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WHC-SD-EN-TI-198

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5. Key Words

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7. Abstract

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ABSTRACT

Forty-four sediment samples were collected from 28 locations in the Hanford Reach of the Columbia River to assess the presence of metals and man-made radionuclides in the near shore and shoreline settings of the Hanford Site. Three locations were sampled upriver of the Hanford Site plutonium-production reactors. Twenty-two locations were sampled near the reactors. Three locations were sampled downstream of the reactors near the Hanford Townsite. Sediment was collected from depths of 0 to 6 in. and between 12 to 24 in. below the surface.

Samples containing concentrations of metals exceeding the 95% upper threshold limit values (DOE-RL 1993b) are considered contaminated. Contamination by arsenic, chromium, copper, lead, and zinc was found. Zinc and lead were the most frequent contaminants; 91% and 68% of the samples exceed the zinc and lead 95% upper threshold limit values. Arsenic, lead, and zinc contamination may not be attributable to Hanford activities; elevated concentrations occur in the upriver samples. Zinc and lead contamination was found in 75% of the upriver samples. Arsenic contamination was found in one upriver sample and in one sample from the 100 K Area. Chromium contamination was found in 25% of the samples. Copper contamination was found in 23% of the samples.

Man-made radionuclides occur in all samples except four collected opposite the Hanford Townsite. Man-made radionuclide concentrations were generally less than 1 pCi/g. Cesium-137 and europium-152 were the most frequently detected radionuclides and had the highest concentrations. Maximum concentrations of cesium-137 and europium-152 were 4.6 and 1.8 pCi/g, from a 100 H Area sample. Radionuclide varieties and abundances and concentrations were greatest in the area from 100 D to the 100 F Slough. Fewer radionuclide varieties and generally lower concentrations were found upriver, and at 100 B/C, 100 K, and Hanford Townsite localities.

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ACRONYMS

ASTM	American Society of Testing and Materials
CLP	Contract Laboratory Program
Ecology	Washington State Department of Ecology
EII	Environmental Investigations Instruction
EPA	U.S. Environmental Protection Agency
GPS	global positioning system
HEIS	Hanford Environmental Information System
IT	International Technology Corporation
MTCA	Model Toxics Control Act
NAD	North American Datum
QC	quality control
TAL	target analyte list
USGS	U.S. Geological Survey
UTL	upper threshold limit
WAC	Washington Administrative Code
WHC	Westinghouse Hanford Company

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1.0 INTRODUCTION

1.1 PURPOSE AND SCOPE

During and as the result of past operations of plutonium production reactors at the Hanford Site in the 100 Areas (Figure 1-1), hazardous and radioactively contaminated effluent discharged to the Columbia River. The effluents consisted primarily of reactor coolant water containing radionuclides, chemical constituents added to control corrosion, and wastes from the process sewers. The effluents were discharged to the mid-channel of the river bottom and at the shoreline. The discharges of cooling water effluent ceased when the production reactors were shut down. However, springs and seeps exist along the 100 Area shoreline that may be contributing contaminants to the nearshore sediments.

The purpose of this investigation was to determine if radiological and chemical contaminants are present in Columbia River sediments. This study is among the activities identified in the *Columbia River Impact Evaluation Plan* (DOE-RL 1993a) and is intended as a first step in the establishment of an appropriate and comprehensive river sediment sampling program. The grain-size of sediments of interest to this study were ≤4 mm in diameter, e.g., sand-sized and smaller. The study was not intended to determine the extent of contamination.

1.2 PREVIOUS STUDIES

Sediment on the shoreline and river bottom along the Hanford Reach was sampled intermittently between 1957 and 1989 (DOE-RL 1993a). In 1989, radionuclide concentrations were measured in sediment samples from locations upstream of the Hanford Reservation (behind Priest Rapids Dam), along the Hanford Reach (White Bluffs Slough, 100 F Slough, and Hanford Slough), and downstream of the Hanford Reservation (behind the McNary Dam) (Jaquish and Bryce 1990). Jaquish and Bryce (1990) collected four samples from behind the Priest Rapids Dam. An upper tolerance limit (Hines and Montgomery 1980) for the 1989 Priest Rapids Dam samples is presented in the Columbia River Impact Evaluation Plan (DOE-RL 1993a) to facilitate comparisons to Hanford Reach and McNary Dam samples. Only concentrations of cobalt-60 (in all samples) and ruthenium-106 (two of three samples) from the Hanford Reach were greater than the upper tolerance limit. The cobalt-60 concentrations ranged from 0.035 to 0.055 pCi/g for Hanford Reach samples. The cobalt-60 upper tolerance limit was 0.003 pCi/g. The ruthenium-106 concentrations ranged from -0.083 (non-detected) to 0.210 pCi/g for Hanford Reach samples. The ruthenium-106 upper tolerance limit was 0.122 pCi/g. All other radionuclide concentrations from the Hanford Reach samples were less than the upper tolerance limits. The average concentrations of cobalt-60, strontium-90, europium-154, europium-155, and plutonium-239/240 from McNary Dam samples (Jaquish and Bryce 1990) were greater than the upper tolerance limits for Priest Rapids Dam samples (DOE-RL 1993a).

The most recent sampling and analyses of sediment from the Hanford Reach for chemical and radiological constituents occurred in 1991 (DOE-RL 1992a). In the fall of 1991 employees of Westinghouse Hanford Company (WHC) and IT Corporation (IT), a WHC-subcontractor, collected samples of ground water and sediment at seeps and springs that discharge along the 100 Area shoreline from the 100 B/C Area to the Hanford Townsite of the Hanford Reach (DOE-RL 1992a). The samples were analyzed for radionuclides and U.S. Environmental Protection Agency (EPA) Contract Laboratory Program (CLP) target analyte list (TAL) metals. The samples were not analyzed for lead or mercury, and specific isotopes of uranium were not identified. The concentrations of radionuclide and chemical constituents found in samples collected in 1991 (DOE-RL 1992a) at sites that were also sampled in 1992 are included in summary tables in Chapter 4.

As part of the reporting of the 1991 sampling results, seep/spring locations were assigned site identification numbers based on the Hanford River miles to provide a consistent method of site identification (DOE-RL 1992a). Hanford River miles are measured downstream beginning at the Vernita Bridge, and are marked by milepost signs situated on the 100 Area shoreline of the Hanford Reach. Although most of these mileposts are visible from the river, some have toppled and some are absent. During the 1992 sediment sampling, location coordinates for most of the Hanford River mileposts and for many of the seeps/springs sampled in 1991 were collected using a global positioning system (GPS) receiver.

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2.0 HYDROLOGIC SETTING

The Columbia River is the largest river in the Pacific Northwest and the fifth largest river (by volume) in North America. It originates in the mountains of eastern British Columbia, Canada and flows through the northern edge of the Hanford Site. It forms the outer boundary of the 100 Area operable units and the 600 Area of the Hanford Site between the 100 F Area and the 300 Area.

Flow of the Columbia River is regulated by 11 dams within the United States: 7 upstream and 4 downstream of the Hanford Site. The Priest Rapids Dam is the nearest dam to the Hanford Site, about 5.5 mi upstream of the site boundary and 9 mi upriver of the Vernita Bridge. The McNary Dam is the first dam downstream of the Hanford Site. It is about 70 mi downstream of the Hanford Townsite.

The Hanford Reach of the Columbia River extends from the Priest Rapids Dam to the head of Lake Wallula, which is created by McNary Dam. The head of Lake Wallula is about 22 mi downstream of the Hanford Townsite. The wetted width of the river through the Hanford Reach ranges from about 305 to 792 m (1,000 to 2,600 ft). There are many bends and several islands in the river along this reach. River elevation may fluctuate daily up to 1.5 m (5 ft) as a result of hourly variations in water releases from Priest Rapids Dam (ERDA 1975).

Although the Hanford Reach is free flowing, the flow rate is regulated. Flows through the Hanford Reach vary considerably, because of the relatively small storage capacities and the operational practices of the nearby upstream impoundments. Flow through the Hanford Reach of the river is relatively swift. Surface velocities vary from <0.85 m/s (3 ft/s) to >3.1 m/s (11 ft/s), depending on the flow rate (ERDA 1975). There are river gauges at both Priest Rapids and at the 100 N Area. Typical daily flows during summer, fall, and winter range from 1,000 to 7,100 m^3/s (37,000 to 250,000 ft^3/s). Flows up to 12,700 m^3/s (450,000 ft^3/s) are frequently recorded during periods of peak spring runoff. Average monthly flow rates generally peak from April through June, and the lowest monthly mean flows are observed during September and October. Recent annual average flows at Priest Rapids Dam range from 2,800 to 3,400 m^3/s (100,000 to 120,000 ft^3/s). The long-term average annual flow at Priest Rapids Dam, based on 68 years of record, is approximately 3,400 m^3/s (120,000 ft^3/s) (McGavock et al. 1987).

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3.0 INVESTIGATION METHODS

3.1 SELECTION OF SAMPLING SITES

Areas of interest for sampling were identified in the *Description of Work for 100 Area Columbia River Sediment Sampling* (Gustafson 1992). Sampling of fine-grained sediment, i.e., <4 mm in diameter, was desired from locations downstream of outfall structures, from backwater sloughs, on downstream side of islands, and from areas of springs/seeps discharge that were sampled in 1991. Areas with the greatest anthropogenic radionuclide concentrations identified by *An Aerial Radiological Survey of the Hanford Site and Surrounding Area* (Reiman and Dahlstrom 1990) were selected from the four categories of sampling areas as potential sampling locations.

The potential sampling locations were evaluated in consultation with representatives of the EPA, the Washington State Department of Ecology (Ecology), WHC and IT. The evaluation included field reconnaissance. During the reconnaissance some of the potential sampling locations were found to lack fine-grained sediment. It was agreed that such locations would not be sampled.

Figure 3-1 shows the 28 locations sampled along the Hanford Reach in the fall of 1992. Samples were collected in the following locations:

- three locations upstream of the Vernita Bridge
- two locations in the 100 B/C Area
- four locations in the 100 K Area
- four locations in the 100 D Area, three of which were on D Island
- three locations between 100 D and 100 H Areas
- four locations in the 100 H Area
- five locations in the 100 F Area
- two locations in the Hanford Townsite area
- one location on the shore opposite of the Hanford Townsite.

The inset boxes in Figure 3-1 refer to more detailed figures in Chapter 4 that show sampling locations for each sampling area. The sampling locations were field screened in accordance with Environmental Investigations Instruction (EII) 3.4 (WHC 1988) using a Ludlum 14C scintillation counter with beta/gamma ($\beta\gamma$) and gross gamma (γ) probes to select sites with the highest activity for sampling. Background levels of activity were established at the White Bluffs boat ramp daily before sampling. Access to the sampling locations was provided by boat or by four-wheel-drive vehicle.

The positions of sampling sites were plotted during sampling on U.S. Geologic Survey (USGS) 1:24000 scale (7.5 minute) topographic maps or on DOE 1:2000 scale topographic maps of the 100 Area operable units. Coordinates of sample locations were obtained using a single GPS receiver. Single position GPS fixes and an average position from 32 GPS fixes were obtained for each sampling location. The single position and average position coordinates were converted from longitude/latitude to North American

Datum (NAD) 1983 metric state plane coordinates using CORPSCON Version 2.1 software obtained from the National Oceanic and Atmospheric Administration, National Coast and Geodetic Survey. The average position coordinates are reported.

3.2 SAMPLE COLLECTION

Forty-four samples were collected in accordance with the *Hanford Reach Sediment Sampling Performance Procedure* (Appendix A) and EII 5.2 (WHC 1988). Sample material consisted predominantly of sand-sized and finer grained material, coarser grained sediments were not selected for sampling or were removed from the sample to the extent practicable.

All samples were collected from the shore. Samples were collected from the 0 to 6-in. interval below land surface (bls) and from the 12 to 24-in. interval bls if possible. The 6 to 12-in. interval was discarded, as directed by the DOW (Gustafson 1992). In many locations coarser grained sediment such as gravel and cobbles, was found beneath the 0 to 6-in. interval. In some cases this coarse-grained sediment prevented the collection of fine grained sediment from the 12 to 24-in. sample interval, or required the removal of the coarse grained clasts to allow collection of finer grained sediment from the clast interstices.

3.3 SAMPLE HANDLING

Each sample was assigned a unique Hanford Environmental Information System (HEIS) sample identification alphanumeric code number in accordance with the *Hanford Environmental Information System (HEIS) Operators Manual* (WHC 1991). After sample container filling, closure, labeling, application of chain-of-custody tape, and bagging, the containers were placed in a cooler with ice. Sample custody was maintained in accordance with EII 5.1 (WHC 1988).

A total activity sample was submitted to the 105 N Health Physics Laboratory for a total activity analysis. The associated sediment sample was held onsite until the total activity results were available and indicated that radioactivity present in the sediment sample did not exceed radiation release standards for shipment to the offsite laboratories. None of the samples exceeded the radiation release standards.

3.4 SAMPLE ANALYSES

The analytes were selected based upon contaminants identified in the Hanford Reach spring sampling effort conducted in the fall of 1991 (DOE-RL 1992a).

3.4.1 Chemical Analyses

Samples were analyzed using EPA CLP methods for TAL metals, (aluminum, antimony, arsenic, barium, beryllium, cadmium, calcium, chromium, cobalt, copper, iron, magnesium, manganese, nickel, potassium, selenium, silver, sodium, thorium, vanadium, zinc) and for mercury and lead. Tables from the *Final Data Validation Summary Report, Columbia River Sediment Data* (WHC 1993) present all the analytical chemical data in Appendix B.

3.4.2 Radionuclide Analyses

Radionuclides were identified and concentrations quantified using alpha spectroscopy, beta counting, and gamma-ray spectroscopy. The gross alpha and gross beta activities were also determined. A total activity analysis was also performed by the 105 N Health Physics Laboratory as described above in Section 3.3. Tables from the *Final Data Validation Summary Report, Columbia River Sediment Data* (WHC 1993) present all the radionuclide analytical data in Appendix C.

3.4.3 Grain Size Analysis

The grain size of the sediment samples was determined using sieve analyses and hydrometer analyses. These analyses were performed onsite by the WHC Geotechnical Engineering Laboratory. The grain size analysis plots are included as Appendix D.

3.5 QUALITY ASSURANCE/QUALITY CONTROL

Quality control (QC) samples were collected as specified in the Quality Assurance Project Plan (DOE-RL 1992b), and documented in the field logbook per EII 1.5 (WHC 1988). Quality control samples consisted of four duplicate samples, two split samples, and two equipment blank samples. Duplicate and split samples were collected in accordance with the sampling performance procedure (Appendix A) and EII 5.2 (WHC 1988). The equipment blank media was silica sand.

3.6 DATA VALIDATION

Analytical data from chemical and radionuclide analyses were validated in accordance with *Data Validation Procedures for Chemical Analyses* (Bechtold 1992a) and *Data Validation Procedures for Radionuclide Analyses* (Bechtold 1992b). Results of the validation are presented in the *Final Data Validation Summary Report, Columbia River Sediment Data* (WHC 1993).

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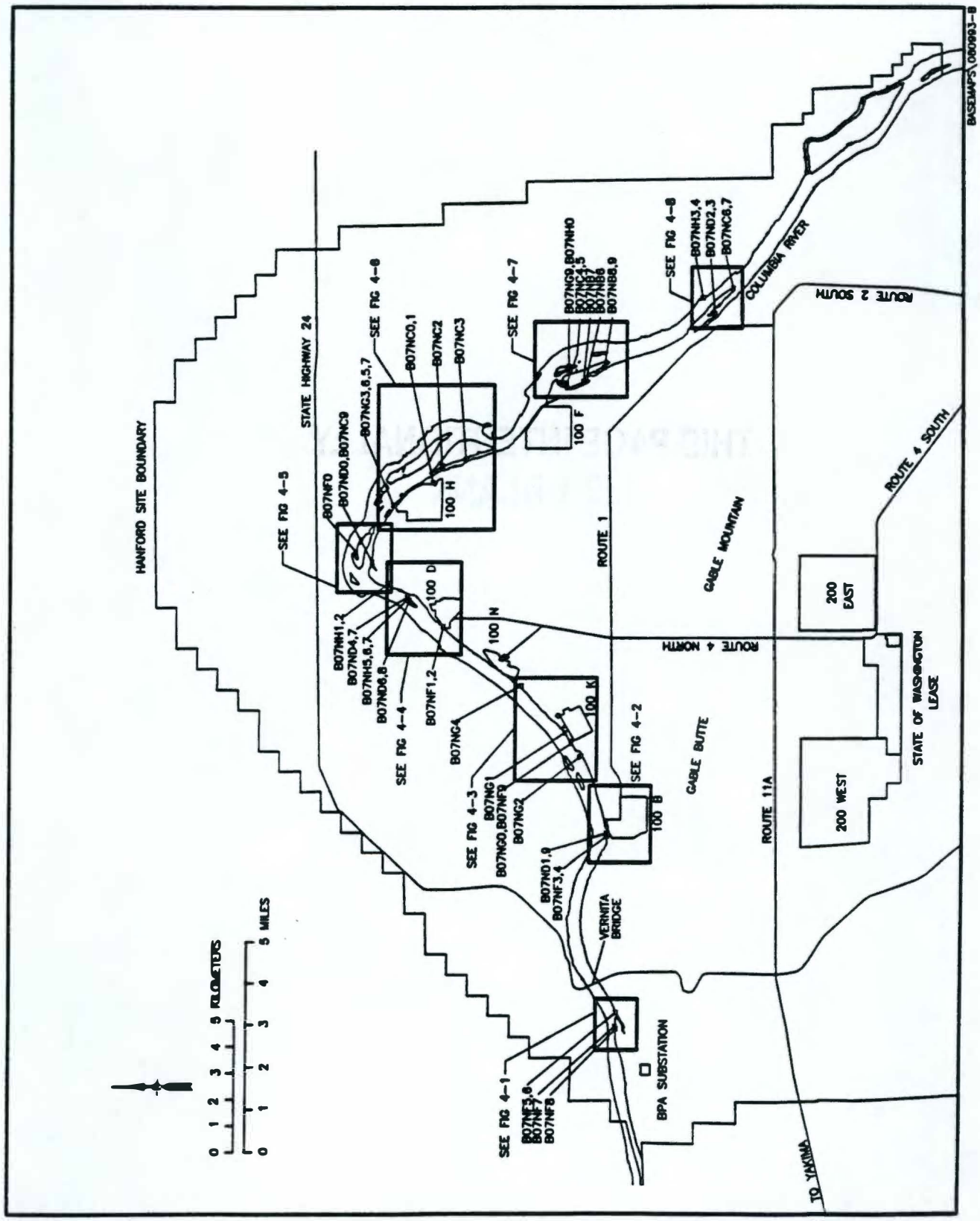
Figure 3-1. Locations of Sediment Samples Collected on the Hanford Reach of the Columbia River, Fall 1992



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4.0 SAMPLING RESULTS

Results of analysis of selected metallic and radionuclide constituents in sediment samples from the Hanford Reach are presented in the following sections.

The inorganic analytical data from the sediment samples are compared to the Sitewide soil background data to determine if sediment concentrations represent contamination. The characterization of the natural chemical composition of Hanford Site soil samples is presented in *Hanford Site Background: Part 1, Soil Background for Nonradioactive Analyses* (DOE-RL 1993b). Soil includes sediment and consists of geologic materials other than bedrock that are less than 2 mm in diameter (DOE-RL 1993b). This characterization is based on the chemical analysis of inorganic constituents from 170 samples. The characterization included an analysis of physical properties and factors that might affect the natural soil chemical composition, as determined by regulatory protocols. Hanford Site background soil concentrations are used to evaluate Columbia River sediment because of the following:

- Soil materials in the vadose zone of the Hanford Site have fundamental physical and chemical similarities that are a result of soil constituent source areas on the periphery of the Columbia Plateau and deposition of the constituents by catastrophic floods, aeolian or fluvial processes (DOE-RL 1993b).

- Chemical composition data from Hanford Site vadose zone background soil samples can be represented as a single Sitewide statistical population for all naturally occurring inorganic analytes (DOE-RL 1993b).

- Only a small number of the analyzed Hanford Site vadose zone background soil samples have one or more analytes concentrations that are significantly larger than the majority of soil background samples (DOE-RL 1993B).

An inorganic constituent is considered a potential contaminant if the reported concentration exceeds the 95% upper threshold limit (UTL) from the Hanford Site background data (DOE-RL 1993b). The 95% UTL is an abbreviation of the 95% confidence limit of the 95th percentile of the data distribution. The 95% UTL, is identified by the Washington Administrative Code (WAC), Model Toxics Control Act (MTCA) (WAC 173-340-708 [lld]) as one way to define contamination threshold levels. Table 4-1 presents the 95% UTL values using a Weibull distribution (DOE-RL 1993b). Table 4-1 also presents the concentrations of metallic constituents found in topsoil from riparian grass and juniper ecosystems at two background sampling sites located between the Vernita Bridge and the 100 B/C Area (DOE-RL 1993b). The riparian samples are notable because concentrations of lead and zinc in the topsoil from grass and juniper ecosystem samples are about five times larger than the 95% UTL values (DOE-RL 1993b). The concentration of arsenic in juniper ecosystem topsoil is three times larger than the 95% UTL value.

Data from the 1991 sediment samples (DOE-RL 1992a) are included in Tables 4-3 and 4-4 for comparison to the 1992 data obtained from samples collected at the same locations.

Because site-wide background levels for radionuclides have not been established (DOE-RL 1993b) all detected concentrations of anthropogenic radionuclides are considered potential contaminants. The detected radionuclides concentrations are compared to those found in samples from the Vernita area. This comparison of radionuclide data is not intended or implied to be a screening process. The radionuclides potassium-40, radium-226, thorium-228, and thorium-232 are naturally occurring and not considered contaminants, but are included in the summary tables.

All grain size percentage values cited in the following sections are weight percents. The grain-size classes utilized follow American Society of Testing and Materials (ASTM) Standards D422-63 and D643-78 (ASTM 1993). The plots of the grain-size analyses are in Appendix D.

4.1 VERNITA AREA

Five samples were collected at three locations shown in Figure 4-1. The samples were collected on the shore. During sampling the Columbia River shoreline was at a lower elevation than is shown by Figure 4-1. These samples were collected to investigate the chemical and radiological characteristics of sediments upriver of the 100 Areas of the Hanford Site. Field screening instruments indicated background-levels of $\beta\gamma$ and γ activity at the Vernita area sampling locations.

