30/96	Total uranium	0.45 ± 0.01		0.02	-0.38 ± 0.03	600
SWSD003	04/25/96	Radium-226	0.41 ± 0.20		0.16	0.10 ± 0.22	100
	10/29/96	Radium-226	0.26 ± 0.18		0.24	-0.05 ± 0.20	100
	04/25/96	Radium-228	0.17 ± 0.16	UJ	0.32	0.10 ± 0.18	100
	10/29/96	Radium-228	0.09 ± 0.13	UJ	0.36	0.02 ± 0.15	100
	04/25/96	Thorium-230	0.68 ± 0.32		0.22	0.50 ± 0.33	300
	10/29/96	Thorium-230	0.92 ± 0.43		0.12	0.74 ± 0.44	300
	04/25/96	Thorium-232	0.14 ± 0.14	UJ	0.30	0.07 ± 0.15	50
	10/29/96	Thorium-232	0.09 ± 0.12	UJ	0.20	0.02 ± 0.13	50
	04/25/96	Total uranium	6.21 ± 0.14		0.02	5.38 ± 0.14	600
	10/29/96	Total uranium	2.05 ± 0.05		0.02	1.22 ± 0.06	600
SWSD004	04/25/96	Radium-226	0.18 ± 0.12		0.12	-0.13 ± 0.14	100
	10/29/96	Radium-226	0.16 ± 0.16	UJ	0.18	-0.15 ± 0.18	100
	04/25/96	Radium-228	0.07 ± 0.10	UJ	0.25	0.00 ± 0.13	100
	10/29/96	Radium-228	0.36 ± 0.26		0.31	0.29 ± 0.27	100
	04/25/96	Thorium-230	0.14 ± 0.15	UJ	0.22	-0.04 ± 0.17	300
	10/29/96	Thorium-230	0.40 ± 0.28		0.24	0.22 ± 0.29	300
	04/25/96	Thorium-232	0.17 ± 0.00	UJ	0.17	0.10 ± 0.04	50
	10/29/96	Thorium-232	0.13 ± 0.16	UJ	0.21	0.06 ± 0.16	50
	04/25/96	Total uranium	8.88 ± 0.55		0.02	8.05 ± 0.55	600
	10/29/96	Total uranium	2.56 ± 0.06		0.02	1.73 ± 0.07	600
SWSD005	04/25/96	Radium-226	0.52 ± 0.29		0.42	0.21 ± 0.30	100
	10/29/96	Radium-226	0.34 ± 0.21		0.18	0.03 ± 0.22	100
	04/25/96	Radium-228	0.33 ± 0.24		0.31	0.26 ± 0.25	100
	10/29/96	Radium-228	0.43 ± 0.30		0.35	0.36 ± 0.31	100
	04/25/96	Thorium-230	0.24 ± 0.20	UJ	0.26	0.06 ± 0.21	300
	10/29/96	Thorium-230	0.42 ± 0.29		0.28	0.24 ± 0.30	300
	04/25/96	Thorium-232	0.04 ± 0.08	UJ	0.22	-0.03 ± 0.09	50
	10/29/96	Thorium-232	0.05 ± 0.09	UJ	0.13	-0.02 ± 0.10	50
	04/25/96	Total uranium	1.09 ± 0.03		0.02	0.26 ± 0.04	600
	10/29/96	Total uranium	1.10 ± 0.03		0.02	0.27 ± 0.04	600

Table 5
1996 Surface Water Analytical Results - Radioactive Constituents
Hazelwood Interim Storage Site