Samples B07NF5 and B07NF6 were collected at location VBU1 from the 0 to 6-in. and 12 to 22-in. intervals bls. Location VBU1 is about 0.9 mi upstream of the bridge. Sample B07NF7 was collected at location VBU2 from the 0 to 6-in. interval bls. Sample B07NF8 was collected at location VBU3 from the 0 to 3-in. interval bls. Locations VBU2 and VBU3 are about 1.2 mi upstream of the bridge. The presence of cobbles at locations VBU2 and VBU3 prevented collection of fine grained sediment from more than 3 to 6-in. bls. The sample location coordinates, distance from Vernita Bridge (in miles), sample dates, intervals sampled, median grain size, inorganic constituents with concentrations greater than the 95% UTL, and all detected radionuclides are presented in Table 4-2.

4.1.1 Inorganic Constituents

Concentrations of arsenic, lead, and zinc were greater than the 95% UTL values in sample B07NF5 from the 0 to 6-in. interval bls at location VBU1. The amounts of lead and zinc present in samples B07NF7 and B07NF8 from locations VBU2 and VBU3 were also greater than the 95% UTL values. The concentrations of lead and zinc are less than values reported for Hanford soils from either riparian ecosystem samples and the arsenic concentration is less than was found in the riparian juniper ecosystem sample (Table 4-1) (DOE-RL 1993b).

4.1.2 Radionuclide Constituents

The maximum concentrations of radionuclides detected were small; 16 pCi/g of potassium-40, 0.14 pCi/g of cesium-137, 1.2 pCi/g of radium-226, 1 pCi/g of uranium-233/234 and uranium-238, and 2.5 pCi/g of thorium-228 and thorium-232. The only man-made radionuclide found was cesium-137.

4.1.3 Grain-Size Analysis

All of the samples from the Vernita area consist predominantly of medium- and fine-grained sand. Medium-grained sand, consisting of particles 2.0 to 0.425 mm in diameter, constitute 56% to 64% of the samples. Fine-grained sand, consisting of particles 0.425 to 0.075 mm in diameter, constitute 36% to 43% of the samples. The samples contain <10% silt and clay, i.e., particles smaller than 0.075 mm and 0.005 mm, respectively.

4.2 100 B/C AREA

Four samples were collected at two locations in the 100 B/C Area as shown in Figure 4-2. The samples were collected on the shore. During sampling the Columbia River shoreline was at a lower elevation than is shown by Figure 4-2. Sediments from these locations were also sampled in the 1991 investigation of Hanford Reach seeps (DOE-RL 1992b). Samples B07NF3 and B07NF4 were collected at location BC2, which corresponds to the 1991 seep 037-1. Sample B07ND1 and QC sample B07ND9 were collected at location BC1, which corresponds to the 1991 seep 038-2. Field screening instruments indicated background-levels of $\beta\gamma$ and γ activity at the 100 B/C sampling locations.

Samples B07NF3 and B07NF4 were collected from the 0 to 6-in. and 12 to 18-in. intervals bls. Sample B07ND9 and the QC split sample B07ND1 were collected from the 0 to 6-in. interval bls at location BC1. The presence of cobbles at location BC1 prevented collection of fine-grained sediment from depths >6 in. bls. The sample location coordinates, distance from Vernita Bridge (in miles), sample dates, intervals sampled, median grain size, inorganic constituents with concentrations greater than the 95% UTL, detected radionuclides, and the maximum radionuclide concentrations found in samples from the Vernita area are presented in Table 4-3.

4.2.1 Inorganic Constituents

Concentrations of chromium were greater than the 95% UTL values in all samples from the 100 B/C Area. The maximum, 131 mg/kg, occurs in sample B07NF4, collected from the 12 to 18-in. interval bls at location BC2. This concentration is twice the maximum found in the 0 to 6-in. interval bls. The concentrations of lead and zinc were also greater than the 95% UTL values in samples B07ND1 and B07ND9. The concentration of zinc in

sample B07ND1 also exceeded the 95% UTL. The concentrations of lead and zinc were within the range found in samples from the Vernita area, as shown in Table 4-2.

4.2.2 Radionuclide Constituents

The maximum concentrations of potassium-40, cesium-137, radium-226, uranium-233/234, uranium-238, thorium-228, and thorium-232 in samples from 100 B/C locations are similar to those from the Vernita area, as shown in Table 4-2. The only man-made radionuclide found was cesium-137.

4.2.3 Grain-Size Analysis

Samples B07ND9 and B07NF3 consist of 14% and 3% medium-grained sand, 85% and 92% fine-grained sand, and 1% and 5% silt and clay. Sample B07ND1 contains 19% gravel, i.e., particles 76.2 to 4.75 mm in diameter, 11% coarse-grained sand, 6% medium-grained sand, 61% fine-grained sand, and 3% silt and clay. Sample B07NF4 consists of 3% medium-grained sand, 45% fine-grained sand, 42% silt, and 10% clay.

4.3 100 K AREA

Five samples were collected at four locations in the 100 K Area, as shown by Figure 4-3. The samples were collected on the shore. During sampling the Columbia River shoreline was at a lower elevation than is shown by Figure 4-3. Sample B07NG2 was collected at location K3 near Coyote Rapids, 5.7 mi downstream of the Vernita Bridge. The riverbank consists predominantly of cobble and gravel. Samples B07NG0 and B07NF9 were collected at location KU1, a small sandy beach about 6.2 mi downriver of the bridge and just upriver of the 100-KW intake structure. Sample B07NG1 was collected at location K2, which is 6.4 mi downriver of the bridge and between the 100-KW and 100-KE intake structures. The shore between the intake structures is composed predominantly of boulders, cobbles, and gravel. Sample B07NG4 was collected at location N, a groundwater seep area upriver of the 100 N Area, and about 8.1 mi downriver of the bridge. The shore at location N consists principally of cobbles, however, the seep has deposited fine-grained sediment. This seep corresponds to the 1991 seep sampling location 082-2 (DOE-RL 1992a). Field screening instruments indicated background levels of $\beta\gamma$ and γ activity at all 100 K sampling locations.

Samples B07NG0 and B07NF9 were collected from the 0 to 6-in. and 12 to 18-in intervals bls. The presence of cobble-sized and larger clasts at locations K2, K3, and N prevented collection of fine-grained sediment from depths >6 in. (K2) or 3 in. (K3 and N) bls. The sample location coordinates, distance from Vernita Bridge (in miles), sample dates, intervals sampled, median grain size, inorganic constituents with concentrations greater than the 95% UTL, detected radionuclides, and the maximum radionuclide concentrations found in samples from the Vernita area are presented in Table 4-4.

4.3.1 Inorganic Constituents

The concentration of arsenic was greater than the 95% UTL value in sample B07NG4 from location N. Concentrations of chromium were greater than the 95% UTL value in samples B07NF9 and B07NG4 collected at locations KU1 and N; the maximum of 64.1 mg/kg occurs in sample B07NF9 collected from the 12 to 18-in. interval bls at location KU1. Concentrations of lead were greater than the 95% UTL values in all samples except B07NG2. Concentrations of zinc exceeded the 95% UTL in all samples. The maximum concentrations of chromium, lead, and zinc from the 100 K Area occur in sample B07NF9 collected from the 12 to 18-in. interval bls at location KU1.

4.3.2 Radionuclide Constituents

The maximum concentrations of potassium-40, radium-226, uranium-233/234, uranium-238, thorium-228, and thorium-232 in the 100 K samples are generally similar to those from the Vernita area, as shown in Table 4-4. The concentrations of cesium-137 and europium-152 in sample B07NF9 exceed those found in Vernita or 100 B/C samples. Europium-152 was not detected at the Vernita area or 100 B/C Area samples. The cesium-137 and europium-152 concentrations from 100 K Area samples are 0.45 and 0.32 pCi/g, respectively.

4.3.3 Grain-Size Analysis

Samples B07NG1, B07NG2, and B07NG4 consists predominantly of medium- and fine-grained sand. Medium-grained sand constitutes 45%, 27%, and 54% of the samples, and fine-grained sand 55%, 65%, and 46%, respectively. All three samples contain <10% (by weight) silt and clay.

Medium-grained sand constitutes 2% of samples B07NF9 and B07NG0, both of which are from location KU1. Fine-grained sand constitutes 55% and 83%, respectively, of samples B07NF9 and B07NG0. The remaining 43% and 15% consists of silt and clay. Sample B07NF9 contained 39% silt and 5% clay. The individual silt and clay percentages are not provided for sample B07NG0.

4.4 100 D AREA

Six samples and three QC samples were collected at four locations in the 100 D Area as shown in Figure 4-4. The sediments were collected on the shore. During sampling the Columbia River shoreline was at a lower elevation than is shown in Figure 4-4. Samples B07NF1 and B07NF2 were collected at location D5, a small sandy beach just upstream of the 100 D intake structure, 10.3 mi downstream of the Vernita Bridge. Samples B07ND4 and B07ND7 were collected at location DI1. Samples B07ND6 and B07ND8 were collected at location DI2. Samples B07NH5, B07NH6, and B07NH7 were collected at location DI3. Locations DI1, DI2, and DI3 are about 11.3 mi downstream of the Vernita Bridge. Field

screening instruments indicated background levels of $\beta\gamma$ and γ activity at all 100 D sampling locations.

Samples B07NF1 and B07NF2 were collected from the 0 to 6-in. and 12 to 18-in. intervals bls, respectively. On D Island six samples were collected from the 0 to 6-in. interval bls, only sample B07ND5 was collected from the 12 to 18-in. interval bls. The sample location coordinates, distance from Vernita Bridge (in miles), sample dates, intervals sampled, median grain size, inorganic constituents with concentrations greater than the 95% UTL, all detected radionuclides, and the maximum radionuclide concentrations found in samples from the Vernita area are presented in Table 4-5.

4.4.1 Inorganic Constituents

Concentrations of chromium, copper, lead, and zinc exceeded the 95% UTL values in 100 D Area samples, as shown in Table 4-5. Concentrations of chromium and copper exceeded the 95% UTL values only in samples B07NF2 (chromium) and B07ND5 (copper). Concentrations of lead exceeded the 95% UTL value in all samples except B07NF1. Concentrations of zinc exceeded the 95% UTL value in all samples. The concentrations of lead were similar to those found in samples from the Vernita area. The maximum concentration of zinc from 100 D samples was 14% greater than the maximum from the Vernita area.

4.4.2 Radionuclide Constituents

The maximum concentrations of potassium-40, radium-226, uranium-233/234, uranium-238, thorium-228, and thorium-232 in the 100 D samples are generally similar to those from the Vernita area, as shown in Table 4-5. Concentrations of cesium-137 ranged from 0.1 to 1.3 pCi/g. Concentrations of europium-152 ranged from non-detectable to 0.9 pCi/g. The maximum concentrations of cesium-137 and europium-152 occur in sample B07NF2 collected from the 12 to 18-in. interval bls at location D5.

Several radionuclides were detected in the 100 D Area that were not detected upstream at Vernita or at the 100 B/C or 100 K Areas: cobalt-60, europium-154, europium-155, radium-228, thorium-231, thorium-234, uranium-235, neptunium-237, and americium-241. Concentrations of cobalt-60 ranged from non-detected to 0.41 pCi/g. The detections of europium-154, europium-155, radium-228, thorium-231, thorium-234, uranium-235, neptunium-237, and americium-241 all occur in sample B07NH7, a QC split sample. Concentrations of europium-154 and europium-155 were 0.04 pCi/g. Concentrations of thorium-231 and thorium-234 were 0.29 and 0.69 pCi/g, respectively. The neptunium-237 concentration was 0.48 pCi/g. The americium-241 concentration was 0.24 pCi/g.

4.4.3 Grain-Size Analysis

Samples B07ND4, B07ND5, B07ND6, B07ND7, B07ND8, BN07NF1, B07NH5, B07NH6, and B07NH8 consist predominantly of medium- and fine-grained sand. The percentage of medium-grained sand in the nine samples ranges from 11% to 38%. The percentage of fine-grained sand ranges from 63% to 90%. Eight of the nine samples contain <2% silt and clay; sample B07ND6 contained 3% silt and 1% clay.

Medium- and fine-grained sand constitute 77% of sample B07NF2. The remaining 23% is silt and clay. This sample is from the 12 to 20-in. interval bls at location D5; a beach just upriver of the 100 D intake structure.

4.5 HORN AREA

Five samples were collected at two locations between the 100 D and 100 H Areas near the horn of the Columbia River and from the island located in the horn as shown in Figure 4-5. The sediments were collected on land. During sampling the Columbia River shoreline was at a lower elevation than is shown in Figure 4-5. Samples B07NH1 and B07NH2 were collected at location DA1, about 11.9 mi downriver of the Vernita Bridge. This location may have been flooded by the river at times when the production reactors were operating and was near an area with elevated concentrations of man-made radionuclides in 1988 (Reiman and Dahlstrom 1990). Field screening instruments indicated background levels of $\beta\gamma$ and γ activity at all horn area locations. Samples B07ND0 and B07NC9 were collected at location D/H, about 12.8 mi downriver of the bridge. Sample B07NF0 was collected on the island located about 13 mi downriver of the bridge.

Samples B07NH1 and B07NH2 were collected from the 0 to 6-in. and 12 to 20-in. intervals bls. Samples B07ND0 and B07NC9 were collected from the 0 to 6-in. and 12 to 18-in. intervals bls. Sample B07NF0 was collected from the 0 to 6-in. interval bls; cobbles were encountered and prevented collection of the deeper interval. The sample location coordinates, distance from Vernita Bridge (in miles), sample dates, intervals sampled, median grain size, inorganic constituents with concentrations greater than the 95% UTL, detected radionuclides, and the maximum radionuclide concentrations found in samples from the Vernita area are presented in Table 4-6.

4.5.1 Inorganic Constituents

Concentrations of chromium, copper, lead, and zinc exceeded the 95% UTL values in samples from the horn, as shown in Table 4-6. Chromium and copper exceeded the 95% UTL values in samples B07NH2. Concentrations of lead exceeded the 95% UTL value in samples from the 0 to 6-in. intervals bls, but not in samples from the deeper intervals. Concentrations of zinc exceeded the 95% UTL value in all samples. The concentrations of lead were similar to those found in samples from the Vernita area. The maximum concentration of zinc (377 mg/kg) from the Horn area samples was 67% greater than the maximum from the Vernita area (226 mg/kg).

4.5.2 Radionuclide Constituents

The maximum concentrations of potassium-40, radium-226, thorium-228, and thorium-232 in samples from the horn of the Columbia are generally similar to those from the Vernita area, as shown in Table 4-6. The maximum concentrations of man-made radionuclides cobalt-60, cesium-137, europium-152, and europium-155 are small; all are <1 pCi/g.

Concentrations of cobalt-60 range from non-detected to 0.33 pCi/g. Concentrations of cesium-137 ranged from non-detected to 0.56 pCi/g. Concentrations of europium-152 ranged from non-detected to 0.94 pCi/g. Concentrations of europium-155 range from non-detected to 0.79 pCi/g. The maximum concentrations of europium-152 and europium-155 occur in sample B07NH1. This location also has the largest uranium concentrations in the 12 to 20-in. interval. Concentrations of cobalt-60 and cesium-137 were largest in sample B07NF0, collected on the island.

4.5.3 Grain-Size Analysis

Medium- and fine-grained sand constitutes 42% and 51% of sample B07NF0, respectively. The remaining 7% of sample B07NF0 consists of silt and clay. This sample was collected on the island in the Horn of the Columbia River from the 0 to 6-in. interval bls.

Sample B07NC9 contains 12% gravel, 6% coarse-grained sand, and 72% medium- and fine-grained sand. Sample B07ND0 consist of 2% medium-grained sand, 88% fine-grained sand, 7% silt, and 3% clay. These samples were collected at location DA1 from the 0 to 6-in. and 12 to 20-in. intervals bls.

Sample B07NH1 consists of 3% medium-grained sand, 72% fine-grained sand, and 25% silt and clay. Sample B07NH2 consists of 34% medium-grained sand, 53% fine-grained sand, and 13% silt and clay. These samples were collected at location D/H from the 0 to 6-in. and 12 to 18-in. intervals bls.

4.6 100 H AREA

Six samples and two QC samples, a duplicate and split sample, were collected at four locations in the 100 H Area, as shown by Figure 4-6. The samples were collected on land. During sampling the Columbia River shoreline was at a lower elevation than is shown in Figure 4-5. Samples B07NG3, B07NG5, B07NG6, and B07NG7 were collected at location HU1, a sandy beach near the former site of the 100 H river water intake structure and near the upstream boundary of the 100 H Area. Location HU1 is about 14.5 mi downstream of the Vernita Bridge and just downstream of seep 145-2, which was sampled in 1991. Samples B07NC0 and B07NC1 were collected at location H1. Samples B07NC2 and B07NC3 were collected at locations H2 and H3, respectively. Locations H1, H2, and H3 were dry and grass-covered when sampled, although they may have been flooded by the river at times

when the production reactors were operating. Locations H1, H2, and H3 were within an area with elevated concentrations of man-made radionuclides in 1988 (Reiman and Dahlstrom 1990). Field screening instruments indicated background levels of $\beta\gamma$ and γ activity during sampling at all 100 H Area locations. Locations H1 and H2 are about 15.6 and 16.0 mi downriver from the Vernita Bridge. Location H3 is about 16.8 mi downriver of the bridge.

Samples B07NG3 and B07NG5 were collected from the 0 to 6-in. and 12 to 18-in. intervals bls at location HU1. A duplicate QC sample, B07NG6, was collected from the 0 to 6-in. interval bls and a split QC sample, B07NG7, was collected from the 12 to 18-in. interval bls at location HU1. Samples B07NC0 and B07NC1 were collected from the 0 to 6-in. and 12 to 18-in. intervals bls at location H1. Samples B07NC2 and B07NC3 were collected from the 0 to 6-in. intervals at locations H2 and H3, respectively. Cobbles and gravel at locations H2 and H3 prevented the collection of material from intervals deeper than 6 in. bls. The sample location coordinates, distance from Vernita Bridge (in miles), sample dates, intervals sampled, median grain size, inorganic constituents with concentrations greater than the 95% UTL, detected radionuclides, and the maximum radionuclide concentrations found in samples from the Vernita area are presented in Table 4-7.

4.6.1 Inorganic Constituents

Concentrations of chromium, copper, lead, and zinc exceed the 95% UTL values in samples from 100 H. The concentrations of chromium exceeded the 95% UTL values in samples B07NC1 and B07NC3 from locations H1 and H3. The concentrations of copper exceeded the 95% UTL value in samples B07NC0 and B07NC1 from location H1 and in sample B07NC2 from location H2. The concentrations of lead and zinc in all the samples are greater than the 95% UTL values. The maximum lead concentrations from 100 H locations were less than the maximum from the Vernita area. The maximum zinc concentration from the 100 H Area (i.e., 397 mg/kg from sample B07NG3) is 76% greater than the maximum found in the Vernita area.

4.6.2 Radionuclide Constituents

The maximum concentrations of potassium-40, radium-226, thorium-228, and thorium-232 in the 100 H samples are generally similar to those from the Vernita area, as shown in Table 4-7. The maximum concentrations of cobalt-60, and europium-154 are small; i.e., <0.4 pCi/g. The concentrations of cesium-137 range from 0.33 to 4.6 pCi/g. The europium-152 concentrations range from non-detected to 1.8 pCi/g. The europium-154 concentrations range from non-detected to 0.24 pCi/g. Sample B07NC0, collected from the 0 to 6-in. interval at location H1, has the maximum concentrations of cesium-137, europium-152, and europium-154 of all the samples analyzed from the 1992 Hanford Reach sampling.

The radionuclides thorium-231, thorium-234, plutonium-239/240, and neptunium-237 were detected in QC split sample B07NG7 but were not found in other 100 H samples. The

plutonium-239/240 concentration is 0.07 pCi/g. Concentrations of thorium-231, thorium-234, and neptunium-237 were all <1 pCi/g.

4.6.3 Grain-Size Analysis

Fine-grained sand, constitutes at least 90% of samples B07NG3, B07NG6, B07NG5, and 82% of sample B07NH7. These samples are from the beach at location HU1. Medium-grained sand constitutes 0% to 2% of these samples. The remaining 4% to 18% of these samples consists of silt and clay.

Sample B07NC0 consists of 2% medium-grained sand, 58% fine-grained sand, and 35% silt and 5% clay. Sample B07NC1 consists of 8% medium-grained sand, 58% fine-grained sand, 23% silt, and 11% clay. These samples were collected at location H1 at the 0 to 6-in. and 12 to 18-in. intervals bls.

Samples B07NC2 and B07NC3 contain 13% and 14% medium-grained sand, 73% and 78% fine-grained sand, and 12% and 8% silt, respectively. Both samples contain 2% clay. These samples were collected from locations H2 and H3 in the 0 to 6-in. intervals bls.

4.7 100 F AREA

Eight samples were collected from five locations in the 100 F Slough which is immediately downstream of the 100 F Area, as shown by Figure 4-7. The samples were collected on land. During sampling the Columbia River shoreline was at a lower elevation than is shown by Figure 4-7. The sampling locations are about 19.9 to 21.0 mi downstream of the Vernita Bridge and about 1 to 2 mi downstream of the 100 F outfall. Samples B07NB8 and B07NB9 were collected in location F3, an area where many springs discharge groundwater through the sediment into the slough. Locations F2, F4, and FI1 were within areas with elevated concentrations of man-made radionuclides in 1988 (Reiman and Dahlstrom 1990). Field screening instruments indicated background-levels of $\beta\gamma$ and γ activity at locations F1, F2, F4, and FI1 during sampling. Field screening instruments indicated activity greater than background $\beta\gamma$ and γ activity at location F3 during sampling.

Samples B07NB6 and B07NB7 were collected from the 0 to 6-in. interval bls at locations F1 and F2. Cobbles were encountered at both locations when attempting to sample at greater depth intervals. Samples B07NB8 and B07NB9 were collected from the 0 to 6-in. and 12 to 24-in. intervals bls, respectively, at location F3. Samples B07NC4 and B07NC5 were collected from the 0 to 6-in. and 12 to 16-in. intervals bls, respectively, at location F4. Samples B07NG9 and B07NH0 were collected from the 0 to 6-in. and 12 to 18-in. intervals bls, respectively, at location FI1. The sample location coordinates, distance from Vernita Bridge (in miles), sample dates, intervals sampled, median grain size, inorganic constituents with concentrations greater than the 95% UTL, detected radionuclides, and the maximum radionuclide concentrations found in samples from the Vernita area are presented in Table 4-8.