Sampling Location	Date Collected	Analyte	Result [a] (pCi/L)	BNI Flag [b]	MDA [c] (pCi/L)	Result Above Background [d] (pCi/L)	DCG [e] (pCi/L)
SWSD006	04/25/96	Radium-226	0.15 ± 0.11		0.10	-0.16 ± 0.14	100
	10/29/96	Radium-226	0.30 ± 0.21		0.20	-0.01 ± 0.22	100
	04/25/96	Radium-228	0.11 ± 0.13	UJ	0.22	0.04 ± 0.15	100
	10/29/96	Radium-228	0.18 ± 0.18	UJ	0.43	0.11 ± 0.20	100
	04/25/96	Thorium-230	0.32 ± 0.22		0.17	0.14 ± 0.23	300
	10/29/96	Thorium-230	0.43 ± 0.29		0.24	0.25 ± 0.30	300
	04/25/96	Thorium-232	0.14 ± 0.14	UJ	0.19	0.07 ± 0.15	50
	10/29/96	Thorium-232	0.04 ± 0.09	UJ	0.12	-0.03 ± 0.10	50
	04/25/96	Total uranium	1.25 ± 0.03		0.02	0.42 ± 0.04	600
	10/29/96	Total uranium	1.09 ± 0.03		0.02	0.26 ± 0.04	600
SWSD006 Duplicate [f]	04/25/96	Radium-226	0.12 ± 0.10	UJ	0.15	-0.19 ± 0.13	100
	10/29/96	Radium-226	0.38 ± 0.24		0.23	0.07 ± 0.25	100
	04/25/96	Radium-228	0.28 ± 0.22	U	0.28	0.21 ± 0.23	100
	10/29/96	Radium-228	0.04 ± 0.08	UJ	0.19	-0.03 ± 0.11	100
	04/25/96	Thorium-230	0.47 ± 0.28		0.11	0.29 ± 0.29	300
	10/29/96	Thorium-230	0.53 ± 0.31		0.27	0.35 ± 0.32	300
	04/25/96	Thorium-232	0.24 ± 0.00	UJ	0.24	0.17 ± 0.04	50
	10/29/96	Thorium-232	0.08 ± 0.12	UJ	0.22	0.01 ± 0.13	50
	04/25/96	Total uranium	1.16 ± 0.03		0.02	0.33 ± 0.04	600
	10/29/96	Total uranium	1.12 ± 0.03		0.02	0.29 ± 0.04	600
SWSD007	04/25/96	Radium-226	0.20 ± 0.16	UJ	0.22	-0.11 ± 0.18	100
	10/29/96	Radium-226	0.54 ± 0.27		0.24	0.23 ± 0.28	100
	04/25/96	Radium-228	0.09 ± 0.13	UJ	0.38	0.02 ± 0.15	100
	10/29/96	Radium-228	0.31 ± 0.24	UJ	0.41	0.24 ± 0.25	100
	04/25/96	Thorium-230	0.09 ± 0.12	UJ	0.26	-0.09 ± 0.14	300
	10/29/96	Thorium-230	0.40 ± 0.28		0.29	0.22 ± 0.29	300
	04/25/96	Thorium-232	0.29 ± 0.00	UJ	0.29	0.22 ± 0.04	50
	10/29/96	Thorium-232	0.04 ± 0.09	UJ	0.24	-0.03 ± 0.10	50
	04/25/96	Total uranium	7.07 ± 0.45		0.02	6.24 ± 0.45	600
	10/29/96	Total uranium	1.72 ± 0.04		0.02	0.89 ± 0.05	600

a. Results reported with (±) radiological error quoted at 2-sigma (95 percent confidence level).
b. Bechtel National, Inc. (BNI) data qualifier flags:
   U = The analyte was not detected.
   UJ = Analyte was not detected; estimated value reported. The result is below the MDA or less than the associated error.
c. Minimum detectable activity.
d. Historical (1992-1996) average background for surface water is 0.31 ± 0.08 pCi/L for radium-226, 0.18 ± 0.07 pCi/L for thorium-230, and 0.83 ± 0.03 pCi/L for total uranium. Historical (1993-1996) average background for thorium-232 is 0.07 ± 0.04 pCi/L. Historical (1996 only) average background for radium-228 is 0.07 ± 0.08 pCi/L. Associated error term for result above background was calculated: $(error^2_{result} + error^2_{background})^{1/2}$.
e. DOE derived concentration guide for water.
f. A quality control duplicate is collected at the same time and location and is analyzed by the same method for evaluating precision of sampling and analysis.

Table 6
1996 Sediment Analytical Results - Radioactive Constituents
Hazelwood Interim Storage Site