4.7.1 Inorganic Constituents

Concentrations of chromium, copper, lead, and zinc exceed the 95% UTL values in 100 F Slough samples, although not all samples contain concentrations that exceed the 95% UTL values, as shown by Table 4-8. Sample B07NC56 does not exceed any 95% UTL values and sample B07NH0 only exceeds the zinc 95% UTL value. Concentrations of chromium exceed the 95% UTL value in samples B07NB8 and B07NB9. The copper concentrations exceed the 95% UTL value in all samples except B07NC5 and B07NH0. Concentrations of lead exceed the 95% UTL value in six of the eight samples, however, the maximum concentration of 55.7 mg/kg is less than the maximum reported from the Vernita area samples, 57.7 mg/kg. The zinc concentrations exceed the 95% UTL value in seven of the eight samples. The maximum zinc concentration from 100 F Slough samples, 315 mg/kg, is 39% greater than the maximum value found in Vernita area samples, 226 mg/kg.

4.7.2 Radionuclide Constituents

The maximum concentrations of potassium-40, radium-226, thorium-228, and thorium-232 in the 100 F samples are generally similar to those from the Vernita area, as shown in Table 4-8. Sample B07NC4 contained 4.4 and 3.2 pCi/g of thorium-228 and thorium-232, respectively, which exceeds the maximum thorium concentration from the Vernita area. The uranium concentrations are all <2 pCi/g. The radionuclides cobalt-60, cesium-137, europium-152, and europium-154 were all detected in samples from the 100 F Slough; however, the maximum concentrations are all <1 pCi/g.

4.7.3 Grain-Size Analysis

The two samples collected from location F3, B07NB8 and B07NB9, contain 27% and 30% silt. considerably more than other locations in the 100 F Slough.

Samples B07NB6 and B07NB7 contain 1% and 3% medium-grained sand, 80% and 86% fine-grained sand, 11% and 14% silt, respectively. Both samples contain 4% clay. These samples were collected at locations F1 and F2 from the 0 to 6-in. interval bls.

Samples B07NB8 and B07NB9 contain 6% and 2% medium-grained sand, 70% and 66% fine-grained sand, 27% and 30% silt, and 3% and 2% clay, respectively. These samples were collected at location F3 from the 0 to 6-in. and 12 to 24-in. intervals bls.

Sample B07NC4 contains 1% medium-grained sand, 91% fine-grained sand, and 7% silt, and 1% clay. Sample B07NC5 contains 1% gravel, 11% coarse-grained sand, 8% medium-grained sand, 67% fine-grained sand, 9% silt, 4% clay. These samples were collected at location F4 from the 0 to 6-in. and 12 to 16-in. intervals bls.

Sample B07NG9 contains 4% medium-grained sand, 91% fine-grained sand, and 5% silt and clay. Sample B07NH0 contains 37% medium-grained sand, 63% fine-grained sand, and no silt or clay. These samples were collected at location FI1 from the 0 to 6-in. and 12 to 18-in. intervals bls.

4.8 HANFORD TOWNSITE

Six samples were collected at three locations in the Hanford Townsite area as shown in Figure 4-8. The samples were collected on land. During sampling the Columbia River shoreline was at a lower elevation than is shown in Figure 4-8. Samples B07NH3 and B07NH4 were collected at location FF1 on the Franklin County shore of the Columbia River opposite of the Hanford Townsite and about 24.6 mi downstream of the Vernita Bridge. There is abundant fine-grained sediment at this site. An abandoned farm is nearby. Samples B07ND2 and B07ND3 were collected at location HAN2, which is at the upstream end of the Hanford Slough. Samples B07NC6 and B07NC7 were collected at location HAN1 at the end of the Hanford Peninsula. Location HAN1 is about 25.5 mi downstream of the Vernita Bridge. Location HAN2 is about 24.8 mi downstream of the Vernita Bridge. Locations HAN1 and HAN2 were within areas with elevated concentrations of man-made radionuclides in 1988 (Reiman and Dahlstrom 1990), although field screening instruments indicated background levels of $\beta\gamma$ and γ activity during sampling.

Two samples were collected at each of the three locations. At each location a sample was collected from the 0 to 6-in. interval bls and from an interval deeper than 12 in; i.e., 12 to 20 in for sample B07NH4 from location at FF1, 12 to 16 in for sample B07NC6 from location HAN1, and 12 to 18 in for sample B07ND3 from location HAN2. The sample location coordinates, distance from Vernita Bridge (in miles), sample dates, intervals sampled, median grain size, inorganic constituents with concentrations greater than the 95% UTL, detected radionuclides, and the maximum radionuclide concentrations found in samples from the Vernita area are presented in Table 4-9.

4.8.1 Inorganic Constituents

Concentrations of zinc exceeded the 95% UTL value in all samples. The maximum concentration 293 mg/kg, from sample B07ND2, exceeded the maximum from the Vernita area by 30%. All the other zinc concentrations from the Hanford Townsite samples were less than the maximum from the Vernita area. No other 95% UTL values were exceeded for Hanford Townsite samples.

4.8.2 Radionuclide Constituents

The concentrations of radionuclides were similar to those reported from the Vernita area in all samples except B07ND2. The concentrations of cobalt-60, cesium-137, europium-152, and europium-154 in sample B07ND2 exceeded those from the Vernita area. In Vernita area samples, cobalt-60, europium-152, and europium-154 were not detected and the

maximum cesium-137 concentration was 0.14 pCi/g. In sample B07ND2 cobalt-60, europium-152, and europium-154 were detected, although concentrations were <1 pCi/g, and the cesium-137 concentration was 1 pCi/g. Sample B07NC6 also contained cesium-137, but less than the Vernita area maximum.

4.8.3 Grain-Size Analysis

Samples B07NH3 and B07NH4 contain 6% and 5% medium-grained sand, 91% and 88% fine-grained sand, and 3% and 7% silt and clay. These samples were collected at location FF1 from the 0 to 6-in. and 12 to 20-in. intervals bls.

Sample B07NC6 contains 2% medium-grained sand, 76% fine-grained sand, 20% silt, and 2% clay. Sample B07NC7 contains 4% gravel, 2% coarse-grained sand, 8% medium-grained sand, 66% fine-grained sand, 14% silt, and 4% clay. These samples were collected at site HAN1, located at the end of the Hanford Townsite Peninsula from the 0 to 6-in. and 12 to 16-in. intervals bls.

Sample B07ND2 contains 1% gravel, 5% coarse-grained sand, 1% medium-grained sand, 77% fine-grained sand, 13% silt, and 3% clay. Sample B07ND3 contains 18% gravel, 24% coarse-grained sand, 3% medium-grained sand, 39% fine-grained sand, 10% silt, and 6% clay. These samples were collected at site HAN2, located in the Hanford Slough, from the 0 to 6-in. and 12 to 18-in. intervals bls.

Sample B07NG9 contains 4% medium-grained sand, 91% fine-grained sand, and 5% silt and clay. Sample B07NH0 contains 37% medium-grained sand, 63% fine-grained sand, and no silt or clay. These samples were collected at location FI1 from the 0 to 6-in and 12 to 18-in. intervals bls.

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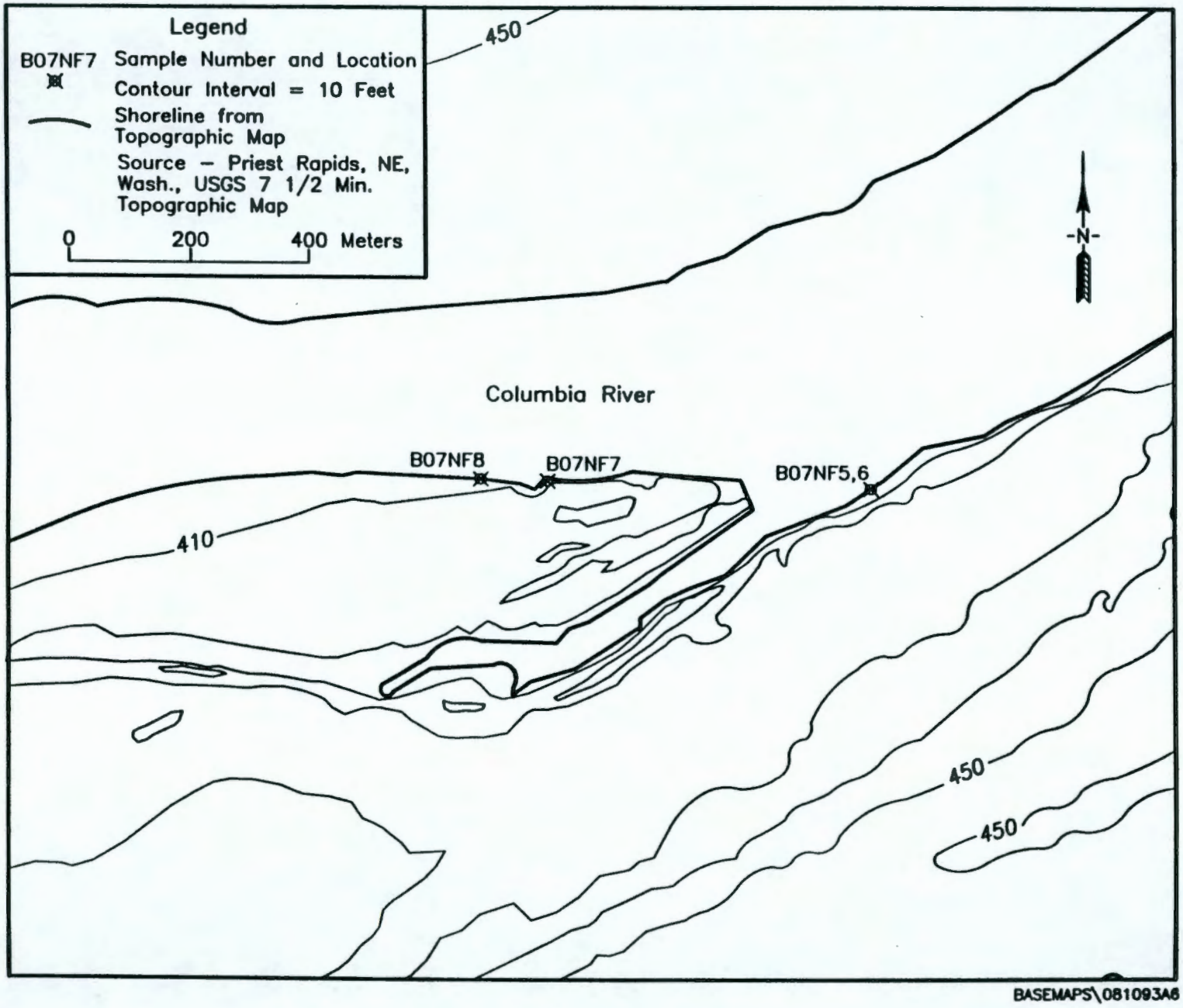


Figure 4-1. Location of Sediment Samples Collected in the Vernita Area, Fall 1992

9413096.0671

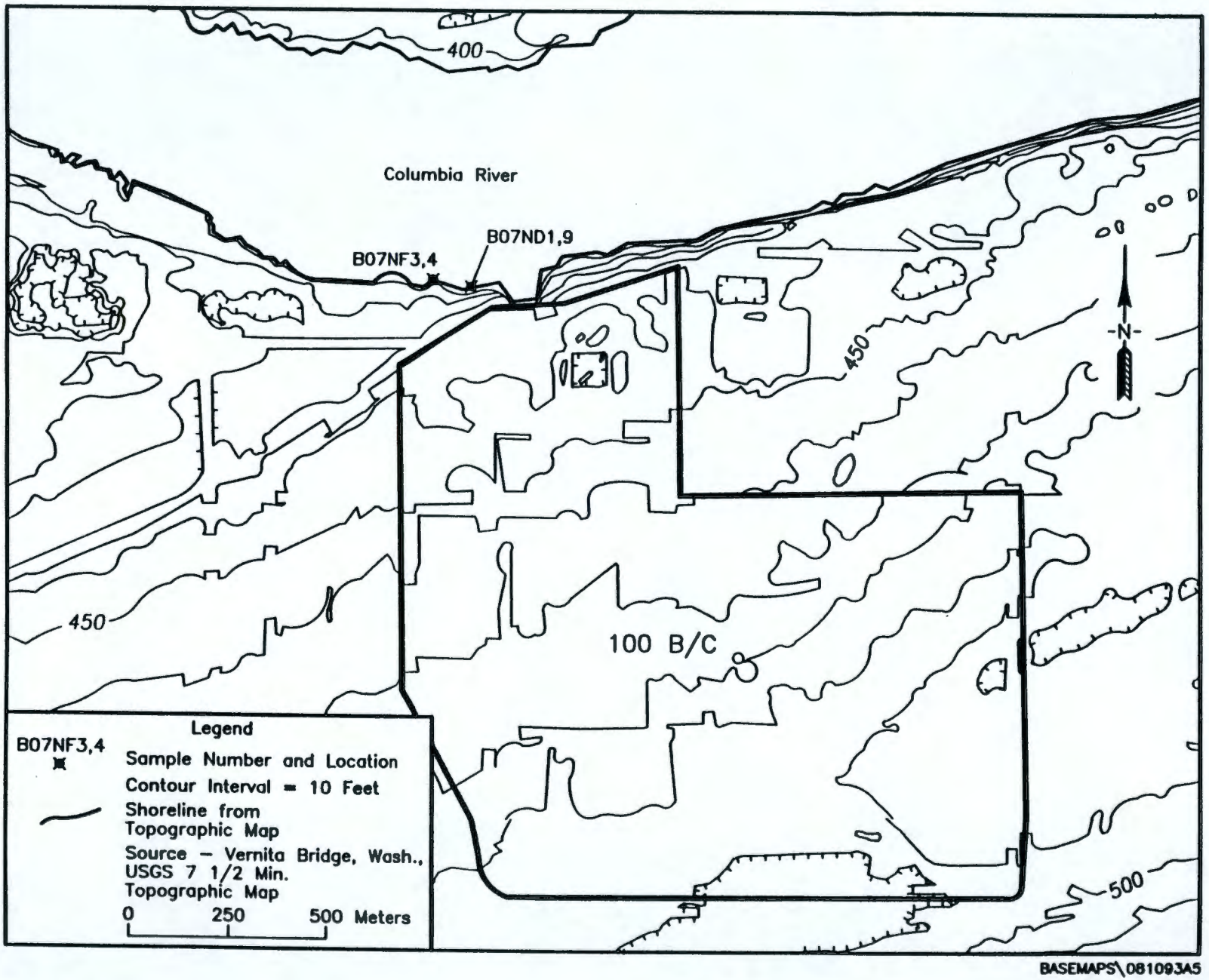


Figure 4-2. Location of Sediment Samples Collected in the 100 B/C Area, Fall 1992

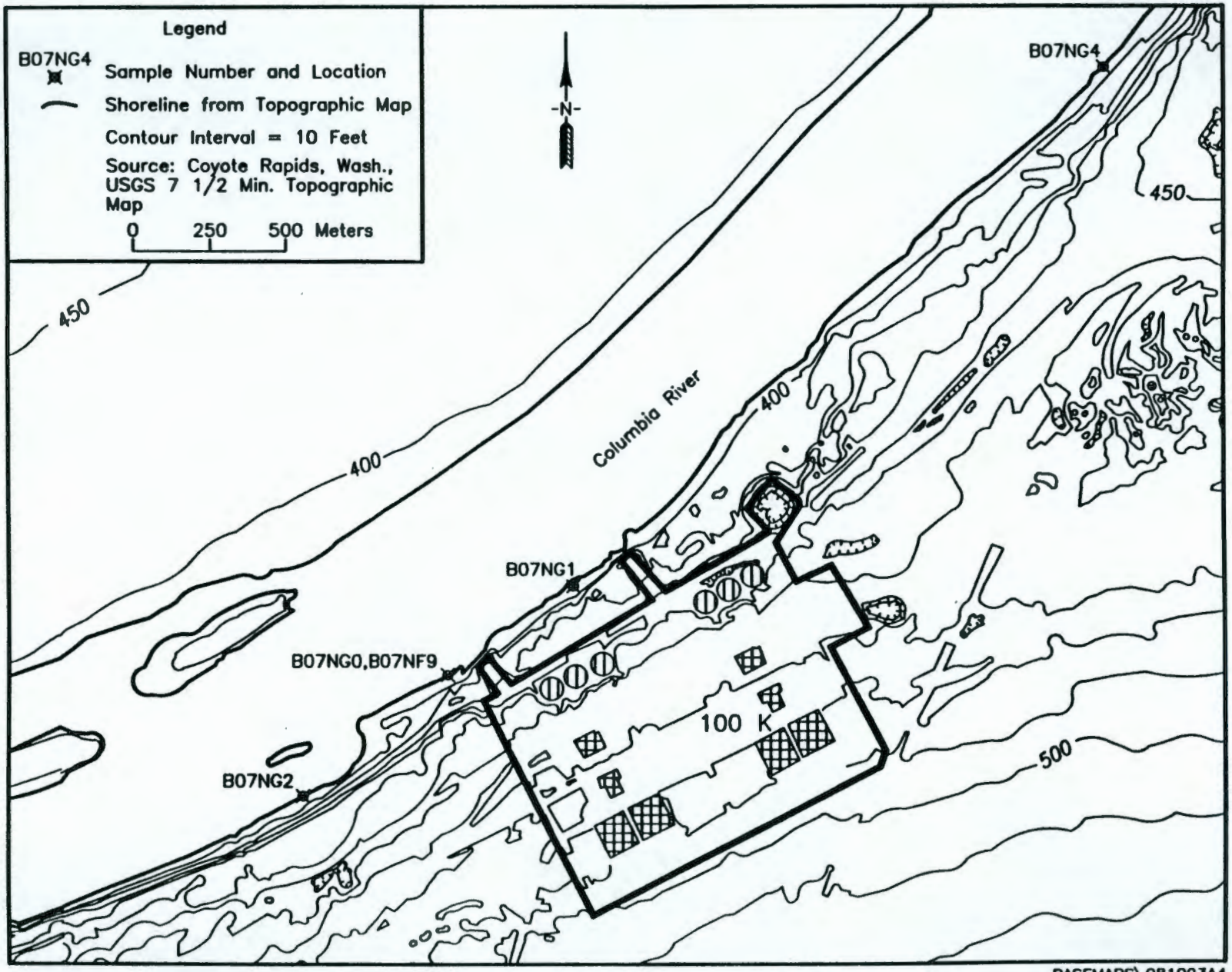


Figure 4-3. Location of Sediment Samples Collected in the 100 K Area, Fall 1992

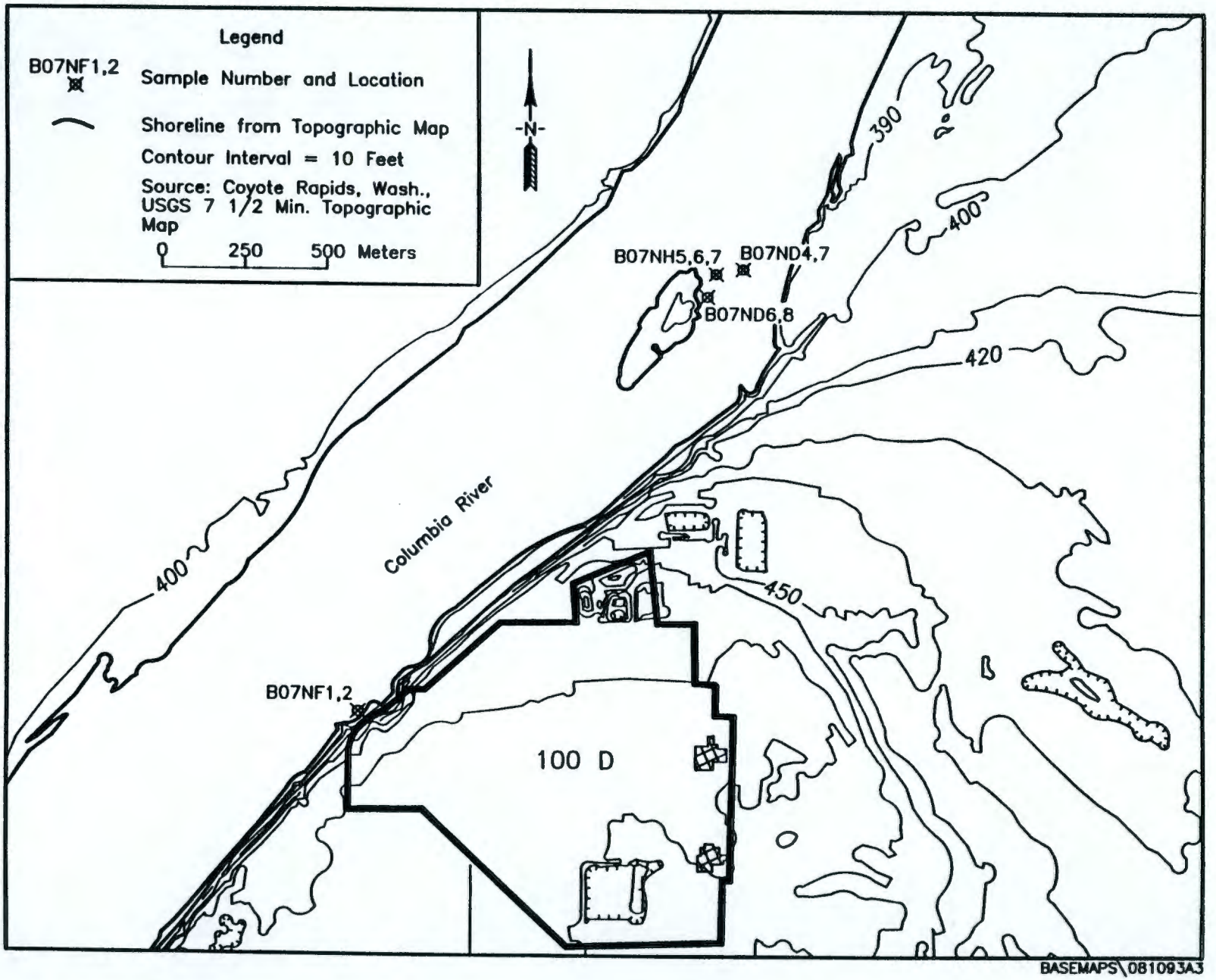


Figure 4-4. Location of Sediment Samples Collected in the 100 D Area, Fall 1992

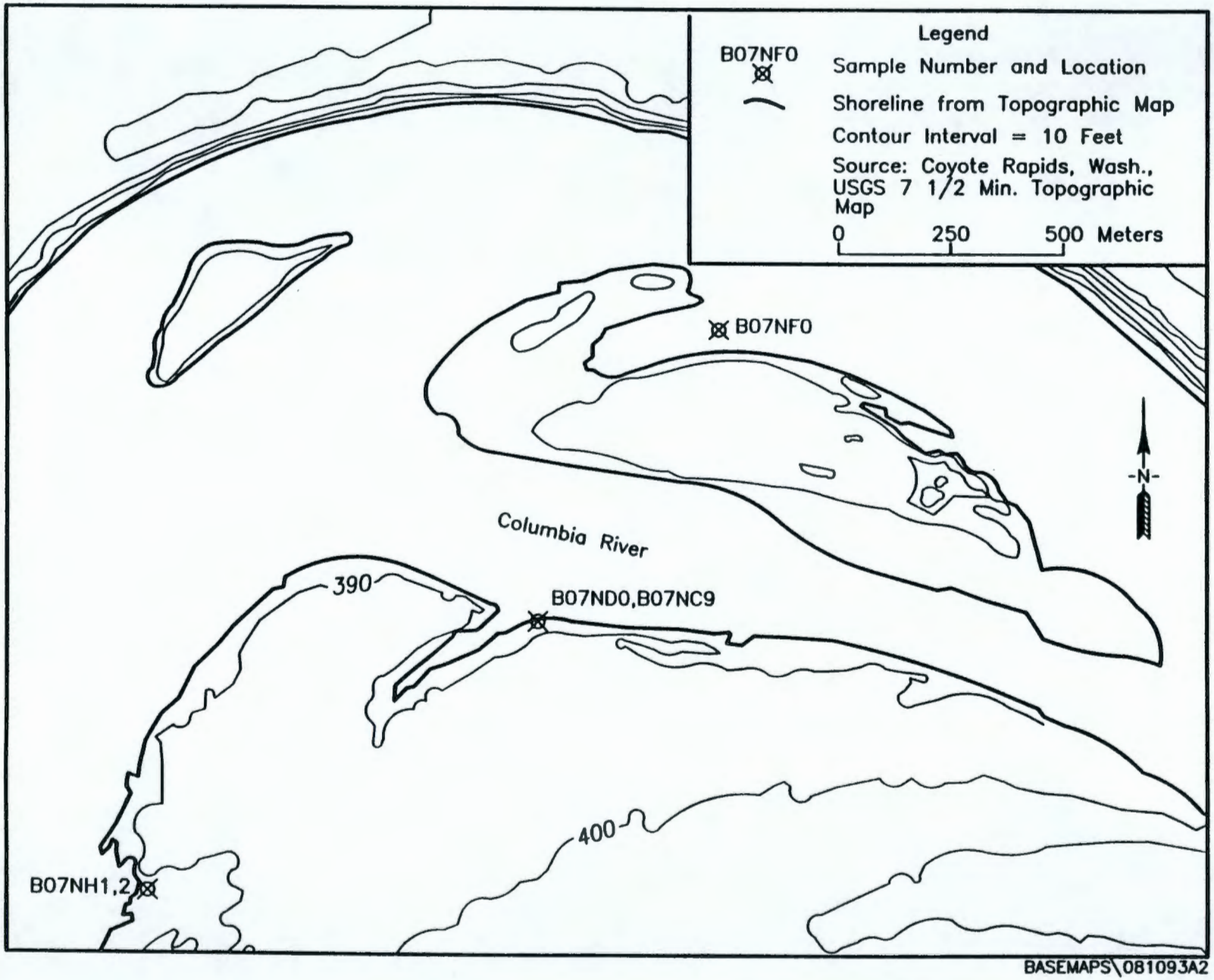


Figure 4-5. Location of Sediment Samples Collected in the Horn of the Columbia River Area, Fall 1992