Sampling Location	Date Collected	Analyte	Result [a] (pCi/g)	BNI Flag [b]	MDA [c] (pCi/g)	Result Above Background [d] (pCi/g)	Cleanup Criteria [e] (pCi/g)
SWSD002	04/25/96	Radium-226	1.60 ± 0.34		0.09	0.52 ± 0.35	5
Background	10/30/96	Radium-226	0.83 ± 0.28		0.12	-0.25 ± 0.29	5
	04/25/96	Radium-228	1.32 ± 0.53		0.29	0.48 ± 0.56	5
	10/30/96	Radium-228	0.43 ± 0.22		0.19	-0.41 ± 0.29	5
	04/25/96	Thorium-230	2.17 ± 0.73	J	0.20	0.93 ± 0.75	5
	10/30/96	Thorium-230	0.92 ± 0.34		0.06	-0.32 ± 0.38	5
	04/25/96	Thorium-232	0.86 ± 0.40	J	0.20	0.15 ± 0.42	5
	10/30/96	Thorium-232	0.42 ± 0.21		0.14	-0.29 ± 0.25	5
	04/25/96	Total uranium	1.02 ± 0.11		0.07	-0.86 ± 0.13	100
	10/30/96	Total uranium	1.44 ± 0.04		0.07	-0.44 ± 0.07	100
SWSD003	04/25/96	Radium-226	0.54 ± 0.17		0.08	-0.54 ± 0.19	5
	10/29/96	Radium-226	1.06 ± 0.28		0.12	-0.02 ± 0.29	5
	04/25/96	Radium-228	0.65 ± 0.33		0.18	-0.19 ± 0.38	5
	10/29/96	Radium-228	1.12 ± 0.47		0.25	0.28 ± 0.51	5
	04/25/96	Thorium-230	6.10 ± 1.58	J	0.16	4.86 ± 1.59	5
	10/29/96	Thorium-230	5.09 ± 1.39		0.17	3.85 ± 1.40	5
	04/25/96	Thorium-232	0.81 ± 0.37	J	0.18	0.10 ± 0.40	5
	10/29/96	Thorium-232	1.31 ± 0.52		0.22	0.60 ± 0.54	5
	04/25/96	Total uranium	2.13 ± 0.07		0.07	0.25 ± 0.09	100
	10/29/96	Total uranium	2.13 ± 0.06		0.07	0.25 ± 0.08	100
SWSD004	04/25/96	Radium-226	0.64 ± 0.21		0.08	-0.44 ± 0.23	5
	10/29/96	Radium-226	1.14 ± 0.40		0.15	0.06 ± 0.41	5
	04/25/96	Radium-228	0.54 ± 0.25		0.18	-0.30 ± 0.31	5
	10/29/96	Radium-228	0.68 ± 0.28		0.14	-0.16 ± 0.34	5
	04/25/96	Thorium-230	3.61 ± 0.88		0.11	2.37 ± 0.90	5
	10/29/96	Thorium-230	2.59 ± 0.68		0.11	1.35 ± 0.70	5
	04/25/96	Thorium-232	0.72 ± 0.29		0.13	0.01 ± 0.32	5
	10/29/96	Thorium-232	0.49 ± 0.23		0.11	-0.22 ± 0.27	5
	04/25/96	Total uranium	1.67 ± 0.07		0.07	-0.21 ± 0.09	100
	10/29/96	Total uranium	1.70 ± 0.05		0.07	-0.18 ± 0.08	100
SWSD005	04/25/96	Radium-226	2.72 ± 0.60		0.29	1.64 ± 0.61	5
	10/29/96	Radium-226	5.66 ± 0.77		0.08	4.58 ± 0.78	5
	04/25/96	Radium-228	1.02 ± 0.31		0.15	0.18 ± 0.36	5
	10/29/96	Radium-228	1.00 ± 0.34		0.17	0.16 ± 0.39	5
	04/25/96	Thorium-230	7.23 ± 1.34		0.16	5.99 ± 1.35	5
	10/29/96	Thorium-230	229.70 ± 41.69		0.11	228.46 ± 41.69	5
	04/25/96	Thorium-232	0.90 ± 0.29		0.18	0.19 ± 0.32	5
	10/29/96	Thorium-232	1.65 ± 0.47		0.11	0.94 ± 0.49	5
	04/25/96	Total uranium	1.87 ± 0.12		0.07	-0.01 ± 0.13	100
	10/29/96	Total uranium	7.87 ± 0.56		0.07	5.99 ± 0.56	100

Table 6
1996 Sediment Analytical Results - Radioactive Constituents
Hazelwood Interim Storage Site

Sampling Location	Date Collected	Analyte	Result [a] (pCi/g)	BNI Flag [b]	MDA [c] (pCi/g)	Result Above Background [d] (pCi/g)	Cleanup Criteria [e] (pCi/g)
SWSD006	04/25/96	Radium-226	0.89 ± 0.27		0.11	-0.19 ± 0.28	5
	10/29/96	Radium-226	1.50 ± 0.35		0.10	0.42 ± 0.36	5
	04/25/96	Radium-228	0.89 ± 0.31		0.11	0.05 ± 0.36	5
	10/29/96	Radium-228	1.44 ± 0.47		0.14	0.60 ± 0.51	5
	04/25/96	Thorium-230	1.83 ± 0.49		0.12	0.59 ± 0.52	5
	10/29/96	Thorium-230	3.48 ± 0.88		0.12	2.24 ± 0.90	5
	04/25/96	Thorium-232	1.30 ± 0.39		0.05	0.59 ± 0.41	5
	10/29/96	Thorium-232	1.25 ± 0.43		0.14	0.54 ± 0.45	5
	04/25/96	Total uranium	1.72 ± 0.07		0.07	-0.16 ± 0.09	100
	10/29/96	Total uranium	1.90 ± 0.06		0.07	0.02 ± 0.08	100
SWSD006 Duplicate [f]	04/25/96	Radium-226	1.47 ± 0.37		0.16	0.39 ± 0.38	5
	10/29/96	Radium-226	1.02 ± 0.26		0.09	-0.06 ± 0.28	5
	04/25/96	Radium-228	1.20 ± 0.35		0.10	0.36 ± 0.40	5
	10/29/96	Radium-228	0.89 ± 0.31		0.14	0.05 ± 0.36	5
	04/25/96	Thorium-230	1.80 ± 0.46		0.11	0.56 ± 0.49	5
	10/29/96	Thorium-230	1.77 ± 0.47		0.09	0.53 ± 0.50	5
	04/25/96	Thorium-232	1.08 ± 0.33		0.05	0.37 ± 0.36	5
	10/29/96	Thorium-232	0.87 ± 0.30		0.05	0.16 ± 0.33	5
	04/25/96	Total uranium	1.80 ± 0.07		0.07	-0.08 ± 0.09	100
	10/29/96	Total uranium	1.74 ± 0.05		0.07	-0.14 ± 0.08	100
SWSD007	04/25/96	Radium-226	1.75 ± 0.48		0.08	0.67 ± 0.49	5
	10/29/96	Radium-226	1.43 ± 0.36		0.15	0.35 ± 0.37	5
	04/25/96	Radium-228	0.81 ± 0.29		0.13	-0.03 ± 0.35	5
	10/29/96	Radium-228	1.18 ± 0.46		0.25	0.34 ± 0.50	5
	04/25/96	Thorium-230	5.64 ± 1.14		0.09	4.40 ± 1.15	5
	10/29/96	Thorium-230	32.38 ± 6.97		0.22	31.14 ± 6.97	5
	04/25/96	Thorium-232	0.76 ± 0.27		0.05	0.05 ± 0.30	5
	10/29/96	Thorium-232	1.12 ± 0.44		0.14	0.41 ± 0.46	5
	04/25/96	Total uranium	2.19 ± 0.07		0.07	0.31 ± 0.09	100
	10/29/96	Total uranium	3.41 ± 0.10		0.07	1.53 ± 0.12	100

a. Results reported with (±) radiological error quoted at 2-sigma (95 percent confidence level).
b. Bechtel National, Inc. (BNI) data qualifier flags:
J = Reported as an estimated value.
c. Minimum detectable activity.
d. Historical (1992-1996) average background for surface water is 1.08 ± 0.09 pCi/g for radium-226, 1.24 ± 0.17 pCi/g for thorium-230, and 1.88 ± .06 pCi/g for total uranium. Historical (1993-1996) average background for thorium-232 is 0.71 ± 0.14 pCi/g. Historical (1994 and 1996) average background for radium-228 is 0.84 ± 0.19 pCi/g. Associated error term for result above background was calculated: $(error^2_{result} + error^2_{background})^{1/2}$.
e. DOE authorized limit for surface soil (averaged over the first 15 cm).
f. A quality control duplicate is collected at the same time and location and is analyzed by the same method for evaluating precision of sampling and analysis.

Table 7
1996 Field Parameter Summary
Hazelwood Interim Storage Site

Sampling Location	Date	Temp (C)	Spec. Cond.[a] (mS/cm)	pH	Eh (mV)[b]	DO[c] mg/L	Turbidity (NTU)[d]	Volume Purged (gal)[e]	Discharge (GPM)[f]
Groundwater									
B53W20S	04/25/96	14.0	0.764	6.81	293	5.34	272	12.5	0.08
HISS13	04/24/96	13.8	6.610	6.51	260	0.54	99	2.75	0.05
HISS15	04/22/96	12.4	1.076	6.60	183	0.78	18	4.0	0.06
HISS16	04/22/96	11.3	4.020	6.92	317	2.81	57	6.0	0.06
HISS17S	04/23/96	13.2	1.280	6.90	250	0.57	93	13.0	0.06
HISS20S	04/23/96	13.6	5.650	6.68	27	0.31	219	15.0	0.08
Surface Water									
SWSD002	04/25/96	17.0	1.210	8.18	239	10.43	2	--[g]	--
	10/30/96	13.0	0.572	7.67	356	3.43	10	--	--
SWSD003	04/25/96	16.4	1.084	7.93	224	6.77	10	--	--
	10/29/96	18.1	0.726	7.80	234	5.48	12	--	--
SWSD004	04/25/96	17.4	0.876	7.69	203	12.83	4	--	--
	10/29/96	17.9	0.752	8.09	244	7.03	6	--	--
SWSD005	04/25/96	17.8	0.924	7.89	213	16.46	7	--	--
	10/29/96	18.5	0.794	7.84	239	7.12	6	--	--
SWSD006	04/25/96	17.6	0.988	7.87	225	9.19	8	--	--
	10/29/96	8.4	0.790	7.77	241	6.82	6	--	--
SWSD007	04/25/96	16.0	1.142	7.95	238	7.40	3	--	--
	10/29/96	18.1	0.708	7.78	228	5.10	9	--	--

a. Specific conductance, measured in milliSiemens/centimeter (mS/cm).
b. Oxidation/reduction potential, measured in milliVolts (mV).
c. Dissolved oxygen.
d. Nephelometric turbidity units.
e. Volume purged is measured in gallons (gal).
f. Gallons per minute.
g. -- Parameter not applicable.

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Table 8
1996 Groundwater Quality Analytical Results
Hazelwood Interim Storage Site