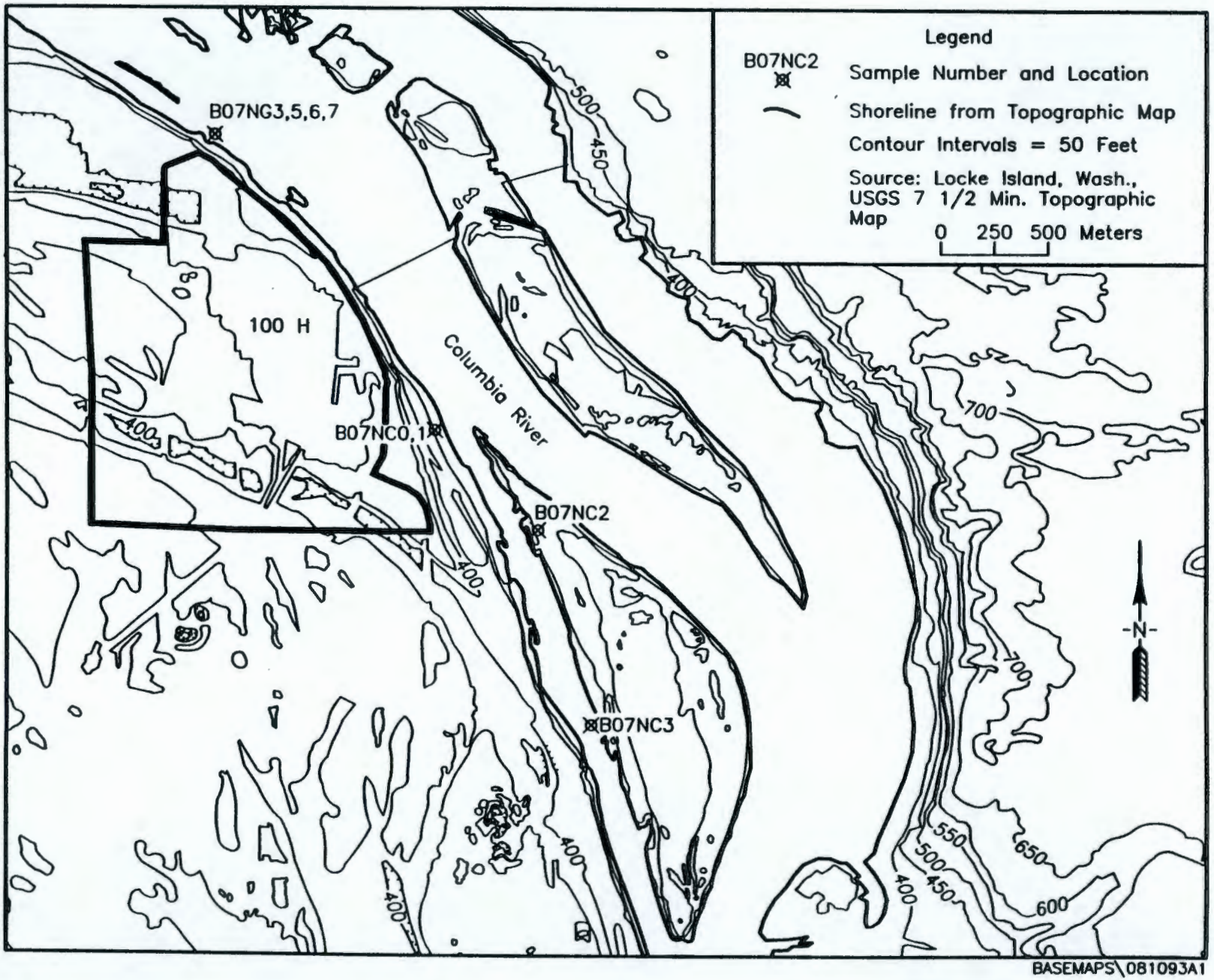
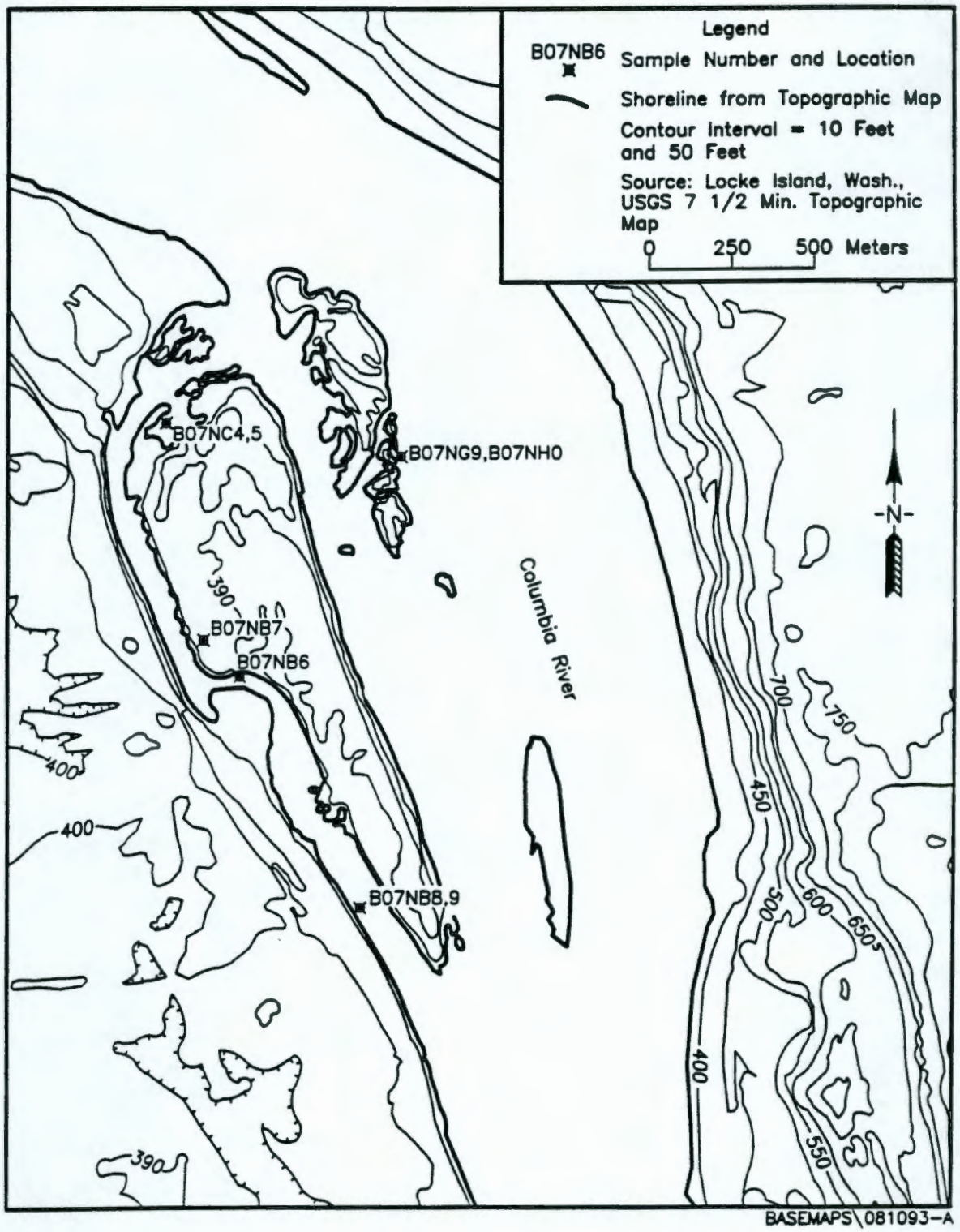


Figure 4-6. Location of Sediment Samples Collected in the 100 H Area, Fall 1992

Figure 4-7. Location of Sediment Samples Collected in the 100 F Area, Fall 1992



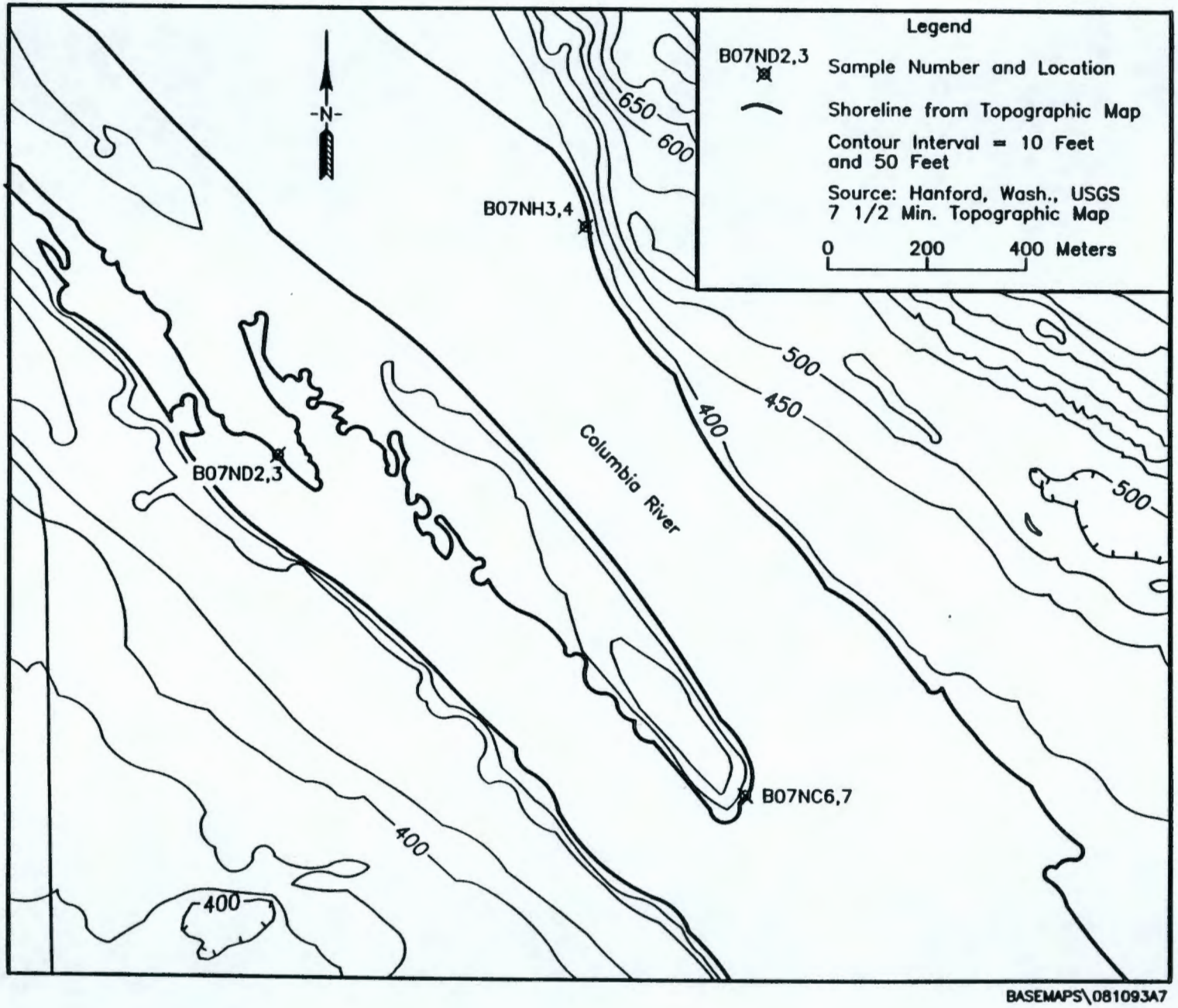


Figure 4-8. Location of Sediment Samples Collected in the Hanford Townsite Area, Fall 1992

Table 4-1. Upper Threshold Limits (UTL) and Riparian Ecosystem Topsoils for Inorganic Analytes (concentrations in mg/kg)

Analyte	95% UTL[a]	Riparian grass topsoil[b]	Riparian juniper topsoil[c]
Aluminum	15,100	9,940	10,200
Antimony	NC[d]	13.7	14.2
Arsenic	9	7.7	27.7
Barium	175	88.8	90.8
Beryllium	1.8	0.94	0.98
Cadmium	NC[d]	3.1	2.9
Calcium	24,600	5,650	5,820
Chromium	28	19.6	20.4
Cobalt	19	10.1	10.6
Copper	30	31.8	32.9
Iron	38,200	20,300	20,800
Lead	14.9	67.4	74.1
Magnesium	9,160	5,110	5,250
Manganese	583	297	304
Mercury	1.3	0.12	0.12
Nickel	25	20.0	19.9
Potassium	3,090	2,020	2,100
Selenium	NC[d]	0.94	0.98
Silver	2.1	2.4	2.5
Sodium	1,390	273	263
Thallium	NC[d]	0.71	0.74
Vanadium	107	43.6	44.7
Zinc	79	356	366

Source: DOE-RL 1993b
* NR = Not Reported
[a] 95% confidence limit of the 95th percentile of the data, Weibull distribution
[b] Riparian grass terrestrial ecosystem topsoil at Hanford Site
[c] Riparian juniper terrestrial ecosystem topsoil at Hanford Site
[d] Not computed

Table 4-2. Vernita Area Sediment Sample Information, Inorganic Concentrations Greater than the 95% UTL, and Detected Radionuclides

Area	Vernita		Vernita		Vernita		Vernita		
Site Identification	VBU1		VBU1		VBU2		VBU3		
Coordinates E (m)	144860.72		144860.72		144898.23		144852.60		
Coordinates N (m)	557603.09		557603.09		557066.32		556975.50		
River Mile	-0.9		-0.9		-1.2		-1.2		
Sample Date	11/20/92		11/20/92		11/20/92		11/20/92		
HEIS Sample No.	B07NF5		B07NF6		B07NF7		B07NF8		
Quality Control Sample	NA		NA		NA		NA		
Sample Depth	0 - 6 in		12 - 22 in		0 - 6 in		0 - 3 in		
Median grain size (mm)	0.50		0.50		0.53		0.60		
									95% UTL
Arsenic (mg/kg)	9.40	J	1.90	BJ	2.40	J	5.80	J	9
Lead (mg/kg)	57.70	J	5.80		15.30		27.00		14.9
Zinc (mg/kg)	226.00	J	43.70	J	151.00	J	205.00	J	79
Gross Alpha (pCi/g)	8.30	J	6.10	J	8.40	J	7.50	J	
Gross Beta (pCi/g)	16.00		14.00		15.00		16.00		
Potassium-40 (pCi/g)	16.00		14.00		15.00		12.00		
Cesium-137 (pCi/g)	N/D		0.082	J	N/D		0.14	J	
Radium-226 (pCi/g)	0.78		1.20		0.63		0.60		
Thorium-228 (pCi/g)	1.30		2.50		1.30		1.10		
Thorium-232 (pCi/g)	1.20		2.50		1.00		0.99		
Uranium-233/234 (pCi/g)	0.85		0.53		1.00		1.00		
Uranium-238 (pCi/g)	0.54		0.74		0.58		0.80		

Coordinates: Meters, North American Datum 1983, state plane coordinates, south zone
River Mile: Locations upstream of Vernita Bridge are negative values, locations downstream are positive values
HEIS: Hanford Environmental Information System
Quality Control Sample: Duplicate samples analyzed by same laboratory as primary sample, split samples analyzed by different laboratory.
95% UTL: Upper threshold limit from 95% confidence interval of the 95 percentile of the Hanford Site soil background data set, Weibull distribution (DOE-RL 1993b)
NA: Not Applicable
N/A: Not Analyzed
N/D: Not Detected
J: Concentration estimated due to quality control deficiencies
BJ: Estimated concentration above the instrument detection limit but less than the contract required detection limit

Table 4-3. 100 B/C Area Sediment Sample Information, Inorganic Concentrations Greater than the 95% UTL, Detected Radionuclides, and Maximum Vernita Area Radionuclide Concentrations

Area	B/C Area	B/C Area	B/C Area	B/C Area	B/C Area	B/C Area	
Site Identification	037-1	BC2	BC2	038-2	BC1	BC1	
Coordinates E (m)	145279.16	145279.16	145279.16	145303.35	145303.35	145303.35	
Coordinates N (m)	564535.47	564535.47	564535.47	564635.69	564635.69	564635.69	
River Mile	3.7	3.7	3.7	3.7	3.7	3.7	
Sample Date	9/18/91	11/20/92	11/20/92	9/17/91	11/20/92	11/20/92	
HEIS Sample No.	B06KR7	B07NF3	B07NF4	B06KS0	B07ND9	B07ND1	
Quality Control Sample	NA	NA	NA	NA	NA	Duplicate	
Sample Depth	0 - 6 in	0 - 6 in	12 - 18 in	0 - 6 in	0 - 6 in	0 - 6 in	
Median grain size (mm)	N/A	0.20	0.60	N/A	0.27	0.35	
							95% UTL
Chromium (mg/kg)	52.10	65.20	131.00	51.70 J	50.60	47.60	28
Lead (mg/kg)	N/A	19.30	39.20	N/A	7.30	9.00	14.9
Zinc (mg/kg)	208.00	159.00 J	192.00 J	79.60	73.10 J	83.10 J	79
							Vernita
Gross Alpha (pCi/g)	4.00	N/D	8.10 J	11.00	N/D	6.70 J	8.40 J
Gross Beta (pCi/g)	15.00	13.00	16.00	20.00	14.00	13.00	16.00
Potassium-40 (pCi/g)	13.91	15.00	15.00	13.03	12.00	12.00	16.00
Strontium-90 (pCi/g)	0.30 J	N/D	N/D	0.40 J	N/D	N/D	N/D
Cesium-137 (pCi/g)	0.146 J	0.058 J	N/D	0.033 J	0.031 J	N/D	0.14 J
Radium-226 (pCi/g)	0.776	0.58	0.70	0.446	0.52	0.51	1.20
Thorium-228 (pCi/g)	1.024 J	1.00	1.40	0.776 J	0.82	1.10	2.50
Thorium-232 (pCi/g)	0.955	0.95	1.10	0.673	0.79	0.75	2.50
Uranium-233/234 (pCi/g)	N/A	0.57	0.84	N/A	0.45	0.59	1.00
Uranium-238 (pCi/g)	N/A	0.52	1.10	N/A	0.26 J	0.44	0.80

Coordinates: Meters, North American Datum 1983, state plane coordinates, south zone
River Mile: Locations upstream of Vernita Bridge are negative values, locations downstream are positive values
HEIS: Hanford Environmental Information System
Quality Control Sample: Duplicate samples analyzed by same laboratory as primary sample, split samples analyzed by different laboratory.
95% UTL: Upper threshold limit from 95% confidence interval of the 95 percentile of the Hanford Site soil background data set, Weibull distribution
(DOE-RL 1993b)
Vernita: Maximum radionuclide concentration found in samples from Vernita area
NA: Not Applicable
N/A: Not Analyzed
N/D: Not Detected
J: Concentration estimated due to quality control deficiencies

9413096.0680

Table 4-4. 100 K Area Sediment Sample Information, Inorganic Concentrations Greater than the 95% UTL, Detected Radionuclides, and Maximum Vernita Area Radionuclide Concentrations