Sampling Location	Date Collected	Analyte	Result (mg/L)	Data Qualifiers[a] BNI	Data Qualifiers[a] Lab	Detection Limit (mg/L)	Related Regulations[b] Federal / State[c] (mg/L)
B53W20S	04/25/96	Alkalinity	313			4	NE
Background	04/25/96	Bicarbonate	313			4	NE
	04/25/96	Calcium	89.5			0.0538	NE
	04/25/96	Carbonate	4		U	4	NE
	04/25/96	Chloride	9.1			0.25	NE
	04/25/96	Magnesium	44.3			0.0772	NE
	04/25/96	Nitrate, as N	2.3			0.1	10
	04/25/96	Phosphate	0.05		U	0.05	NE
	04/25/96	Potassium	1.39		U	1.39	NE
	04/25/96	Sodium	9.54			0.0677	NE
	04/25/96	Sulfate	103			12.5	NE
	04/25/96	Total dissolved solids	495			5	NE
HISS13	04/24/96	Alkalinity	302			4	NE
	04/24/96	Bicarbonate	302			4	NE
	04/24/96	Calcium	854			0.538	NE
	04/24/96	Carbonate	4		U	4	NE
	04/24/96	Chloride	16.9			1.2	NE
	04/24/96	Magnesium	324			0.0772	NE
	04/24/96	Nitrate, as N	878			50	10
	04/24/96	Phosphate	0.071			0.05	NE
	04/24/96	Potassium	1.39		U	1.39	NE
	04/24/96	Sodium	126			0.0677	NE
	04/24/96	Sulfate	239			25	NE
	04/24/96	Total dissolved solids	7320			20	NE
HISS15	04/22/96	Alkalinity	453			4	NE
	04/22/96	Bicarbonate	453			4	NE
	04/22/96	Calcium	124			0.0538	NE
	04/22/96	Carbonate	4		U	4	NE
	04/22/96	Magnesium	52.7			0.0772	NE
	04/22/96	Nitrate, as N	1.9			0.1	10
	04/22/96	Phosphate	0.087			0.05	NE
	04/22/96	Potassium	1.39		U	1.39	NE
	04/22/96	Sodium	27.9			0.0677	NE
	04/22/96	Sulfate	50.4			10	NE
	04/22/96	Total dissolved solids	697			5	NE

Table 8
1996 Groundwater Quality Analytical Results
Hazelwood Interim Storage Site

Sampling Location	Date Collected	Analyte	Result (mg/L)	Data Qualifiers [a] BNI	Data Qualifiers [a] Lab	Detection Limit (mg/L)	Related Regulations [b] Federal / State [c] (mg/L)
HISS15	04/22/96	Alkalinity	458			4	NE
Duplicate [d]	04/22/96	Bicarbonate	458			4	NE
	04/22/96	Calcium	125			0.0538	NE
	04/22/96	Carbonate	4		U	4	NE
	04/22/96	Magnesium	52.5			0.0772	NE
	04/22/96	Nitrate, as N	1.8			0.1	10
	04/22/96	Phosphate	0.095			0.05	NE
	04/22/96	Potassium	1.39		U	1.39	NE
	04/22/96	Sodium	27.8			0.0677	NE
	04/22/96	Sulfate	47.5			10	NE
	04/22/96	Total dissolved solids	716			5	NE
HISS17S	04/23/96	Alkalinity	372			4	NE
	04/23/96	Bicarbonate	372			4	NE
	04/23/96	Calcium	129			0.0538	NE
	04/23/96	Carbonate	4		U	4	NE
	04/23/96	Chloride	26			1.2	NE
	04/23/96	Magnesium	65.7			0.0772	NE
	04/23/96	Nitrate, as N	53			2	10
	04/23/96	Phosphate	0.05		U	0.05	NE
	04/23/96	Potassium	1.39		U	1.39	NE
	04/23/96	Sodium	34.7			0.0677	NE
	04/23/96	Sulfate	100			10	NE
	04/23/96	Total dissolved solids	851			5	NE

a. Bechtel National, Inc. (BNI) and laboratory data qualifier flags:
U = Analyte was not detected. Detection limit reported.

b. Regulations presented pertain to drinking water quality and are listed for comparison.
No drinking water supply is obtained from groundwater at HISS. NE = Not established.

c. Federal Safe Drinking Water Act maximum contaminant levels, EPA-822-R-96-001 (February 1996).
The state of Missouri incorporates federal regulations by reference.

d. A quality control duplicate is collected at the same time and location and is analyzed by the same method for evaluating precision of sampling and analysis.

Table 9
1996 Groundwater Analytical Results - Radioactive Constituents
Hazelwood Interim Storage Site