Area	K Area	K Area	K Area	K Area	K-N Area	K-N Area	
Site identification	K3	KU1	KU1	K2	N	082-2	
Coordinates E (m)	146308.69	146712.49	146712.49	146308.69	148672.43	148672.43	
Coordinates N (m)	567619.70	568105.94	568105.94	568519.69	570348.56	570348.56	
River Mile	5.7	6.2	6.2	6.4	8.1	8.1	
Sample Date	11/21/92	11/21/92	11/21/92	11/21/92	11/22/92	10/18/91	
HEIS Sample No.	B07NG2	B07NG0	B07NF9	B07NG1	B07NG4	B06KT8	
Quality Control Sample	NA	NA	NA	NA	NA	NA	
Sample Depth	0 - 6 in	0 - 6 in	12 - 18 in	0 - 3 in	0 - 3 in	0 - 6 in	
Median grain size (mm)	0.40	0.14	0.09	0.40	0.50	N/A	
							95% UTL
Arsenic (mg/kg)	2.90	5.10	6.20	6.00	**10.70**	N/A	9
Chromium (mg/kg)	18.80	25.80	**64.10**	24.30	**56.40**	**34.90**	28
Lead (mg/kg)	10.60	**40.20**	**59.30**	**30.50**	**23.90**	N/A	14.9
Zinc (mg/kg)	**94.80**	**378.00**	**454.00**	**209.00**	**152.00**	**80.30**	79
							Vernita
Gross Alpha (pCi/g)	15.00	5.20 J	5.40 J	N/D	N/D	5.00	8.40 J
Gross Beta (pCi/g)	16.00	13.00	12.00	14.00	15.00	23.00	16.00
Potassium-40 (pCi/g)	15.00	13.00	13.00	13.00	15.00	14.58	16.00
Cesium-137 (pCi/g)	N/D	0.27	0.45	0.11 J	0.19	0.187	0.14 J
Europium-152 (pCi/g)	N/D	N/D	0.32	N/D	N/D	0.10	N/D
Europium-155 (pCi/g)	N/D	N/D	N/D	N/D	N/D	0.077	N/D
Radium-226 (pCi/g)	0.95	0.71	0.90	0.66	0.90	1.019	1.20
Thorium-228 (pCi/g)	1.90	0.91	1.40	1.10	1.30	1.516	2.50
Thorium-232 (pCi/g)	1.50	0.89	0.91	0.91	1.20	1.419	2.50
Uranium-233/234 (pCi/g)	0.98	0.53	0.77	0.45	0.35 R	N/A	1.00
Uranium-238 (pCi/g)	0.68	0.57	0.96	0.67	0.53 R	N/A	0.80

Coordinates: Meters, North American Datum 1983, state plane coordinates, south zone
River Mile: Locations upstream of Vernita Bridge are negative values, locations downstream are positive values
HEIS: Hanford Environmental Information System
Quality Control Sample: Duplicate samples analyzed by same laboratory as primary sample, split samples analyzed by different laboratory.
95% UTL: Upper threshold limit from 95% confidence interval of the 95 percentile of the Hanford Site soil background data set, Weibull distribution (DOE-RL 1993b)
Vernita: Maximum radionuclide concentration found in samples from Vernita area
NA: Not Applicable
N/A: Not Analyzed
N/D: Not Detected
J: Concentration estimated due to quality control deficiencies
R: Concentration rejected due to quality control deficiencies

Table 4-5. 100 D Area Sediment Sample Information, Inorganic Concentrations Greater than the 95% UTL, Detected Radionuclides, and Maximum Vernita Area Radionuclide Concentrations (Page 1 of 2)

Area	D Intake	D Intake	D Island	D Island	D Island	
Site Identification	D5	D5	DI3	DI3	DI3	
Coordinates E (m)	151684.53	151684.53	153053.20	153053.20	153053.20	
Coordinates N (m)	572658.65	572658.65	573711.27	573711.27	573711.27	
River Mile	10.3	10.3	11.3	11.3	11.3	
Sample Date	11/19/92	11/19/92	11/24/92	11/24/92	11/24/92	
HEIS Sample No.	B07NF1	B07NF2	BO7NH5	B07NH6	B07NH7	
Quality Control Sample	NA	NA	NA	Duplicate	Split	
Sample Depth	0 - 6 in	12 - 18 in	0 - 6 in	0 - 6 in	0 - 6 in	
Median grain size (mm)	0.23	0.12	0.40	0.39	0.38	
						95% UTL
Chromium (mg/kg)	**47.00**	21.90	9.10	11.30	5.30	28
Copper (mg/kg)	15.90	21.30	18.20	23.70	23.00	30
Lead (mg/kg)	**18.60**	**27.30**	**24.10**	**24.80**	**18.10**	14.9
Zinc (mg/kg)	**221.00**	**257.00**	**185.00**	**209.00**	**167.00**	79
						Vernita
Gross Alpha (pCi/g)	5.70 J	N/D	5.30 J	N/D	N/R	8.40 J
Gross Beta (pCi/g)	9.00	12.00	17.00	16.00	15.70 J	16.00
Potassium-40 (pCi/g)	12.00	13.00	15.00	13.00	17.80 J	16.00
Cobalt-60 (pCi/g)	0.20	0.09	0.25	0.20	0.22 J	N/D
Cesium-137 (pCi/g)	0.48 J	1.30 J	0.50	0.54	0.52 J	0.14 J
Europium-152 (pCi/g)	0.35 J	0.90 J	0.32	0.32	0.27 J	N/D
Europium-154 (pCi/g)	N/D	N/D	N/D	N/D	0.04 J	N/D
Europium-155 (pCi/g)	N/D	N/D	N/D	N/D	0.04 J	N/D
Radium-226 (pCi/g)	0.54	0.61	0.59	0.54	N/D	1.20
Radium-228 (pCi/g)	N/D	N/D	N/D	N/D	0.54 J	N/D
Thorium-228 (pCi/g)	0.91	0.95	0.78	0.59	N/D	2.50
Thorium-231 (pCi/g)	N/D	N/D	N/D	N/D	0.29 J	N/D
Thorium-232 (pCi/g)	0.74	0.93	0.51	0.60	N/D	2.50
Thorium-234 (pCi/g)	N/D	N/D	N/D	N/D	0.69 J	N/D
Uranium-233/234 (pCi/g)	0.44	0.37	0.49	N/D	N/R	1.00
Uranium-235 (pCi/g)	N/D	N/D	N/D	N/D	0.02 J	N/D
Uranium-238 (pCi/g)	0.44	0.58	0.30	0.36	N/D	0.80
Neptunium-237 (pCi/g)	N/D	N/D	N/D	N/D	0.48 J	N/D
Americium-241 (pCi/g)	N/D	N/D	N/D	N/D	0.24 J	N/D

Coordinates: Meters, North American Datum 1983, state plane coordinates, south zone
River Mile: Locations upstream of Vernita Bridge are negative values, locations downstream are positive values
HEIS: Hanford Environmental Information System
Quality Control Sample: Duplicate samples analyzed by same laboratory as primary sample, split samples analyzed by different laboratory.
95% UTL: Upper threshold limit from 95% confidence interval of the 95 percentile of the Hanford Site soil background data set, Weibull distribution (DOE-RL 1993b)
Vernita: Maximum radionuclide concentration found in samples from Vernita area
NA: Not Applicable
N/D: Not Detected
N/R: Not Reported
J: Concentration estimated due to quality control deficiencies

Table 4-5. 100 D Area Sediment Sample Information, Inorganic Concentrations Greater than the 95% UTL, Detected Radionuclides, and Maximum Vernita Area Radionuclide Concentrations (Page 2 of 2)

Area	D Island	D Island	D Island	D Island	D Island	
Site Identification	DI1	DI1	DI2	DI2	DI2	
Coordinates E (m)	153077.98	153077.98	152981.88	153077.98	152981.88	
Coordinates N (m)	573793.60	573793.60	573687.50	573793.60	573687.50	
River Mile	11.3	11.3	11.3	11.3	11.3	
Sample Date	11/19/92	11/19/92	11/19/92	11/19/92	11/19/92	
HEIS Sample No.	B07ND4	B07ND5	B07ND6	B07ND7	B07ND8	
Quality Control Sample	NA	NA	NA	Duplicate	NA	
Sample Depth	0 - 6 in	12 - 18 in	0 - 6 in	0 - 6 in	12 - 20 in	
Median grain size (mm)	0.35	0.38	0.30	0.40	0.33	
						95% UTL
Chromium (mg/kg)	10.30	9.40	10.60	12.90	9.2	28
Copper (mg/kg)	26.00	34.20	20.70	27.50	6.9	30
Lead (mg/kg)	18.00	21.60	23.60	20.60	3.4	14.9
Zinc (mg/kg)	192.00	216.00	144.00	203.00	26.8	79
						Vernita
Gross Alpha (pCi/g)	4.90 J	N/D	6.20 J	4.50 J	7.5 J	8.40 J
Gross Beta (pCi/g)	17.00	20.00	14.00	13.00	18	16.00
Potassium-40 (pCi/g)	14.00	15.00	15.00	13.00	17	16.00
Cobalt-60 (pCi/g)	0.18	0.41	N/D	0.19	N/D	N/D
Cesium-137 (pCi/g)	0.56	0.74 J	0.10 J	0.62 J	N/D	0.14 J
Europium-152 (pCi/g)	0.22	0.48 J	N/D	0.25 J	N/D	N/D
Europium-154 (pCi/g)	N/D	N/D	N/D	N/D	N/D	N/D
Europium-155 (pCi/g)	N/D	N/D	N/D	N/D	N/D	N/D
Radium-226 (pCi/g)	0.46	0.42	0.58	0.48	0.5	1.20
Radium-228 (pCi/g)	N/D	N/D	N/D	N/D	N/D	N/D
Thorium-228 (pCi/g)	0.50	0.46	0.88	0.53	0.69	2.50
Thorium-231 (pCi/g)	N/D	N/D	N/D	N/D	N/D	N/D
Thorium-232 (pCi/g)	0.58	0.50	0.84	0.50	0.89	2.50
Thorium-234 (pCi/g)	N/D	N/D	N/D	N/D	N/D	N/D
Uranium-233/234 (pCi/g)	0.58	0.49	0.29 J	0.44	0.46	1.00
Uranium-235 (pCi/g)	N/D	N/D	N/D	N/D	N/D	N/D
Uranium-238 (pCi/g)	0.68	0.36	0.49	0.44	0.46	0.80
Neptunium-237 (pCi/g)	N/D	N/D	N/D	N/D	N/D	N/D
Americium-241 (pCi/g)	N/D	N/D	N/D	N/D	N/D	N/D

Coordinates: Meters, North American Datum 1983, state plane coordinates, south zone
River Mile: Locations upstream of Vernita Bridge are negative values, locations downstream are positive values
HEIS: Hanford Environmental Information System
Quality Control Sample: Duplicate samples analyzed by same laboratory as primary sample, split samples analyzed by different laboratory.
95% UTL: Upper threshold limit from 95% confidence interval of the 95 percentile of the Hanford Site soil background data set, Weibull distribution (DOE-RL 1993b)
Vernita: Maximum radionuclide concentration found in samples from Vernita area
NA: Not Applicable
N/D: Not Detected
J: Concentration estimated due to quality control deficiencies

Table 4-6. Horn of the Columbia River Area Sediment Sample Information, Inorganic Concentrations Greater than the 95% UTL, Detected Radionuclides, and Maximum Vernita Area Radionuclide Concentrations

Area	D/H Horn	D/H Horn	D/H Horn	D/H Horn	Island 385	
Site Identification	DA1	DA1	D/H	D/H	D4	
Coordinates E (m)	153825.06	153825.06	154444.13	154444.13	155101.07	
Coordinates N (m)	574306.10	574306.10	575174.08	575174.08	575580.39	
River Mile	11.9	11.9	12.8	12.8	13.0	
Sample Date	11/23/92	11/23/92	11/17/92	11/17/92	11/19/92	
HEIS Sample No.	B07NH1	B07NH2	B07ND0	B07NC9	B07NF0	
Quality Control Sample	NA	NA	NA	NA	NA	
Sample Depth	0 - 6 in	12 - 20 in	0 - 6 in	12 - 18 in	0 - 6 in	
Median grain size (mm)	0.14	0.27	0.18	0.24	0.24	
						95% UTL
Chromium (mg/kg)	22.30	**31.90**	15.00	17.90	14.10	28
Copper (mg/kg)	23.80	**31.10**	23.3 J	23.3 J	23.1	30
Lead (mg/kg)	**59.80**	11.40	**23.30** J	11.90 J	**32.00**	14.9
Zinc (mg/kg)	**294.00**	**85.10**	**221.00**	**279.00**	**377.00**	79
						Vernita
Gross Alpha (pCi/g)	7.70 J	11.00	N/D	16.00 J	8.70 J	8.40 J
Gross Beta (pCi/g)	14.00	22.00	12.00	20.00	12.00	16.00
Potassium-40 (pCi/g)	14.00	15.00	11.00	14.00	8.40	16.00
Manganese-54 (pCi/g)	N/D	N/D	N/D	N/D	0.057	N/D
Cobalt-60 (pCi/g)	0.10	N/D	0.062	0.13	0.33	N/D
Cesium-137 (pCi/g)	0.09	N/D	0.24 J	0.071 J	0.56 J	0.14 J
Europium-152 (pCi/g)	0.94	N/D	0.11	0.37	0.41 J	N/D
Europium-155 (pCi/g)	0.79	N/D	N/D	0.18	N/D	N/D
Radium-226 (pCi/g)	0.98	1.30	0.77	1.00	0.55	1.20
Thorium-228 (pCi/g)	1.50	2.50	1.20	1.70	0.84	2.50
Thorium-232 (pCi/g)	1.20	2.30	1.20	1.60	0.71	2.50
Uranium-233/234 (pCi/g)	0.90	2.60	0.82	0.99	0.84	1.00
Uranium-235 (pCi/g)	N/D	N/D	N/D	0.085 J	N/D	N/D
Uranium-238 (pCi/g)	0.98	2.00	0.68	0.95	0.69	0.80

Coordinates: Meters, North American Datum 1983, state plane coordinates, south zone
River Mile: Locations upstream of Vernita Bridge are negative values, locations downstream are positive values
HEIS: Hanford Environmental Information System
Quality Control Sample: Duplicate samples analyzed by same laboratory as primary sample, split samples analyzed by different laboratory.
95% UTL: Upper threshold limit from 95% confidence interval of the 95 percentile of the Hanford Site soil background data set, Weibull distribution (DOE-RL 1993b)
Vernita: Maximum radionuclide concentration found in samples from Vernita area
NA: Not Applicable
N/A: Not Analyzed
N/D: Not Detected
J: Concentration estimated due to quality control deficiencies

Table 4-7. 100 H Area Sediment Sample Information, Inorganic Concentrations Greater than the 95% UTL, Detected Radionuclides, and Maximum Vernita Area Radionuclide Concentrations (Page 1 of 2)

Area	H Area	H Area	H Area	H Area	
Site Identification	HU1	HU1	HU1	HU1	
Coordinates E (m)	153623.91	153623.91	153623.91	153623.91	
Coordinates N (m)	577389.46	577389.46	577389.46	577389.46	
River Mile	14.5	14.5	14.5	14.5	
Sample Date	11/22/92	11/22/92	11/22/92	11/22/92	
HEIS Sample No.	B07NG3	B07NG6	B07NG5	B07NG7	
Quality Control Sample	NA	Duplicate	NA	Split	
Sample Depth	0 - 6 in	0 - 6 in	12 - 18 in	12 - 18 in	
Median grain size (mm)	0.15	0.15	0.13	0.13	
					95% UTL
Chromium (mg/kg)	22.80	21.70	20.80	13.30	28
Copper (mg/kg)	18.90	18.40	21.50	17.20	30
Lead (mg/kg)	32.70	31.30	27.80	27.90	14.9
Zinc (mg/kg)	397.00	369.00	253.00	230.00	79
					Vernita
Gross Alpha (pCi/g)	N/D	N/D	N/D	N/D	8.40 J
Gross Beta (pCi/g)	14.00	9.30 J	13.00	16.00 J	16.00
Potassium-40 (pCi/g)	15.00	14.00	14.00	15.20 J	16.00
Cobalt-60 (pCi/g)	0.38	0.37	0.12	0.111 J	N/D
Cesium-137 (pCi/g)	0.76	0.79	1.50	1.61 J	0.14 J
Europium-152 (pCi/g)	0.50	0.56	1.50	1.33 J	N/D
Europium-154 (pCi/g)	N/D	N/D	0.21	0.141 J	N/D
Radium-226 (pCi/g)	0.64	0.66	0.65	N/R	1.20
Thorium-228 (pCi/g)	0.85	0.90	0.88	N/R	2.50
Thorium-231 (pCi/g)	N/D	N/D	N/D	0.454 J	N/D
Thorium-232 (pCi/g)	0.84	0.94	0.93	N/R	2.50
Thorium-234 (pCi/g)	N/D	N/D	N/D	0.812 J	N/D
Uranium-233/234 (pCi/g)	0.45 R	0.85	0.49	N/R	1.00
Uranium-235 (pCi/g)	N/D	N/D	N/D	0.0217 J	N/D
Uranium-238 (pCi/g)	0.75 R	0.71	0.41	N/D	0.80
Neptunium-237 (pCi/g)	N/D	N/D	N/D	0.606 J	N/D
Plutonium-239/240 (pCi/g)	N/D	N/D	N/D	0.0707	N/D

Coordinates: Meters, North American Datum 1983, state plane coordinates, south zone
River Mile: Locations upstream of Vernita Bridge are negative values, locations downstream are positive values
HEIS: Hanford Environmental Information System
Quality Control Sample: Duplicate samples analyzed by same laboratory as primary sample, split samples analyzed by different laboratory.
95% UTL: Upper threshold limit from 95% confidence interval of the 95 percentile of the Hanford Site soil background data set, Weibull distribution (DOE-RL 1993b)
Vernita: Maximum radionuclide concentration found in samples from Vernita area
NA: Not Applicable
N/A: Not Analyzed
N/D: Not Detected
J: Concentration estimated due to quality control deficiencies
R: Concentration rejected due to quality control deficiencies

Table 4-7. 100 H Area Sediment Sample Information, Inorganic Concentrations Greater than the 95% UTL, Detected Radionuclides, and Maximum Vernita Area Radionuclide Concentrations (Page 2 of 2)

Area	H Area	H Area	H Area	H Slough	
Site Identification	H1	H1	H2	H3	
Coordinates E (m)	152108.21	152108.21	151754.44	150833.85	
Coordinates N (m)	578262.99	578262.99	578910.94	579163.96	
River Mile	15.6	15.6	16.0	16.8	
Sample Date	11/13/92	11/13/92	11/13/92	11/13/92	
HEIS Sample No.	B07NC0	B07NC1	B07NC2	B07NC3	
Quality Control Sample	NA	NA	NA	NA	
Sample Depth	0 - 6 in	12 - 18 in	0 - 6 in	0 - 6 in	
Median grain size (mm)	0.10	0.14	0.25	0.27	
					95% UTL
Chromium (mg/kg)	22.60	**28.90**	18.80	**28.30**	28
Copper (mg/kg)	**34.00**	**42.70**	**32.60**	26.10	30
Lead (mg/kg)	**43.40**	**16.40**	**35.70**	**28.30**	14.9
Zinc (mg/kg)	**287.00**	**79.40**	**168.00**	**141.00**	79
					Vernita
Gross Alpha (pCi/g)	N/D	26.00 J	27.00 J	13.00 J	8.40 J
Gross Beta (pCi/g)	18.00	23.00	20.00	21.00	16.00
Potassium-40 (pCi/g)	14.00	13.00	14.00	14.00	16.00
Cobalt-60 (pCi/g)	0.38	N/D	0.09	N/D	N/D
Cesium-137 (pCi/g)	4.60 J	0.52 J	0.43 J	0.33 J	0.14 J
Europium-152 (pCi/g)	1.80	N/D	0.47	0.23	N/D
Europium-154 (pCi/g)	0.24	N/D	N/D	N/D	N/D
Radium-226 (pCi/g)	0.85	1.40	1.00	0.69	1.20
Thorium-228 (pCi/g)	0.90	3.00	1.90	1.30	2.50
Thorium-231 (pCi/g)	N/D	N/D	N/D	N/D	N/D
Thorium-232 (pCi/g)	0.96	2.50	1.80	1.30	2.50
Thorium-234 (pCi/g)	N/D	N/D	N/D	N/D	N/D
Uranium-233/234 (pCi/g)	0.79	2.30	1.20	1.40	1.00
Uranium-235 (pCi/g)	N/D	N/D	N/D	N/D	N/D
Uranium-238 (pCi/g)	0.77	2.30	1.20	1.20	0.80
Neptunium-237 (pCi/g)	N/D	N/D	N/D	N/D	N/D
Plutonium-239/240 (pCi/g)	N/D	N/D	N/D	N/D	N/D

Coordinates: Meters, North American Datum 1983, state plane coordinates, south zone
River Mile: Locations upstream of Vernita Bridge are negative values, locations downstream are positive values
HEIS: Hanford Environmental Information System
Quality Control Sample: Duplicate samples analyzed by same laboratory as primary sample, split samples analyzed by different laboratory.
95% UTL: Upper threshold limit from 95% confidence interval of the 95 percentile of the Hanford Site soil background data set, Weibull distribution (DOE-RL 1993b)
Vernita: Maximum radionuclide concentration found in samples from Vernita area
NA: Not Applicable
N/A: Not Analyzed
N/D: Not Detected
J: Concentration estimated due to quality control deficiencies
R: Concentration rejected due toquality control deficiencies

Table 4-8. 100 F Area Sediment Sample Information, Inorganic Concentrations Greater than the 95% UTL, Detected Radionuclides, and Maximum Vernita Area Radionuclide Concentrations (Page 1 of 2)

Area	F Slough	F Slough	F Slough	F Slough	F Slough	
Site Identification	F4	F4	FI1	FI1	F2	
Coordinates E (m)	146961.31	146961.31	146871.73	146871.73	146304.26	
Coordinates N (m)	582032.69	582032.69	582731.80	582731.80	582149.86	
River Mile	19.9	19.9	20.2	20.2	20.4	
Sample Date	11/16/92	11/16/92	11/23/92	11/23/92	11/12/92	
HEIS Sample No.	B07NC4	B07NC5	B07NG9	B07NH0	B07NB7	
Quality Control Sample	NA	NA	NA	NA	NA	
Sample Depth	0 - 6 in	12 - 16 in	0 - 6 in	12 - 18 in	0 - 6 in	
Median grain size (mm)	0.18	0.27	0.27	0.39	0.14	
						95% UTL
Chromium (mg/kg)	16.80	16.10	15.40	12.50	17.70	28
Copper (mg/kg)	69.60 J	27.20 J	29.30	12.80	51.40	30
Lead (mg/kg)	50.00	3.80 J	49.70	11.10	49.70	14.9
Zinc (mg/kg)	315.00	27.60	296.00	97.30	309.00	79
						Vernita
Gross Alpha (pCi/g)	33.00 J	6.90 J	4.70 J	N/D	N/D	8.40 J
Gross Beta (pCi/g)	25.00	16.00	10.00	18.00	15.00	16.00
Potassium-40 (pCi/g)	14.00	15.00	15.00	15.00	16.00	16.00
Cobalt-60 (pCi/g)	N/D	N/D	0.36	0.076	N/D	N/D
Cesium-137 (pCi/g)	0.14 J	N/D	0.83	0.16	0.33 J	0.14 J
Europium-152 (pCi/g)	N/D	N/D	0.92	0.30	0.28	N/D
Europium-154 (pCi/g)	N/D	N/D	0.16	N/D	N/D	N/D
Radium-226 (pCi/g)	1.70	0.81	0.69	0.67	0.92	1.20
Thorium-228 (pCi/g)	4.40	1.60	1.10	0.99	1.70	2.50
Thorium-232 (pCi/g)	3.20	1.50	0.98	0.92	1.80	2.50
Uranium-233/234 (pCi/g)	1.60	1.40	0.77	0.88	1.10	1.00
Uranium-238 (pCi/g)	2.00	0.84	0.49	0.70	0.93	0.80