Sampling Location	Date Collected	Analyte	Result [a] (pCi/L)	BNI Flag [b]	MDA [c] (pCi/L)	Result Above Background [d] (pCi/L)	DCG [e] (pCi/L)
B53W20S Background	04/25/96	Radium-226	0.22 ± 0.19	UJ	0.40	0.05 ± 0.20	100
	04/25/96	Radium-228	0.07 ± 0.11	UJ	0.26	0.00 ± 0.16	100
	04/25/96	Thorium-230	0.15 ± 0.15	UJ	0.22	0.00 ± 0.16	300
	04/25/96	Thorium-232	0.17 ± 0.00	UJ	0.17	0.10 ± 0.02	50
	04/25/96	Total uranium	0.97 ± 0.02		0.02	-0.61 ± 0.06	600
HISS13	04/24/96	Radium-226	0.43 ± 0.22		0.17	0.26 ± 0.23	100
	04/24/96	Radium-228	0.08 ± 0.12	UJ	0.31	0.01 ± 0.16	100
	04/24/96	Thorium-230	0.24 ± 0.20	UJ	0.30	0.09 ± 0.21	300
	04/24/96	Thorium-232	0.16 ± 0.16	UJ	0.28	0.09 ± 0.16	50
	04/24/96	Total uranium	6.03 ± 0.14		0.02	4.45 ± 0.15	600
HISS15	04/22/96	Radium-226	0.40 ± 0.22		0.17	0.23 ± 0.23	100
	04/22/96	Radium-228	0.14 ± 0.14	UJ	0.21	0.07 ± 0.18	100
	04/22/96	Thorium-230	0.37 ± 0.23		0.21	0.22 ± 0.24	300
	04/22/96	Thorium-232	0.03 ± 0.07	UJ	0.21	-0.04 ± 0.07	50
	04/22/96	Total uranium	1.95 ± 0.04		0.02	0.37 ± 0.07	600
HISS15 Duplicate [f]	04/22/96	Radium-226	0.26 ± 0.14		0.12	0.09 ± 0.15	100
	04/22/96	Radium-228	0.04 ± 0.09	UJ	0.34	-0.03 ± 0.14	100
	04/22/96	Thorium-230	0.50 ± 0.30		0.19	0.35 ± 0.31	300
	04/22/96	Thorium-232	0.11 ± 0.00	UJ	0.11	0.04 ± 0.02	50
	04/22/96	Total uranium	1.92 ± 0.04		0.02	0.34 ± 0.07	600
HISS16	04/22/96	Radium-226	1.93 ± 0.53		0.35	1.76 ± 0.53	100
	04/22/96	Radium-228	0.18 ± 0.17	UJ	0.38	0.11 ± 0.20	100
	04/22/96	Thorium-230	0.47 ± 0.27		0.28	0.32 ± 0.28	300
	04/22/96	Thorium-232	0.04 ± 0.07	UJ	0.32	-0.03 ± 0.07	50
	04/22/96	Total uranium	25.62 ± 1.81		0.02	24.04 ± 1.81	600
HISS17S	04/23/96	Radium-226	0.25 ± 0.16		0.13	0.08 ± 0.17	100
	04/23/96	Radium-228	0.05 ± 0.10	UJ	0.35	-0.02 ± 0.15	100
	04/23/96	Thorium-230	0.24 ± 0.22	U	0.22	0.09 ± 0.23	300
	04/23/96	Thorium-232	0.22 ± 0.00	UJ	0.22	0.15 ± 0.02	50
	04/23/96	Total uranium	3.85 ± 0.09		0.02	2.27 ± 0.11	600
HISS20S	04/23/96	Radium-226	1.13 ± 0.37		0.19	0.96 ± 0.37	100
	04/23/96	Radium-228	0.12 ± 0.14	UJ	0.32	0.05 ± 0.18	100
	04/23/96	Thorium-230	0.55 ± 0.31		0.24	0.40 ± 0.32	300
	04/23/96	Thorium-232	0.08 ± 0.11	UJ	0.18	0.01 ± 0.11	50
	04/23/96	Total uranium	8.56 ± 0.54		0.02	6.98 ± 0.54	600

Table 9
1996 Groundwater Analytical Results - Radioactive Constituents
Hazelwood Interim Storage Site

a. Results reported with (±) radiological error quoted at 2-sigma (95 percent confidence level).
b. Bechtel National, Inc. (BNI) data qualifier flags:
   U = The analyte was not detected.
   UJ = Analyte was not detected; estimated value reported. The result is below the MDA or less than the associated error.
c. Minimum detectable activity.
d. Historical (1992-1996) average background for groundwater is 0.17 ± 0.05 pCi/L for radium-226, 0.15 ± 0.06 pCi/L for thorium-230, 0.07 ± 0.02 pCi/L for thorium-232, and 1.58 ± 0.06 pCi/L for total uranium. Historical (1996 only) average background for radium-228 is 0.07 ± 0.11 pCi/L. Associated error term for result above background was calculated: $(error^2_{result} + error^2_{background})^{½}$.
e. DOE derived concentration guide for water.
f. A quality control duplicate is collected at the same time and location and is analyzed by the same method for evaluating precision of sampling and analysis.

Table 10
1996 Stormwater Analytical Results and Field Parameters - Chemical Constituents
Hazelwood Interim Storage Site