Coordinates: Meters, North American Datum 1983, state plane coordinates, south zone
River Mile: Locations upstream of Vernita Bridge are negative values, locations downstream are positive values
HEIS: Hanford Environmental Information System
Quality Control Sample: Duplicate samples analyzed by same laboratory as primary sample, split samples analyzed by different laboratory.
95% UTL: Upper threshold limit from 95% confidence interval of the 95 percentile of the Hanford Site soil background data set, Weibull distribution (DOE-RL 1993b)
Vernita: Maximum radionuclide concentration found in samples from Vernita area
NA: Not Applicable
N/A: Not Analyzed
N/D: Not Detected
J: Concentration estimated due to quality control deficiencies

Table 4-8. 100 F Area Sediment Sample Information, Inorganic Concentrations Greater than the 95% UTL, Detected Radionuclides, and Maximum Vernita Area Radionuclide Concentrations (Page 2 of 2)

Area	F Slough	F Slough	F Slough	
Site Identification	F1	F3	F3	
Coordinates E (m)	146193.69	145485.02	145485.02	
Coordinates N (m)	582262.17	582692.10	582692.10	
River Mile	20.5	21.0	21.0	
Sample Date	11/12/92	11/12/92	11/12/92	
HEIS Sample No.	B07NB6	B07NB8	B07NB9	
Quality Control Sample	NA	NA	NA	
Sample Depth	0 - 6 in	0 - 6 in	12 - 24 in	
Median grain size (mm)	0.14	0.12	0.11	
				95% UTL
Chromium (mg/kg)	15.20	28.10	45.70	28
Copper (mg/kg)	62.90	37.40	42.10	30
Lead (mg/kg)	55.70	31.40	44.30	14.9
Zinc (mg/kg)	335.00	246.00	195.00	79
				Vernita
Gross Alpha (pCi/g)	N/D	9.80 J	21.00 J	8.40 J
Gross Beta (pCi/g)	22.00	17.00	23.00	16.00
Potassium-40 (pCi/g)	16.00	14.00	15.00	16.00
Cobalt-60 (pCi/g)	N/D	N/D	N/D	N/D
Cesium-137 (pCi/g)	0.18 J	0.26 J	0.19 J	0.14 J
Europium-152 (pCi/g)	0.10	0.18	0.20	N/D
Europium-154 (pCi/g)	N/D	N/D	N/D	N/D
Radium-226 (pCi/g)	0.74	0.78	0.98	1.20
Thorium-228 (pCi/g)	1.20	1.10	2.00	2.50
Thorium-232 (pCi/g)	1.10	1.20	1.90	2.50
Uranium-233/234 (pCi/g)	0.67	0.79	1.00	1.00
Uranium-238 (pCi/g)	0.88	0.64	1.30	0.80

Coordinates: Meters, North American Datum 1983, state plane coordinates, south zone
River Mile: Locations upstream of Vernita Bridge are negative values, locations downstream are positive values
HEIS: Hanford Environmental Information System
Quality Control Sample: Duplicate samples analyzed by same laboratory as primary sample, split samples analyzed by different laboratory.
95% UTL: Upper threshold limit from 95% confidence interval of the 95 percentile of the Hanford Site soil background data set, Weibull distribution (DOE-RL 1993b)
Vernita: Maximum radionuclide concentration found in samples from Vernita area
NA: Not Applicable
N/A: Not Analyzed
N/D: Not Detected
J: Concentration estimated due to quality control deficiencies

Table 4-9. Hanford Townsite Area Sediment Sample Information, Inorganic Concentrations Greater than the 95% UTL, Detected Radionuclides, and Maximum Vernita Area Radionuclide Concentrations

Area	Franklin Co.	Franklin Co.	Hanford	Hanford	Hanford	Hanford	
Site Identification	FF1	FF1	HAN2	HAN2	HAN1	HAN1	
Coordinates E (m)	141598.93	141598.93	141117.46	141117.46	140407.72	140407.72	
Coordinates N (m)	585380.62	585380.62	584739.50	584739.50	585736.77	585736.77	
River Mile	24.6	24.6	24.8	24.8	25.5	25.5	
Sample Date	11/23/92	11/23/92	11/17/92	11/17/92	11/16/92	11/16/92	
HEIS Sample No.	B07NH3	BO7NH4	B07ND2	B07ND3	B07NC6	B07NC7	
Quality Control Sample	NA	NA	NA	NA	NA	NA	
Sample Depth	0 - 6 in	12 - 20 in	0 - 6 in	12 - 18 in	0 - 6 in	12 - 16 in	
Median grain size (mm)	0.27	0.23	0.17	0.33	0.18	0.13	
							95% UTL
Zinc (mg/kg)	82.00	96.00	293.00	155.00	123.00	219.00	79
							Vernita
Gross Alpha (pCi/g)	7.40 J	N/D	N/D	11.00 J	9.00 J	6.30 J	8.40 J
Gross Beta (pCi/g)	12.00	19.00	16.00	19.00	19.00	21.00	16.00
Potassium-40 (pCi/g)	15.00	17.00	14.00	17.00	16.00	17.00	16.00
Cobalt-60 (pCi/g)	N/D	N/D	0.056	N/D	N/D	N/D	N/D
Cesium-137 (pCi/g)	N/D	N/D	1.00 J	N/D	0.074 J	N/D	0.14 J
Europium-152 (pCi/g)	N/D	N/D	0.82	N/D	N/D	N/D	N/D
Europium-154 (pCi/g)	N/D	N/D	0.17	N/D	N/D	N/D	N/D
Radium-226 (pCi/g)	0.67	0.82	0.81	1.20	0.67	0.84	1.20
Thorium-228 (pCi/g)	0.94	1.10	1.40	2.10	1.10	1.80	2.50
Thorium-232 (pCi/g)	0.83	1.00	1.00	2.10	1.20	1.10	2.50
Uranium-233/234 (pCi/g)	0.51	0.80	0.73	1.30	0.60	0.85	1.00
Uranium-235 (pCi/g)	N/D	N/D	0.11 J	N/D	N/D	N/D	N/D
Uranium-238 (pCi/g)	0.75	0.69	0.75	1.00	0.48	0.87	0.80

Coordinates: Meters, North American Datum 1983, state plane coordinates, south zone
River Mile: Locations upstream of Vernita Bridge are negative values, locations downstream are positive values
HEIS: Hanford Environmental Information System
Quality Control Sample: Duplicate samples analyzed by same laboratory as primary sample, split samples analyzed by different laboratory.
95% UTL: Upper threshold limit from 95% confidence interval of the 95 percentile of the Hanford Site soil background data set, Weibull distribution (DOE-RL 1993b)
Vernita: Maximum radionuclide concentration found in samples from Vernita area
NA: Not Applicable
N/A: Not Analyzed
N/D: Not Detected
J: Concentration estimated due to quality control deficiencies

5.0 CONCLUSIONS

5.1 INORGANIC CONTAMINATION

Sediments that contain concentrations of metals that exceed the 95% UTL values derived from Hanford Site background soil samples (DOE-RL 1993b) are considered to be contaminated. Concentrations of arsenic, chromium, copper, lead, and zinc exceed the 95% UTL values in sediment samples from the Hanford Reach of the Columbia River. Zinc and lead were the most commonly found metallic contaminants in the sediment samples; 91% and 68% of the samples analyzed contained zinc and lead concentrations exceeding 95% UTL values. Concentrations of zinc and lead exceed the 95% UTL values in 75% of the samples from the Vernita area. Concentrations of arsenic above the 95% UTL were found in two samples, one from the Vernita area and the other from the 100 K Area. The concentrations of arsenic in the two samples were 4% (Vernita) and 20% (100 K) greater than the 95% UTL. The arsenic, lead, and zinc contamination may not be attributable to Hanford activities, since elevated concentrations occur in the upriver sample locations.

Concentrations of chromium that exceed the 95% UTL value occur in 25% of the samples analyzed. Two locations at each of the 100 B/C, 100 K, and 100 F areas have chromium concentrations greater than the 95% UTL. Single locations at each of the 100 D, 100 H, and 100 F areas have chromium concentrations greater than the 95% UTL. Concentrations of chromium were below the 95% UTL at the Vernita or Hanford Townsite locations.

Concentrations of copper that exceed the 95% UTL value occur in 23% of the samples analyzed. Single locations at each of the 100 D and the Horn areas have copper concentrations greater than the 95% UTL. Two locations at the 100 H area and four locations at the 100 F area have copper concentrations greater than the 95% UTL. It is notable that 63% of the samples from the 100 F area contain elevated copper concentrations. Concentrations of copper were below the 95% UTL value at all Vernita, 100 B/C, 100 K, and Hanford Townsite locations.

5.2 RADIONUCLIDE CONTAMINATION

Man-made radionuclides were detected in nearly all locations sampled. Sample location FF1, opposite of the Hanford Townsite, was the exception. Concentrations of man-made radionuclides were generally <1 pCi/g. The radionuclides cesium-137 and europium-152 are the most frequently detected, and have the highest concentrations. The maximum concentrations of cesium-137 and europium-152 are 4.6 and 1.8 pCi/g. These maximum values occur at location H1 in sample B07NC0. The abundance of radionuclide species and concentrations found was greatest in the samples collected from the 100 D Area to the 100 F Slough. Samples from the 100 B/C, 100 K, and Hanford Townsite locations contain fewer radionuclide species and generally lower

concentrations. No man-made radionuclides were detected in samples B07NH3 and B07NH4, collected at location FF1, across the Columbia River from the Hanford Townsite.

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APPENDIX A - HANFORD REACH SEDIMENT SAMPLING PERFORMANCE PROCEDURE

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HANFORD REACH SEDIMENT SAMPLING

PERFORMANCE PROCEDURE

Prepared by:

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Task Order I-92-26
Purchase Order No. MLV-SVV-073751

For:

Westinghouse Hanford Company

Revision 1
November 10, 1992

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1.0 PURPOSE

This procedure is designed to provide a consistent means of sampling Columbia River sediments so that the analytical results are indicative of environmental conditions at the sampling point.

2.0 SCOPE

This procedure applies to sampling of sediments from the Columbia River and is limited to IT Corp. (IT), Westinghouse Hanford Company (WHC) and their subcontractors involved in the Columbia River sediment sampling effort.

3.0 DEFINITIONS

Sediment: Material recently deposited from the waters of streams, lakes or seas. In this instance material deposited by the Columbia River.

4.0 RESPONSIBILITIES

Specific individual responsibilities may vary depending on the magnitude of the sampling operation. Personnel will be assigned to the effort and their responsibilities designated by the Field Team Leader. The following responsibility descriptions are presented as general guidelines.

4.1 IT FIELD TEAM LEADER/COGNIZANT ENGINEER

The Field Team Leader/Cognizant Engineer is responsible for:

- Directing field operations
- Coordinating IT and WHC support activities
- Assigning sampler responsibilities
- Maintaining notebook(s)
- Maintaining Field Activity Daily Log
- Conducting daily Tailgate Safety meetings
- Processing field generated records per WHC-CM-7-7, EII 1.6
- Coordinating transportation and shipment of samples
- Acquiring sample numbers from OSM
- Determining sampling position from GPS system
- Plotting sample locations on maps while in the field
- Recording Sediment Sampling Checklists data (Figure 1)
- Initiating Project Change forms (Figure 2), if needed.

4.2 WHC FIELD REPRESENTATIVE

The WHC Field Representative is responsible for direct interface between subcontractors.

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4.3 IT SAMPLER

The Sampler(s) reports to the Field Team Leader and is responsible for:

- Characterizing the sample area with a Ludlum 14-C portable scintillation counter
- Collecting samples
- Completing forms required for each sample
- Packaging, labeling, and sealing (e.g., evidence tape) individual sediment samples in accordance with WHC-CM-7-7, EII 5.11, Rev. 11, "Sample Packaging and Shipping"
- Controlling investigation-derived wastes
- Maintaining field custody for all samples pending transportation to the analytical laboratory in accordance with WHC-CM-7-7, EI1 5.1 "Chain of Custody," and
- Performing decontamination of sampling equipment.

5.0 REQUIREMENTS

5.1 SAFETY REQUIREMENTS

All sampling activities shall comply with applicable site-specific Job Safety Analysis (JSA) requirements for the areas being sampled. In addition, a "tailgate" safety meeting will be held before the beginning of work each day to brief field personnel on specific hazards anticipated for that day's effort.

Working in and around moving water in the Columbia River creates specific hazard exposures. Sampling will not be attempted if river conditions impede the ability of personnel to safely collect sediment samples. The buddy system will be used whenever samples are being collected in the river. A life-line will be attached to the in-river sampler and controlled by the on shore "buddy". Hip or chest-high waders or rubber kneeboots shall be worn during sample collection in the river. In no case shall the river be entered while barefoot. In addition, an inflatable "Mae West" flotation device will be worn. Slip, trip and fall hazards are normal when working in moving water, care must be taken to assure positive footing. Hypothermia is a hazard.

Activity-specific safety concerns are detailed in Section 6.

5.2 RADIOLOGICAL SAFETY

Any sampling activities conducted in areas under radiological control will require a Radiation Work Permit (RWP) in accordance with WHC-IP-0718 "Guidelines for Conduct of Radiological Work." Before sampling is initiated in an area under radiological control a radiological survey shall be made of the immediate vicinity of the site(s) to be sampled to determine site-specific background radiation levels. Sample containers shall be closed and sealed while still inside the posted boundaries of the controlled area. All sampling equipment and samples shall be surveyed by a Health Physics Technician (HPT) and either unconditionally released or appropriately labeled upon removal from the controlled area. Sample containers shall not be permitted to leave the controlled area until exterior surfaces are found to be free of removable radioactive contamination. The determination of the presence or absence of removable radioactive contamination shall be accomplished using standard wipe counting methods.

During sampling activities all protective clothing and/or wastes that are used or generated shall be controlled in a manner that protects it from undue exposure to the elements (wind, rain, etc.) and prevents inadvertent loss of control. Used protective clothing and wastes that are generated during the sampling activities conducted in radiologically controlled areas shall be contained, surveyed, labeled and transported to appropriate storage or disposal areas at completion of activities. Upon completion of sampling activities, surface radiological contamination levels shall be determined; radiological contamination levels in excess of pre-sampling levels shall be remediated prior to cessation of activities in that area.

5.3 MANAGEMENT OF INVESTIGATION-DERIVED WASTE

Investigation-derived wastes, such as used gloves and disposable personnel protective equipment, not generated in areas under radiological control, will be contained and controlled in accordance with WHC-CM-7-7, EII 6.1, "Interim Control of Unknown, Suspected Hazardous and Mixed Waste." Wastes generated in areas under radiological control will be handled as described above in Section 5.2, and in accordance with WHC-IP-0718, "Guidelines for the Conduct of Radiological Work."

5.4 RECORDS

The Field Team Leader is responsible for processing field generated records in accordance with WHC-CM-7-7, EII 1.6 "Records Management."

5.5 TRAINING

Personnel involved directly in the collection and handling of sediment and water samples shall be trained to meet the requirements of 29 CFR

1910.120, documentation of such training will be available at the IT Richland Engineering Office. Person(s) in direct control of the watercraft used to transport sampling personnel shall meet all applicable state and federal requirements and the specifications set forth in the WHC Statement of Work for that subcontract, documentation will be maintained with subcontracts files.

5.6 TIMING

Access to the selected sampling locations and minimization of danger to personnel necessitates sampling during periods of below average river flows. It is anticipated that flows of less than 85,000 cfs will permit sampling to occur in a safe and efficient manner. Irrespective of the flow, sampling will not be undertaken if weather or river conditions impede the ability of personnel to work safely.

6.0 PROCEDURE

The following activities will occur at the start of each field day:

- Contact the Grant County Public Utility District power dispatcher for the expected discharge from Priest Rapids Dam
- Initiate a new Field Activity Daily Log (Figure 3) or notebook page
- Select sampling locations
- Conduct Tailgate Safety Meeting (Figure 4)
- Load required sampling equipment into boat and depart.

Upon arrival at the selected sample location the following activities will occur:

1. Characterize the area of sampling with a scintillation detector
2. Determine location coordinates from GPS system
3. Plot the sample location on field map(s)
4. Record description of the sample location and weather conditions
5. Select and document the sampling method
6. Assemble sample collection equipment and sample containers
7. Don appropriate safety equipment
8. Collect sediment samples
9. Fill, label, and seal sediment sample containers
10. Place each container in Ziplock®-type plastic bag and seal
11. Place bagged containers cap up, in cooler with ice
12. Verify that all containers are filled and labeled
13. Survey samples if collected in a radiologically-controlled area

14. Contain and control waste materials generated during sampling
15. Decontaminate sampling equipment and put into clean plastic bag(s)

Major changes to this description of work will be submitted on the Project Change Form (Figure 2) for review and approval.

6.1 CHARACTERIZE THE SAMPLE LOCATION

Upon arrival at the sampling location characterize the immediate area with a Ludlum 14-C portable scintillation detector in accordance with EII 3.4, Rev. 0, "Field Screening" to bias the sample towards the highest levels possible.

6.2 DETERMINATION OF SAMPLE LOCATION COORDINATES

Record the location coordinates provided by the GPS system on the Sample Collection Log (Figure 5) or the notebook. The GPS system will have single instrument field accuracy of ± 15 meters.

Plot the location of the sample location on the field maps.

6.3 COLLECTION OF SEDIMENT SAMPLES

Sediments that are either exposed or in shallow water areas along the shoreline of either bank or islands will be sampled.

Collect sediments consisting of sand-sized and smaller particles, i.e., less than 2 mm in diameter following the general procedures described in WHC-CM-7-7, EII 5.2. Rev. 3, "Soil and Sediment Sampling," with the following adaptations.

1. Record description of the sample location and weather conditions on the Sample Collection Log (Figure 5).

2. Select sampling method; either the spoon/trowel/shovel manual method (Section 6.2.1) or the AMS core sampler method may be used if the sampling location is not below water (Section 6.2.2). If the sampling location is submerged the AMS core sampler should be used. Success in sampling with the AMS core sampler will depend on local sediment conditions such as presence or absence of gravel and cobbles.

3. Record the sampling method to be used on a Sample Collection Log (Figure 5) or in the controlled notebook.

4. Assemble the clean, previously decontaminated, sample collection equipment; AMS core sampler, large stainless steel spoons or trowels, stainless steel bowls, shovel, clean nitrile rubber gloves.

5. Complete sample labels on containers with required information such as: date, time, analytes, and OSM number. The following six (6) containers must be labeled and filled with sediment for each sample: one 1000 mℓ, one 500 mℓ, two 250 mℓ, one 120 mℓ, and one 20 mℓ. Table 1 lists required container types and analytes.

6. Don appropriate sampling attire, including new gloves. Attire for sampling in radiologically controlled areas will be selected in consultation with the WHC HPT.

7. Collect sediment sample. A volume of 2.2 liters will be required for each interval; 0 to 6 in. and for 12 to 24 in. Do not decant any turbid water from the sampling containers.

8. Place filled, labeled, and sealed container in Ziplock™-type plastic bag and seal.

9. Place bagged containers cap up, in cooler with ice.

10. Verify that all containers are filled, labeled, and sealed; then sign Sampling Checklist.

11. Remove used gloves and place in plastic bag that is labeled with location and interval.

12. Decontaminate the sampling equipment and wrap or bag in clean plastic.

13. If samples were collected in a radiologically-controlled area, survey out samples equipment, waste and personnel.

14. Sign the Sampling Checklist.

6.3.1 Excavation Sampling

1. Personnel will don new nitrile gloves prior to each sampling interval to reduce potential for cross contamination of samples.

2. Use a decontaminated (per Sec. 6.5) stainless steel spoon/trowel or similar size implement, or shovel.

3. Collect approximately 2.2 liters of sediment for each sample interval. Six containers will be filled per interval. See Table 1 for list of containers and analytes.

4. Do not decant liquid from the sample containers unless it is clear and non-turbid.

5. Record description of texture and color of sediment.

6. Fill containers with sediment, seal, bag, and verify all label data are complete; then place samples on ice.

7. Document collection and labeling on Sampling Checklist form.

8. Decontaminate the sampling equipment and wrap or bag in clean plastic.

6.3.2 Sampling With AMS Core Sampler

To collect the required 2.2 ℓ of sediment from each interval at least seven cores from the 0 to 6 in. interval and three to four cores from the 12 to 24 in. interval will be needed. Cores will be collected with the AMS sampler assembled in the 24 in.-long configuration to sample the 0 to 6 in. and the 12 to 24 in. interval without cross contamination. The 6 to 12 in. interval will be discarded. The remaining cores required for the 0 to 6 in. interval will be collected with the AMS sampler assembled in the 12 in.- long configuration. When the AMS core sampler is used:

- Verify core catcher is operational before use
- Use stainless steel or clear plastic liners
- Use core tip with drive hammer and
- Do not hammer down sampler once penetration stops or
- Use auger tip with "T-Handle."

1. Assemble the AMS sampler in the 24 in.-long configuration.

2. Drive or auger the AMS sampler 24 in. into the sediment, if possible.

3. Extract the sampler.

4. Place the 0 to 6 in. interval in a decontaminated stainless steel bowl.

5. Place the 6 to 12 in. interval in the container for waste materials.

6. Place the 12 to 24 in. interval in a second decontaminated stainless steel bowl.

7. Decontaminate and reassemble the sampler and collect the next core.

8. Repeat steps 2 through 7 above to collect 2.2 liters of sediment for the 12 to 24 in. interval.

9. Record description of the texture and color of the sediment.

10. Mix the sediment from the 12 to 24 in. interval and fill the sample bottles. Include any turbid liquid. Do not decant liquid from sample bottles.

11. Immediately after filling bottles, seal, bag, and verify bottle labels are complete; then place samples on ice.

If additional sediment is needed for the 0 to 6 in. interval:

12. Assemble the AMS sampler in the 12 in.-long configuration.

13. Drive or auger the AMS sampler 8 to 12 in. into the sediment.

14. Extract the sampler.

15. Place the sediment from the 0 to 6 in. interval in the decontaminated stainless steel bowl.

16. Place the 6 to 12 in. interval in the container for waste materials.

17. Repeat steps 11 through 14 above until the 2.2 ℓ of sediment is collected from the 0 to 6 in. interval.

18. Record description of the texture and color of the sediment.

19. Mix the sediment from the 0 to 6 in. interval and fill the sample bottles. Include any turbid liquid. Do not decant liquid from sample bottles.

20. Immediately after filling bottles, seal, bag, and verify bottle labels are complete; then place samples on ice.

21. Document collection by signing Sampling Checklist form.

22. Decontaminate the sampling equipment and wrap or bag in clean plastic.

6.4 SAMPLING IN RADIOLOGICAL CONTROLLED AREAS

Any sampling activities conducted in areas under radiological control will require a Radiation Work Permit (RWP) in accordance with WHC-IP-0718 "Guidelines for Conduct of Radiological Work" as described in Section 5.3.

1. Before sampling is initiated, a radiological survey shall be made of the immediate vicinity of the site(s) to be sampled to determine site-specific background radiation levels.

2. Sample containers shall be closed and sealed while still inside the posted boundaries of the controlled area.

3. All sampling equipment and samples shall be surveyed by a Health Physics Technician (HPT) and either unconditionally released or appropriately labeled upon removal from the controlled area.

4. Sample containers shall not be permitted to leave the controlled area until exterior surfaces are found to be free of removable radioactive contamination. The determination of the presence or absence of removable radioactive contamination shall be accomplished using standard wipe/counting methods. The Sampling Checklist form shall be used to document sample survey by the HPT.

5. During sampling activities all protective clothing and/or waste that are used or generated shall be controlled in a manner that protects it from undue exposure to the elements (wind, rain, etc.) and prevents inadvertent loss of control.

6. Used protective clothing and waste that are generated during the sampling activities conducted in radiologically controlled areas shall be contained, surveyed, labeled and transported to appropriate storage or disposal areas at completion of activities.

7. Upon completion of sampling activities, surface radiological contamination levels shall be determined; radiological contamination levels in excess of pre-sampling levels shall be remediated prior to cessation of activities in that area.

6.5 PREPARATION OF SAMPLES FOR OFF-SITE SHIPMENT

1. Immediately after collection seal, label, bag, and place sample containers on ice per WHC-CM-7-7, EII 5.11, Rev 1, "Sample Packaging and Shipping."

2. Place samples in storage location that meets chain of custody requirements identified in WHC-CM-7-7, EII 5.1, "Chain of Custody."

3. Complete a Sample Analysis Request form (Figure 6) for total activity analysis, and sign Sampling Checklist form.

4. Complete a Chain of Custody form (Figure 7) for total activity analysis and sign Sampling Checklist form.

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5. Submit the samples of sediment that were collected for total activity analysis for radiological release counting to the WHC 222S or 105N laboratory. The counting analysis is required for radiation release of samples for transport of samples off the Hanford Site or to uncontrolled areas/facilities on the Hanford Site.

6. Sign and date the Sampling Checklist form when total activity scan of the samples is completed and the samples are cleared.

7. Prepare the sample for shipment off site per EII 5.11, Rev. 1.

6.6 ANALYTES, PRESERVATIVES, SAMPLE CONTAINERS AND HOLDING TIMES

All sample containers shall be purchased "certified clean".

Sediment samples will be collected and transported in the containers listed in Table 1. Following collection and labeling all sediment samples will be placed in an ice chest and cooled with frozen "blue ice" or water ice.

6.7 DECONTAMINATION OF EQUIPMENT

Decontamination of sampling equipment shall be done in accordance with WHC-CM-7-7, EII 5.4 Rev 3, "Field Decontamination of Drilling, Well Development and Sampling Equipment."

1. Sediment sampling equipment shall be decontaminated at the start of each day's activity and between sampling locations.

2. Decontaminate by:

- Scrubbing the instrument in river water to remove coarse material;
- Wash and scrub using Alconox® or equivalent detergent solution;
- Rinse twice using commercially available distilled or deionized water and;
- Wrap or bag in clean plastic pending use at next sample interval or location.

6.8 FIELD DATA

Site characteristics shall be recorded in the Sample Collection Log or controlled notebook. A Field Activity Daily Log (Figure 3) will also be maintained. A new page is necessary for each sampling location. These data consist of the following:

- Record date, time, and names of sample crew members
- Record sampling location coordinates
- Record the start and finish 24 hour sampling times to the minute
- Record a physical description of the sampling site
- Record the color and texture of the sediments
- Record a description of weather conditions during sampling
- Record unusual occurrences.

6.8 SAMPLE CONTROL AND SHIPMENT

6.8.1 Sample Packaging and Shipment

Once the samples have received a radiation release they will be packed for shipping in accordance with WHC-CM-7-7, EII 5.11, "Sample Packaging and Shipping."

The Sampling Checklist form (Figure 1) will be used to document:

- Sample(s) packaged in shipping container
- Completion of total activity scan
- Completion of Sample Analysis Request forms (Figure 6)
- Completion of Chain of Custody forms (Figure 7)
- Shipment of samples to the laboratory.

Once samples are shipped OSM will be provided with a list of sample numbers. OSM will be requested to include total activity count data with the data package for the sample.

6.8.2 Chain-of-Custody

Maintenance of chain-of-custody shall be in accordance with WHC-CM-7-7, EII 5.1, "Chain of Custody."

A Chain of Custody form (Figure 7) will be initiated when samples are transported to the 222S or 105N total activity scanning laboratory, and for all other transfers of custody.

The Sampling Checklist form will also be used to document completion of the chain of custody process.

7.0 REFERENCES

1. US Environmental Protection Agency (EPA), 1986, "Test Methods for Evaluating Solid Waste - Physical Chemical Methods, Third Edition (Revised), SW-846."

2. WHC-CM-7-7, Environmental Investigations and Site Characterization Manual, EII 1.6, "Records Management."

3. WHC-CM-7-7, Environmental Investigations and Site Characterization Manual, EII 3.4, "Field Screening."

4. WHC-CM-7-7, Environmental Investigations and Site Characterization Manual, EII 4.2, "Interim Control of Unknown, Suspected Hazardous and Mixed Waste."

5. WHC-CM-7-7, Environmental Investigations and Site Characterization Manual, EII 5.1, "Chain of Custody."

6. WHC-CM-7-7, Environmental Investigations and Site Characterization Manual, EII 5.2, "Soil and Sediment Sampling."

7. WHC-CM-7-7, Environmental Investigations and Site Characterization Manual, EII 5.4, "Field Decontamination of Drilling, Well Development and Sampling Equipment."

8. WHC-CM-7-7, Environmental Investigations and Site Characterization Manual, EII 5.11, "Sample Packaging and Shipping.

9. WHC-IP-0718, Guidelines for the Conduct of Radiological Work.

Table 1. Sediment Sample Analytical Methods, Holding Times, and Containers

ANALYTE	METHOD	HOLDING TIME	CONTAINER/VOLUME
ICP METALS	EPA SW846 6010 (EPA 1986)	6 months	Glass - wide mouth 120 mℓ
LEAD	EPA SW846 7421[1] (EPA 1986)	6 months	Glass - wide mouth 250 mℓ
MERCURY	EPA SW846 7471[2] (EPA 1986)	28 days	Glass - wide mouth 250 mℓ
STRONTIUM-90 ALPHA SPEC. GROSS BETA GAMMA SPEC.	Laboratory Standard Operating Procedures	6 months	Plastic - wide mouth 1000 mℓ
TOTAL ACTIVITY	Laboratory Standard Operating Procedure	N/A	Plastic 20-100 mℓ
SIEVE	ASTM 422-63 or ASTM 136-84a and ASTM 117-90	None	Plastic - wide mouth 500 mℓ

ICP - Inductively coupled plasma atomic emission spectroscopy

EPA (1986) - US Environmental Protection Agency (EPA), 1986, "Test Methods for Evaluating Solid Waste - Physical Chemical Methods, Third Edition (Revised), SW-846."

[1] - Graphite Furnace AA

[2] - Cold Vapor Detector

ALPHA SPEC. - Alpha radiation spectrographic analysis including Americium, Plutonium, and Uranium

GAMMA SPEC. - Gamma ray spectrographic analysis

N/A - Not applicable, transport sample to lab on same day, analyze as soon as practical

ASTM - American Society of Testing and Materials

Figure 1 COLUMBIA RIVER SEDIMENT SAMPLING CHECKLIST

Activity Performed	Signature - Date - Time
TAILGATE SAFETY MEETING COMPLETED	_____
SAMPLES COLLECTED AND LABELED	_____
SAMPLES SURVEYED BY HPT	_____
SAMPLES PACKED IN ICE AT END OF DAY	_____
CHAIN OF CUSTODY FORM INITIATED FOR TOTAL ACTIVITY SAMPLES	_____
SAMPLE ANALYSIS REQUEST FORMS COMPLETED FOR TOTAL ACTIVITY ANALYSIS	_____
TOTAL ACTIVITY SAMPLE DELIVERED TO LABORATORY	_____
TOTAL ACTIVITY SAMPLE SCAN COMPLETED	_____
RADIATION RELEASE COMPLETED	_____
SAMPLE ANALYSIS REQUEST COMPLETED FOR CHEMICAL, RADIOLOGICAL, AND SIEVE ANALYSES	_____
CHAIN OF CUSTODY FORM INITIATED FOR CHEMICAL, RADIOLOGICAL, AND SIEVE ANALYSES	_____
SAMPLES SHIPPED TO LABORATORY	_____
DAILY LIST OF SAMPLES	_____

Figure 2 COLUMBIA RIVER SEDIMENT SAMPLING PROJECT CHANGE FORM

COLUMBIA RIVER SEDIMENT SAMPLING PROJECT CHANGE FORM

Date: _____

Person Initiating Change: _____

Change: _____

_____

_____

_____

_____

_____

Reason for Change: _____

_____

_____

_____

_____

_____

APPROVAL:

Field Team Leader: _____

Operable Unit Coordinator: _____

Environmental QA Representative: _____

Figure 3 FIELD ACTIVITY DAILY LOG

INTERNATIONAL TECHNOLOGY CORPORATION

DAILY LOG			
DATE			
NO.			
SHEET		OF	

FIELD ACTIVITY DAILY LOG

PROJECT NAME	PROJECT NO.
FIELD ACTIVITY SUBJECT:	
DESCRIPTION OF DAILY ACTIVITIES AND EVENTS:	
VISITORS ON SITE:	CHANGES FROM PLANS AND SPECIFICATIONS, AND OTHER SPECIAL ORDERS AND IMPORTANT DECISIONS.
WEATHER CONDITIONS:	IMPORTANT TELEPHONE CALLS:
IT PERSONNEL ON SITE:	
SIGNATURE	DATE:

9413096.0711

Figure 4 TAILGATE SAFETY MEETING

TAILGATE SAFETY MEETING

Division/Subsidiary _____ Facility _____

Date _____ Time _____ Job Number _____

Customer _____ Address: _____

Specific Location _____

Type of Work _____

Chemicals Used _____

SAFETY TOPICS PRESENTED

Protective Clothing/Equipment _____

Chemical Hazards _____

Physical Hazards _____

Emergency Procedures _____

Hospital / Clinic _____ Phone ( ) _____ Paramedic Phone ( ) _____

Hospital Address _____

Special Equipment _____

Other _____

ATTENDEES

NAME PRINTED	SIGNATURE

Meeting conducted by:

_____ _____
NAME PRINTED SIGNATURE

Supervisor _____ Manager _____

30-6-85

Figure 5 SAMPLE COLLECTION LOG

INTERNATIONAL TECHNOLOGY CORPORATION

DATE	
TIME	
PAGE ____ OF ____	
PAGE	
PROJECT NO.	

SAMPLE COLLECTION LOG

PROJECT NAME _____

SAMPLE NO. _____

SAMPLE LOCATION _____

SAMPLE TYPE _____

COMPOSITE ____ YES ____ NO

COMPOSITE TYPE _____

DEPTH OF SAMPLE _____

WEATHER _____

CONTAINERS USED	AMOUNT COLLECTED

COMMENTS:

PREPARED BY: _____

Figure 6 SAMPLE ANALYSIS REQUEST FORM

Westinghouse Hanford Company

SAMPLE ANALYSIS REQUEST

PART I: FIELD SECTION

Collector _____ Date Sampled _____ Time ____ hours

Company Contact _____ Telephone (____) _____

Sample Number	Number and Type of Sample Containers	Type of Sample*	Analysis Requested

Field Information** _____

Special Handling and/or Storage _____

Possible Sample Hazards _____

PART II: LABORATORY SECTION

Received by _____ Title _____ Date _____

Analysis Required _____

*Indicate whether sample is soil, sludge, water, etc.
**Use back of page for additional information relative to sample location.

A-6000-406 (05/90)

Figure 7 CHAIN OF CUSTODY FORM

Westinghouse Hanford Company	CHAIN OF CUSTODY

Custody Form Initiator _____

Company Contact _____ Telephone _____

Project Designation/Sampling Locations _____ Collection Date _____

_____

Ice Chest No. _____ Field Logbook No. _____

Bill of Lading/Airbill No. _____ Offsite Property No. _____

Method of Shipment _____

Shipped to _____

Possible Sample Hazards/Remarks _____

_____

Sample Identification

☐ Field Transfer of Custody — CHAIN OF POSSESSION — (Sign and Print Names)

Relinquished by:	Received by:	Date/Time:
Relinquished by:	Received by:	Date/Time:
Relinquished by:	Received by:	Date/Time:
Relinquished by:	Received by:	Date/Time:

Final Sample Disposition

Disposal Method:	Disposed by:	Date/Time:

Comments:

L-6000-407 (12/90)

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APPENDIX B - VALIDATED METALS DATA SUMMARY TABLES

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Data Validation Qualifier Codes for Inorganic Analyses

B - Analyte concentration is greater than instrument detection limit but less than contract required detection limit

J - Concentration estimated due to quality control deficiencies

U - Analyte not detected, detection limit shown

BJ - Estimated concentration is greater than instrument detection limit but less than contract required detection limit, concentration estimated due to quality control deficiencies

UJ - Analyte not detected, estimated detection limit shown

9413096.0212

Parameter	Samp# / Date / Site / Depth / Type	B07NC8 11-19-92 Eq Blk 0.00 - 0.00 Eq Blk		B07NG8 11-23-92 Eq Blk 0.00 - 0.00 Eq Blk		B07ND1 11-20-92 SITE BC1 0.00 - 6.00 Duplicate		B07ND9 11-20-92 SITE BC1 0.00 - 6.00		B07NF3 11-20-92 SITE BC2 0.00 - 6.00		B07NF4 11-20-92 SITE BC2 12.00 - 18.00	
	Units	Result	Q	Result	Q	Result	Q	Result	Q	Result	Q	Result	Q
Inorganics													
ALUMINUM	MG/KG	387.000		572.000		4720.000		3650.000		5670.000		7460.000	
ANTIMONY	MG/KG	3.200	UJ	4.400	UJ	4.700	UJ	3.800	UJ	4.800	UJ	3.900	UJ
ARSENIC	MG/KG	0.570	BJ	0.700	J	1.890	J	1.600	BJ	1.200	BJ	1.200	BJ
BARIUM	MG/KG	8.000	B	13.600	J	58.300		45.800		50.400	B	71.800	
BERYLLIUM	MG/KG	0.080	U	0.100	U	0.110	U	0.090	U	0.110	U	0.090	U
CADMIUM	MG/KG	0.190	U	0.260	U	0.280	U	0.220	U	0.280	U	0.230	U
CALCIUM	MG/KG	127.000	B	162.000	B	2140.000		1850.000		2960.000		3110.000	
CHROMIUM	MG/KG	0.850	U	1.200	B	47.600		50.600		65.200		131.000	
COBALT	MG/KG	0.600	U	0.810	B	6.400	U	4.600	B	5.400	B	7.300	B
COPPER	MG/KG	1.300	B	0.910	U	10.200		7.000		11.500		19.200	
IRON	MG/KG	1940.000		1940.000		97[illegible] 000		8690.000		10900.000		14100.000	
LEAD	MG/KG	1.700	J	2.800		[illegible]		7.300		19.300		39.200	
MAGNESIUM	MG/KG	61.800	B	88.600	U	2630.000		2210.000		3400.000		3950.000	
MANGANESE	MG/KG	42.100	J	58.600	J	220.000	J	100.000	J	110.000	J	140.000	J
MERCURY	MG/KG	0.040	U	0.060	U	0.070	U	0.060	U	0.070	U	0.060	U
NICKEL	MG/KG	1.000	U	1.400	U	12.600		9.300		11.200	B	15.200	
POTASSIUM	MG/KG	76.600	B	147.000	B	819.000	B	640.000	B	789.000	B	1150.000	
SELENIUM	MG/KG	0.580	U	0.920	U	0.820	U	0.670	UJ	0.820	U	0.630	U
SILVER	MG/KG	0.470	U	0.860	U	0.700	U	0.780	U	0.710	U	0.570	U
SODIUM	MG/KG	22.400	B	51.600	U	114.000	B	96.600	B	167.000	B	145.000	B
THALLIUM	MG/KG	0.260	UJ	0.970	U	0.370	UJ	0.300	UJ	0.370	UJ	0.280	UJ
VANADIUM	MG/KG	1.800	U	1.800	U	23.400		19.100		28.200		34.800	
ZINC	MG/KG	7.100	J	8.300	U	83.100	J	73.100	J	159.000	J	192.000	J

Parameter	Sample Date Site Depth Type	B07ND0 11-17-92 SITE D/H 0.00 - 6.00		B07NC9 11-17-92 SITE D/H 12.00 - 18.00		B07NF0 11-19-92 SITE D4 0.00 - 6.00		B07NF1 11-19-92 SITE D5 0.00 - 6.00		B07NF2 11-19-92 SITE D5 12.00 - 18.00		B07NH1 11-23-92 SITE DA1 0.00 - 6.00	
	Units	Result	Q	Result	Q	Result	Q	Result	Q	Result	Q	Result	Q
Inorganics													
ALUMINUM	MG/KG	5340.000		5960.000		7400.000		5220.000		9680.000		8030.000	
ANTIMONY	MG/KG	6.800	BJ	3.600	UJ	7.500	UJ	3.800	UJ	4.300	UJ	4.200	UJ
ARSENIC	MG/KG	2.300	B	6.300		1.900	B	2.000	B	4.400		6.100	
BARIUM	MG/KG	40.900	B	83.000		55.200	B	52.800		89.300		73.200	J
BERYLLIUM	MG/KG	0.200	B	0.310	B	0.180	U	0.110	B	0.100	U	0.100	U
CADMIUM	MG/KG	0.870	U	0.910	U	3.400	U	1.100	U	1.700	U	1.600	
CALCIUM	MG/KG	3180.000		2750.000		5070.000		3990.000		4470.000		4260.000	
CHROMIUM	MG/KG	15.000		17.900		14.100		47.000		21.900		22.300	
COBALT	MG/KG	5.400	B	8.300	B	5.700	B	8.800	B	8.800	B	7.700	B
COPPER	MG/KG	23.300	J	22.300	J	23.100		15.900		21.300		23.800	
IRON	MG/KG	11500.000		16200.000		13900.000		17800.000		18500.000		16700.000	
LEAD	MG/KG	23.300	J	11.900	J	32.000		18.600		27.300		59.800	
MAGNESIUM	MG/KG	3130.000		3380.000		3870.000		3700.000		5230.000		4640.000	
MANGANESE	MG/KG	168.000	J	244.000	J	181.000		207.000		209.000		202.000	J
MERCURY	MG/KG	0.070	U	0.050	U	0.100	B	0.060	U	0.060	U	0.070	B
NICKEL	MG/KG	12.000		14.900		11.200	B	7.900	B	16.200		14.300	
POTASSIUM	MG/KG	614.000	B	552.000	B	962.000	B	661.000	B	1500.000		993.000	B
SELENIUM	MG/KG	1.100	UJ	0.870	UJ	1.200	U	0.690	U	0.780	UJ	0.860	U
SILVER	MG/KG	1.000	U	0.890	U	1.100	U	0.810	J	0.640	U	1.400	U
SODIUM	MG/KG	242.000	B	122.000	B	364.000	B	213.000	B	237.000	B	224.000	B
THALLIUM	MG/KG	1.100	U	0.870	U	0.820	B	0.610	J	0.460	B	0.910	U
VANADIUM	MG/KG	26.800		36.600		35.900		44.400		40.600		35.400	
ZINC	MG/KG	221.000		279.000		377.000		221.000		257.000		294.000	

Parameter	Samp# / Date / Site / Depth / Type	B07NH2 11-23-92 SITE DA1 12.00 - 20.00		B07ND4 11-19-92 SITE DI1 0.00 - 6.00		B07ND7 11-19-92 SITE DI1 0.00 - 6.00 Duplicate		B07ND6 11-19-92 SITE DI2 0.00 - 6.00		B07ND8 11-19-92 SITE DI2 12.00 - 20.00		B07NH5 11-24-92 SITE DI3 0.00 - 6.00	
	Units	Result	Q	Result	Q	Result	Q	Result	Q	Result	Q	Result	Q
Inorganics													
ALUMINUM	MG/KG	11100.000		5290.000		6020.000		5580.000		5260.000		4400.000	
ANTIMONY	MG/KG	4.700	J	4.100	UJ	4.200	UJ	3.300	UJ	3.400	UJ	3.900	UJ
ARSENIC	MG/KG	6.000		2.900	B	3.100		2.700		2.200		3.000	
BARIUM	MG/KG	111.000	J	45.500	B	53.100		51.900		40.000	B	42.300	J
BERYLLIUM	MG/KG	0.540	B	0.100	U	0.100	U	0.080	U	0.080	U	0.090	U
CADMIUM	MG/KG	0.200	U	0.330	U	0.390	U	0.200	U	0.200	U	0.230	U
CALCIUM	MG/KG	2830.000		3650.000		3880.000		9120.000		2140.000		2770.000	
CHROMIUM	MG/KG	31.900		10.300		12.900		10.600		9.200		9.100	
COBALT	MG/KG	9.700	B	5.400	B	6.000	B	5.100	B	4.000	B	4.200	B
COPPER	MG/KG	31.100		26.000		27.500		20.700		6.900		18.200	
IRON	MG/KG	31100.000		13100.000		14200.000		13400.000		11400.000		10200.000	
LEAD	MG/KG	11.400		18.000		20.600		23.600		3.400		24.100	
MAGNESIUM	MG/KG	3880.000		3800.000		4230.000		3840.000		3690.000		3010.000	
MANGANESE	MG/KG	168.000	J	193.000		250.000		195.000		164.000		206.000	J
MERCURY	MG/KG	0.050	U	0.060	U	0.060	U	0.050	U	0.050	U	0.060	U
NICKEL	MG/KG	21.600		10.000		12.600		10.500		10.700		8.400	B
POTASSIUM	MG/KG	619.000	B	716.000	B	797.000	B	653.000	B	563.000	B	560.000	B
SELENIUM	MG/KG	0.740	UJ	3.400	U	0.660	UJ	0.580	U	0.580	U	0.810	UJ
SILVER	MG/KG	0.940	U	0.610	U	0.630	U	0.490	U	0.500	U	0.610	U
SODIUM	MG/KG	113.000	B	279.000	B	299.000	B	224.000	B	103.000	B	199.000	B
THALLIUM	MG/KG	0.780	UJ	0.300	U	0.390	B	0.260	U	0.260	U	0.850	U
VANADIUM	MG/KG	86.200		27.900		30.000		26.900		23.200		18.300	
ZINC	MG/KG	85.100		192.000		203.000		144.000		26.800		185.000	