Sampling Location	Date Collected	Analyte	Result	Result Units	Data Qualifiers [a] BNI	Data Qualifiers [a] Lab	Detection Limit	NPDES Permit Limitations [b]
STW001	01/18/96	Settleable solids	0.5	mL/L/h	UJ	U	0.5	1.0 mL/L/h [c]
	02/28/96	Settleable solids	0.5	mL/L/h		U	0.5	1.0 mL/L/h
	03/05/96	Settleable solids	0.5	mL/L/h		U	0.5	1.0 mL/L/h
	04/23/96	Settleable solids	0.5	mL/L/h		U	0.5	1.0 mL/L/h
	05/31/96	Settleable solids	no sample [d]					
	06/10/96	Settleable solids	0.5	mL/L/h		U	0.5	1.0 mL/L/h
	07/30/96	Settleable solids	0.5	mL/L/h		U	0.5	1.0 mL/L/h
	08/31/96	Settleable solids	no sample [d]					
	09/24/96	Settleable solids	0.5	mL/L/h		U	0.5	1.0 mL/L/h
	10/22/96	Settleable solids	0.5	mL/L/h		U	0.5	1.0 mL/L/h
	11/05/96	Settleable solids	0.5	mL/L/h	UJ	U	0.5	1.0 mL/L/h
	12/31/96	Settleable solids	no sample [d]					
	03/05/96	Total organic carbon	15.4	mg/L			0.5	NE
	06/10/96	Total organic carbon	11.2	mg/L	J		0.5	NE
	09/26/96	Total organic carbon	6.2	mg/L			0.5	NE
	12/31/96	Total organic carbon	no sample [d]					
	03/05/96	Total organic halides	48.5	µg/L			10	NE
	06/10/96	Total organic halides	13.8	µg/L	J		5	NE
	09/26/96	Total organic halides	51.1	µg/L			5	NE
	12/31/96	Total organic halides	no sample [d]					
	09/26/96	Bromacil	40	µg/L	NJ	J	0	NE
	03/05/96	pH	7.70	pH units			NA [e]	6-9 pH units
	06/10/96	pH	8.37	pH units			NA [e]	6-9 pH units
	09/26/96	pH	7.85	pH units			NA [e]	6-9 pH units
	12/31/96	pH	no sample [d]					
	03/05/96	Specific conductivity	288	µmhos/cm			NA [e]	NE
	06/10/96	Specific conductivity	196	µmhos/cm			NA [e]	NE
	09/26/96	Specific conductivity	121	µmhos/cm			NA [e]	NE
	12/31/96	Specific conductivity	no sample [d]					

Table 10
1996 Stormwater Analytical Results and Field Parameters - Chemical Constituents
Hazelwood Interim Storage Site

Sampling Location	Date Collected	Analyte	Result	Result Units	Data Qualifiers [a] BNI	Data Qualifiers [a] Lab	Detection Limit	NPDES Permit Limitations [b]
STW002	01/18/96	Settleable solids	0.5	mL/L/h	UJ	U	0.5	1.0 mL/L/h [c]
	02/28/96	Settleable solids	0.5	mL/L/h		U	0.5	1.0 mL/L/h
	03/31/96	Settleable solids	no sample [d]					
	04/23/96	Settleable solids	0.5	mL/L/h		U	0.5	1.0 mL/L/h
	05/31/96	Settleable solids	no sample [d]					
	06/10/96	Settleable solids	0.5	mL/L/h		U	0.5	1.0 mL/L/h
	07/30/96	Settleable solids	0.5	mL/L/h		U	0.5	1.0 mL/L/h
	08/31/96	Settleable solids	no sample [d]					
	09/24/96	Settleable solids	0.5	mL/L/h		U	0.5	1.0 mL/L/h
	10/22/96	Settleable solids	0.5	mL/L/h		U	0.5	1.0 mL/L/h
	11/05/96	Settleable solids	0.5	mL/L/h	UJ	U	0.5	1.0 mL/L/h
	12/31/96	Settleable solids	no sample [d]					
	03/31/96	Total organic carbon	no sample [d]					
	06/10/96	Total organic carbon	9.9	mg/L	J		0.5	NE
	09/26/96	Total organic carbon	3	mg/L			0.5	NE
	12/31/96	Total organic carbon	no sample [d]					
	03/31/96	Total organic halides	no sample [d]					
	06/10/96	Total organic halides	26.8	µg/L	J		5	NE
	09/26/96	Total organic halides	38.7	µg/L			6.6	NE
	12/31/96	Total organic halides	no sample [d]					
	09/26/96	Bromacil	70	µg/L	NJ	J	0	NE
	03/05/96	pH	no sample [d]					
	06/10/96	pH	7.83	pH units			NA [e]	6-9 pH units
	09/26/96	pH	7.61	pH units			NA [e]	6-9 pH units
	12/31/96	pH	no sample [d]					
	03/05/96	Specific conductivity	no sample [d]					
	06/10/96	Specific conductivity	183	µmhos/cm			NA [e]	NE
	09/26/96	Specific conductivity	82	µmhos/cm			NA [e]	NE
	12/31/96	Specific conductivity	no sample [d]					

a. Bechtel National, Inc. (BNI) and laboratory data qualifier flags:
U = The analyte was not detected. The detection limit is reported.
J = Reported as an estimated value. Data quality evaluation indicates that the analytical result is an estimate of the actual value.
NJ = Tentatively identified compound (TIC); reported as an estimated value.
UJ = Analyte was undetected; estimated value reported.

b. National Pollutant Discharge Elimination System Permit requirements. NE = Not established.

c. 1.0 mL/L/h is the monthly average limit; the daily maximum limit is 1.5 mL/L/h.

d. No sample collected because of constraints imposed by meteorological or field conditions.

e. pH and specific conductivity are field measurements; detection limits are not applicable.

Table 11
1996 Stormwater Analytical Results - Radioactive Constituents
Hazelwood Interim Storage Site

Sampling Location	Date Collected	Analyte	Result [a] (pCi/L)	BNI Flag [b]	MDA [c] (pCi/L)	DCG [d] (pCi/L)
STW001	03/05/96	Gross alpha	16.23 ± 2.26	J	1.29	NE
	06/10/96	Gross alpha	11.91 ± 3.47		2.72	NE
	09/26/96	Gross alpha	5.14 ± 2.26		1.92	NE
	12/31/96	Gross alpha	no sample [e]			
	03/05/96	Gross beta	13.23 ± 1.88		2.30	NE
	06/10/96	Gross beta	9.13 ± 2.42		2.92	NE
	09/26/96	Gross beta	7.40 ± 2.30		2.89	NE
	12/31/96	Gross beta	no sample [e]			
	03/05/96	Lead-210	1.70 ± 1.50	U	0.46	30
	06/10/96	Lead-210	3.00 ± 1.00		0.35	30
	09/24/96	Lead-210	1.80 ± 1.40		0.29	30
	12/31/96	Lead-210	no sample [e]			
	03/05/96	Radium-226	4.15 ± 1.51		0.62	100
	06/10/96	Radium-226	0.21 ± 0.16		0.18	100
	09/26/96	Radium-226	0.47 ± 0.33		0.38	100
	12/31/96	Radium-226	no sample [e]			
	03/05/96	Radium-228	-2.25 ± 1.54	UJ	4.88	100
	06/10/96	Radium-228	0.66 ± 0.51		0.56	100
	09/26/96	Radium-228	0.27 ± 0.25	UJ	0.40	100
	12/31/96	Radium-228	no sample [e]			
	03/05/96	Thorium-230	4.26 ± 1.33	J	0.36	300
	06/10/96	Thorium-230	8.25 ± 2.29		0.50	300
	09/26/96	Thorium-230	2.90 ± 0.93		0.25	300
	12/31/96	Thorium-230	no sample [e]			
	03/05/96	Thorium-232	0.13 ± 0.19	UJ	0.36	50
	06/10/96	Thorium-232	0.09 ± 0.19	UJ	0.56	50
	09/26/96	Thorium-232	0.25 ± 0.00	UJ	0.25	50
	12/31/96	Thorium-232	no sample [e]			
	03/05/96	Total uranium	11.16 ± 0.70		0.03	600
	06/10/96	Total uranium	8.92 ± 0.56		0.03	600
	09/26/96	Total uranium	1.77 ± 0.03		0.03	600
	12/31/96	Total uranium	no sample [e]			

Table 11
1996 Stormwater Analytical Results - Radioactive Constituents
Hazelwood Interim Storage Site

Sampling Location	Date Collected	Analyte	Result [a] (pCi/L)	BNI Flag [b]	MDA [c] (pCi/L)	DCG [d] (pCi/L)
STW002	03/31/96	Gross alpha	no sample [e]			
	06/10/96	Gross alpha	25.39 ± 4.79		2.63	NE
	09/26/96	Gross alpha	16.64 ± 3.57		1.62	NE
	12/31/96	Gross alpha	no sample [e]			
	03/31/96	Gross beta	no sample [e]			
	06/10/96	Gross beta	13.14 ± 2.69		2.90	NE
	09/26/96	Gross beta	10.48 ± 2.49		2.80	NE
	12/31/96	Gross beta	no sample [e]			
	03/31/96	Lead-210	no sample [e]			
	06/10/96	Lead-210	3.20 ± 1.10		0.33	30
	09/24/96	Lead-210	3.20 ± 1.30		0.29	30
	12/31/96	Lead-210	no sample [e]			
	03/31/96	Radium-226	no sample [e]			
	06/10/96	Radium-226	0.76 ± 0.41		0.25	100
	09/26/96	Radium-226	0.80 ± 0.39		0.35	100
	12/31/96	Radium-226	no sample [e]			
	03/31/96	Radium-228	no sample [e]			
	06/10/96	Radium-228	0.18 ± 0.26	UJ	0.71	100
	09/26/96	Radium-228	0.29 ± 0.22	UJ	0.33	100
	12/31/96	Radium-228	no sample [e]			
	03/31/96	Thorium-230	no sample [e]			
	06/10/96	Thorium-230	16.76 ± 3.87		0.42	300
	09/26/96	Thorium-230	13.44 ± 2.69		0.27	300
	12/31/96	Thorium-230	no sample [e]			
	03/31/96	Thorium-232	no sample [e]			
	06/10/96	Thorium-232	0.18 ± 0.26	UJ	0.49	50
	09/26/96	Thorium-232	0.08 ± 0.12	UJ	0.25	50
	12/31/96	Thorium-232	no sample [e]			
	03/31/96	Total uranium	no sample [e]			
	06/10/96	Total uranium	15.24 ± 0.97		0.03	600
	09/26/96	Total uranium	1.27 ± 0.03		0.03	600
	12/31/96	Total uranium	no sample [e]			

a. Results reported with (±) radiological error quoted at 2-sigma (95 percent confidence level).
b. Bechtel National, Inc. (BNI) data qualifier flags:
   U = The analyte was not detected.
   J = Reported as an estimated value.
   UJ = Analyte was not detected; estimated value reported. The result is below the MDA or less than the associated error term.
c. Minimum detectable activity.
d. DOE derived concentration guide for water. NE = Not established.
e. No sample collected because of constraints imposed by meteorological or field conditions.

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