Parameter	Samp# / Date / Site / Depth / Type	B07NH6 11-24-92 SITE D13 0.00 - 6.00 Duplicate		B07NH7 11-24-92 SITE D13 0.00 - 6.00 Split		B07NB7 11-12-92 SITE F2 0.00 - 6.00		B07NB8 11-12-92 SITE F3 0.00 - 6.00		B07NB9 11-12-92 SITE F3 12.00 - 24.00		B07NC4 11-16-92 SITE F4 0.00 - 6.00	
	Units	Result	Q	Result	Q	Result	Q	Result	Q	Result	Q	Result	Q
Inorganics													
ALUMINUM	MG/KG	5630.000		2460.000		7380.000		7260.000		8490.000		6030.000	
ANTIMONY	MG/KG	4.200	UJ	14.700	U	4.700	UJ	4.300	UJ	4.000	UJ	4.100	UJ
ARSENIC	MG/KG	2.800		2.200	BJ	6.000		5.400		6.200		5.700	
BARIUM	MG/KG	53.300	J	36.200	B	68.400		56.100		70.300		56.100	
BERYLLIUM	MG/KG	0.100	U	0.250	U	0.460	B	0.530	B	0.630	B	0.220	B
CADMIUM	MG/KG	0.250	U	1.720	U	0.280	U	0.240	U	0.240	U	0.410	U
CALCIUM	MG/KG	3460.000		2740.000		4180.000		4100.000		4300.000		4850.000	
CHROMIUM	MG/KG	11.300		5.300		17.700		28.100		45.700		16.800	
COBALT	MG/KG	5.900	B	3.300	B	7.600	B	8.100	B	8.900	B	7.700	B
COPPER	MG/KG	23.700		23.000		51.400		37.400		42.100		69.600	J
IRON	MG/KG	12500.000		6480.000	J	16100.000		17400.000		18300.000		19300.000	
LEAD	MG/KG	24.800		18.100		49.700		31.400		44.300		50.000	J
MAGNESIUM	MG/KG	3830.000		1480.000		4440.000		4630.000		5140.000		3690.000	
MANGANESE	MG/KG	234.000	J	144.000		165.000		197.000		254.000		179.000	J
MERCURY	MG/KG	0.060	U	0.060	UJ	0.060	U	0.080	B	0.090	B	0.060	U
NICKEL	MG/KG	11.200		7.400	B	14.000		12.800		16.300		11.100	
POTASSIUM	MG/KG	726.000	B	424.000	B	1010.000	B	1080.000	B	1200.000		887.000	B
SELENIUM	MG/KG	0.890	U	0.500	UJ	0.750	U	0.730	U	0.840	B	1.000	UJ
SILVER	MG/KG	0.890	U	5.300	J	0.980	U	0.800	U	0.760	U	0.990	U
SODIUM	MG/KG	272.000	B	219.000	B	227.000	B	215.000	B	209.000	B	346.000	B
THALLIUM	MG/KG	0.940	U	0.520	BJ	0.980	UJ	0.960	UJ	0.940	UJ	1.000	U
VANADIUM	MG/KG	23.600		6.500	B	33.200		38.300		39.100		43.700	
ZINC	MG/KG	209.000		167.000		309.000		246.000		195.000		315.000	

Parameter	Samp# / Date / Site / Depth / Type	B07NC5 11-16-92 SITE F4 12.00 - 16.00		B07NH3 11-23-92 SITE FF1 0.00 - 6.00		B07NH4 11-23-92 SITE FF1 12.00 - 20.00		B07NG9 11-23-92 SITE F11 0.00 - 6.00		B07NH0 11-23-92 SITE F11 12.00 - 18.00		B07NC0 11-13-92 SITE H1 0.00 - 6.00	
	Units	Result	Q	Result	Q	Result	Q	Result	Q	Result	Q	Result	Q
Inorganics													
ALUMINUM	MG/KG	5940.000		6410.000		7700.000		6700.000		5040.000		9060.000	
ANTIMONY	MG/KG	3.500	UJ	4.100	UJ	4.200	UJ	4.000	UJ	4.200	UJ	3.600	UJ
ARSENIC	MG/KG	3.000		4.500		3.500		4.900		4.900	J	7.900	
BARIUM	MG/KG	48.800		100.000	J	97.100	J	48.700	J	48.100	J	89.500	
BERYLLIUM	MG/KG	0.240	B	0.100	U	0.100	U	0.090	U	0.100	U	0.570	B
CADMIUM	MG/KG	0.350	U	0.240	U	0.250	U	0.530	U	0.380	U	1.200	U
CALCIUM	MG/KG	1760.000		5450.000		6210.000		4060.000		2300.000		4530.000	
CHROMIUM	MG/KG	16.100		10.100		12.500		15.400		12.500		22.600	
COBALT	MG/KG	7.200	B	8.000	B	7.200	B	6.600	B	4.800	B	8.500	B
COPPER	MG/KG	27.200	J	13.400		16.500		29.300		12.800		34.000	
IRON	MG/KG	22000.000		12800.000		13400.000		14700.000		11700.000		17300.000	
LEAD	MG/KG	3.800	J	22.600		12.100		49.700		11.100		43.400	
MAGNESIUM	MG/KG	2890.000		3940.000		4420.000		4190.000		3760.000		5320.000	
MANGANESE	MG/KG	146.000	J	344.000	J	286.000	J	156.000	J	170.000	J	284.000	
MERCURY	MG/KG	0.050	U	0.060	U	0.070	U	0.070	U	0.060	U	0.060	B
NICKEL	MG/KG	16.100		10.400		9.900	B	11.700		13.900		16.200	
POTASSIUM	MG/KG	573.000	B	952.000	B	1210.000	B	855.000	B	570.000	B	1550.000	
SELENIUM	MG/KG	0.890	UJ	0.850	UJ	0.870	U	0.880	UJ	0.830	U	1.800	J
SILVER	MG/KG	1.500	B	0.770	U	0.630	U	1.300	U	0.620	U	1.000	U
SODIUM	MG/KG	98.300	B	144.000	B	141.000	B	291.000	B	147.000	B	225.000	B
THALLIUM	MG/KG	0.890	U	0.890	U	0.920	U	0.930	U	0.880	U	0.820	UJ
VANADIUM	MG/KG	40.300		25.400		25.900		29.800		21.100		35.300	
ZINC	MG/KG	27.600		82.000		96.000		296.000		97.300		287.000	

Parameter	Sample#	B07NC1		B07NC2		B07NL3		B07NC6		B07NC7		B07ND2	
	Date	11-13-92		11-13-92		11-13-92		11-16-92		11-16-92		11-17-92	
	Site	SITE N1		SITE N2		SITE N3		SITE NAN1		SITE NAN1		SITE NAN2	
	Depth	12.00 - 18.00		0.00 - 6.00		0.00 - 6.00		0.00 - 6.00		12.00 - 16.00		0.00 - 6.00	
	Type												
	Units	Result	Q	Result	Q	Result	Q	Result	Q	Result	Q	Result	Q
Inorganics													
ALUMINUM	MG/KG	9690.000		5480.000		5790.000		[illegible].000		6030.000		6790.000	
ANTIMONY	MG/KG	3.500	UJ	4.400	UJ	4.900	UJ	3.700	BJ	3.400	UJ	3.800	UJ
ARSENIC	MG/KG	12.600		2.400	B	4.500		2.500		5.600		3.400	
BARIUM	MG/KG	82.300		54.300		44.300	B	48.800	B	48.200		63.500	
BERYLLIUM	MG/KG	0.210	B	0.420	B	0.500	B	0.180	B	0.170	B	0.290	B
CADMIUM	MG/KG	0.200	U	0.260	U	0.630	U	0.370	U	0.990	U	1.400	U
CALCIUM	MG/KG	2790.000		3780.000		3940.000		2960.000		3040.000		4060.000	
CHROMIUM	MG/KG	28.900		18.800		28.300		13.400		13.200		20.000	
COBALT	MG/KG	9.400	B	6.200	B	5.900	B	5.900	B	6.400	B	6.700	B
COPPER	MG/KG	42.700		32.600		26.100		23.900	J	24.500	J	29.100	J
IRON	MG/KG	29700.000		13500.000		13600.000		12800.000		13000.000		13700.000	
LEAD	MG/KG	16.400		35.700		28.300		14.900	J	39.100	J	42.800	J
MAGNESIUM	MG/KG	3610.000		3450.000		3620.000		3830.000		3810.000		3920.000	
MANGANESE	MG/KG	296.000		206.000		117.000		161.000	J	146.000	J	130.000	J
MERCURY	MG/KG	0.060	B	0.060	U	0.080	U	0.060	U	0.680		0.080	B
NICKEL	MG/KG	22.600		9.800	B	10.000	B	13.000		12.400		11.800	
POTASSIUM	MG/KG	541.000	B	687.000	B	706.000	B	697.000	B	822.000	B	802.000	B
SELENIUM	MG/KG	0.600	UJ	0.830	B	1.100	B	0.900	UJ	0.930	UJ	0.970	UJ
SILVER	MG/KG	1.800	U	0.770	U	0.730	U	0.880	U	0.820	U	0.920	U
SODIUM	MG/KG	137.000	B	249.000	B	267.000	B	161.000	B	155.000	B	198.000	B
THALLIUM	MG/KG	0.780	UJ	0.940	UJ	1.000	U	0.900	U	0.930	U	0.970	U
VANADIUM	MG/KG	83.200		28.900		41.000		25.200		25.300		33.600	
ZINC	MG/KG	79.400		168.000		141.000		123.000		219.000		293.000	

Parameter	Samp# / Date / Site / Depth / Type	B07ND3 11-17-92 SITE NAN2 12.00 - 18.00		B07NG3 11-22-92 SITE HU1 0.00 - 6.00		B07NG6 11-22-92 SITE HU1 0.00 - 6.00 Duplicate		B07NG5 11-22-92 SITE HU1 12.00 - 18.00		B07NG7 11-22-92 SITE HU1 12.00 - 18.00 Split		B07NG1 11-21-92 SITE K2 0.00 - 3.00	
	Units	Result	Q	Result	Q	Result	Q	Result	Q	Result	Q	Result	Q
Inorganics													
ALUMINUM	MG/KG	7430.000		7640.000		7430.000		8620.000		4830.000		6040.000	
ANTIMONY	MG/KG	3.600	UJ	4.400	UJ	4.600	UJ	4.000	UJ	17.800	U	4.800	UJ
ARSENIC	MG/KG	3.200		4.500		3.900		4.800		4.300	J	6.000	
BARIUM	MG/KG	68.200		58.400	J	58.500	J	88.500	J	76.500		58.000	J
BERYLLIUM	MG/KG	0.340	B	0.100	U	0.110	U	0.090	U	0.420	B	0.110	U
CADMIUM	MG/KG	0.610	U	2.000		1.700		1.200	U	2.080	U	0.650	U
CALCIUM	MG/KG	3610.000		3720.000		3520.000		3970.000		3280.000		3580.000	
CHROMIUM	MG/KG	17.600		22.800		21.700		20.800		13.300		24.300	
COBALT	MG/KG	8.500	B	8.500	B	7.800	B	8.600	B	7.000	B	6.700	B
COPPER	MG/KG	25.400	J	18.900		18.400		21.500		17.200		23.200	
IRON	MG/KG	18800.000		15500.000		15000.000		16700.000		10500.000	J	14900.000	
LEAD	MG/KG	17.100	J	32.700	J	31.300		27.800		27.900		30.500	
MAGNESIUM	MG/KG	4090.000		4450.000		4350.000		4990.000		3040.000		3870.000	
MANGANESE	MG/KG	155.000	J	193.000	J	193.000	J	182.000	J	130.000		231.000	J
MERCURY	MG/KG	0.060	U	0.070	B	0.080	B	0.050	U	0.070	UJ	0.070	U
NICKEL	MG/KG	15.000		13.800		14.500		15.100		11.800	B	12.300	
POTASSIUM	MG/KG	864.000	B	1040.000	B	1050.000	B	1420.000		1080.000	B	831.000	B
SELENIUM	MG/KG	0.910	UJ	1.000	U	0.970	UJ	0.890	U	0.590	UJ	1.000	UJ
SILVER	MG/KG	0.870	U	0.650	U	0.680	U	1.000	U	2.970	UJ	0.890	U
SODIUM	MG/KG	179.000	B	205.000	B	209.000	B	194.000	B	131.000	B	237.000	B
THALLIUM	MG/KG	0.910	U	1.100	UJ	1.000	UJ	0.940	UJ	0.590	UJ	1.100	U
VANADIUM	MG/KG	43.600		29.900		28.700		33.900		14.500	B	31.800	
ZINC	MG/KG	155.000		397.000		369.000		253.000		230.000		209.000	

Parameter	Samp# / Date / Site / Depth / Type	B07NG2 11-21-92 SITE K3 0.00 - 6.00		B07NG0 11-21-92 SITE KU1 0.00 - 6.00		B07NF9 11-22-92 SITE KU1 12.00 - 18.00		B07NG4 11-22-92 SITE N 0.00 - 3.00		B07NF5 11-20-92 SITE VBU1 0.00 - 6.00		B07NF6 11-20-92 SITE VBU1 12.00 - 22.00	
	Units	Result	Q	Result	Q	Result	Q	Result	Q	Result	Q	Result	Q
Inorganics													
ALUMINUM	MG/KG	7550.000		7250.000		9850.000		5110.000		7470.000		5990.000	
ANTIMONY	MG/KG	3.700	UJ	5.100	UJ	4.900	UJ	4.500	UJ	4.200	UJ	4.200	UJ
ARSENIC	MG/KG	2.900		5.100		6.200		10.700		9.400	J	1.900	BJ
BARIUM	MG/KG	55.100	J	61.300	J	87.500	J	60.500	J	70.900		57.000	
BERYLLIUM	MG/KG	0.090	U	0.120	U	0.120	U	0.110	U	0.100	U	0.100	U
CADMIUM	MG/KG	0.220	U	1.500	U	5.600		0.270	U	0.300	B	0.250	U
CALCIUM	MG/KG	3760.000		4070.000		5040.000		3310.000		3480.000		2760.000	
CHROMIUM	MG/KG	18.800		25.800		64.100		56.400		15.000		13.200	
COBALT	MG/KG	6.700	B	7.300	B	10.100	B	6.700	B	7.200	B	6.400	B
COPPER	MG/KG	17.700		20.500		42.700		14.900		24.700		9.900	
IRON	MG/KG	15400.000		15300.000		17600.000		15800.000		15400.000		12600.000	
LEAD	MG/KG	10.600		40.200		59.300		23.900		57.700	J	5.800	
MAGNESIUM	MG/KG	4640.000		4320.000		5520.000		3310.000		4540.000		4060.000	
MANGANESE	MG/KG	222.000	J	203.000	J	173.000	J	305.000	J	189.000	J	160.000	J
MERCURY	MG/KG	0.060	U	0.060	U	0.090	B	0.070	U	0.060	U	0.060	U
NICKEL	MG/KG	15.200		13.700		19.100		10.900		15.600		13.100	
POTASSIUM	MG/KG	877.000	B	1010.000	B	1650.000		630.000	B	1100.000	B	836.000	B
SELENIUM	MG/KG	0.830	UJ	1.100	U	1.100	UJ	0.920	UJ	0.700	U	0.720	U
SILVER	MG/KG	0.550	U	0.920	U	1.400	U	0.660	U	0.620	U	0.630	U
SODIUM	MG/KG	168.000	B	232.000	B	213.000	B	166.000	B	138.000	B	102.000	B
THALLIUM	MG/KG	0.880	U	1.100	U	1.100	U	0.970	U	0.310	UJ	0.320	UJ
VANADIUM	MG/KG	30.500		30.800		41.700		32.700		28.900		23.800	
ZINC	MG/KG	94.800		378.000		454.000		152.000		226.000	J	43.700	J

Parameter	Samp# / Date / Site / Depth / Type	B07NF7 11-20-92 SITE VBU2 0.00 - 6.00		B07NF8 11-20-92 SITE VBU3 0.00 - 3.00		B07NB6 11-12-92 SITE F1 0.00 - 6.00		B07ND5 11-19-92 SITE DI1 12.00 - 18.00	
	Units	Result	Q	Result	Q	Result	Q	Result	Q
Inorganics									
ALUMINUM	MG/KG	4790.000		5040.000		7230.000		5740.000	
ANTIMONY	MG/KG	4.000	UJ	4.000	UJ	4.500	UJ	4.000	UJ
ARSENIC	MG/KG	2.400	J	5.800	J	7.400		3.500	
BARIUM	MG/KG	33.100	B	51.000		73.000		50.900	
BERYLLIUM	MG/KG	0.100	U	0.100	U	0.430	B	0.100	U
CADMIUM	MG/KG	0.650	B	0.620	B	0.410	U	0.450	U
CALCIUM	MG/KG	3640.000		3300.000		3730.000		4020.000	
CHROMIUM	MG/KG	14.800		11.200		15.200		9.400	
COBALT	MG/KG	6.300	B	6.300	B	8.000	B	5.400	B
COPPER	MG/KG	20.400		20.600		62.900		34.200	
IRON	MG/KG	14900.000		13200.000		15900.000		13100.000	
LEAD	MG/KG	15.300		27.000		55.700		21.600	
MAGNESIUM	MG/KG	3440.000		3290.000		4440.000		3870.000	
MANGANESE	MG/KG	160.000	J	263.000	J	194.000		251.000	
MERCURY	MG/KG	0.050	U	0.060	U	0.070	U	0.060	
NICKEL	MG/KG	12.400		11.000		14.100		8.900	B
POTASSIUM	MG/KG	565.000	B	659.000	B	955.000	B	736.000	B
SELENIUM	MG/KG	0.690	U	0.690	UJ	0.790	U	0.720	U
SILVER	MG/KG	0.590	U	0.590	UJ	0.990	U	0.590	U
SODIUM	MG/KG	208.000	B	213.000	B	215.000	B	339.000	B
THALLIUM	MG/KG	0.350	BJ	0.560	BJ	1.000	UJ	0.320	U
VANADIUM	MG/KG	40.300		27.600		28.600		26.400	
ZINC	MG/KG	151.000	J	205.000	J	335.000		216.000	

APPENDIX C - VALIDATED RADIONUCLIDE DATA SUMMARY TABLES

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Data Validation Qualifier Codes for Radiological Analyses

J - Concentration estimated due to quality control deficiencies
R - Concentration rejected due to quality control deficiencies
U - Analyte not detected, detection limit shown
UJ - Analyte not detected, estimated detection limit shown
UR - Analyte not detected, concentration rejected due to quality control deficiencies

Other Acronyms

N/R - Concentration not reported

9413096.1728

Parameter	Sampl#	B07NC8		B07NG8		B07ND1		B07ND9		B07NF3		B07NF4	
	Date	11-19-92		11-23-92		11-20-92		11-20-92		11-20-92		11-20-92	
	Site	Eq Blk		Eq Blk		SITE BC1		SITE BC1		SITE BC2		SITE BC2	
	Depth	0.00 - 0.00		0.00 - 0.00		0.00 - 6.00		0.00 - 6.00		0.00 - 6.00		12.00 - 18.00	
	Type	Eq Blk		Eq Blk		Duplicate							
	Units	Result	Q	Result	Q	Result	Q	Result	Q	Result	Q	Result	Q
Radionuclides													
GROSS ALPHA	pCi/g	5.000	U	4.000	U	6.700	J	5.000	U	8.000	U	8.100	J
GROSS BETA	pCi/g	27.000		30.000		13.000		14.000		13.000		16.000	
URANIUM-233/234	pCi/g	0.200	U	0.220	J	0.590		0.450		0.570		0.840	
URANIUM-235	pCi/g	0.200	UR	0.200	U	0.200	UR	0.300	UR	0.200	UR	0.200	UR
URANIUM-238	pCi/g	0.200	U	0.200	J	0.440		0.260	J	0.520		1.100	
PLUTONIUM-238	pCi/g	0.040	U	0.050	U	0.060	U	0.060	U	0.040	U	0.040	U
PLUTONIUM-239	pCi/g	0.030	U	0.030	U	0.040	U	0.020	U	0.020	U	0.010	U
AMERICIUM-241	pCi/g	0.090	U	0.030	U	0.030	U	0.100	UR	0.050	U	0.050	U
STRONTIUM-90	pCi/g	0.100	U	0.900	U	0.200	U	0.200	U	0.100	U	0.800	U
POTASSIUM-40	pCi/g	22.000		23.000		12.000		12.000		15.000		15.000	
IRON-59	pCi/g	0.400	U	0.400	U	0.300	U	0.100	U	0.200	U	0.200	U
CHROMIUM-51	pCi/g	2.000	U	2.000	U	2.000	U	0.800	U	0.900	U	1.000	U
COBALT-60	pCi/g	0.050	U	0.060	U	0.050	U	0.020	U	0.040	U	0.020	U
ZINC-65	pCi/g	0.200	U	0.200	U	0.100	U	0.060	U	0.080	U	0.080	U
RUTHENIUM-106	pCi/g	0.400	U	0.400	U	0.400	U	0.200	U	0.200	U	0.200	U
CESIUM-134	pCi/g	0.050	U	0.060	U	0.050	U	0.040	U	0.030	U	0.030	U
CESIUM-137	pCi/g	0.040	UJ	0.050	U	0.050	UJ	0.031	J	0.058	J	0.020	UJ
EUROPIUM-152	pCi/g	0.090	UJ	0.070	U	0.090	UJ	0.050	UJ	0.050	UJ	0.050	UJ
EUROPIUM-154	pCi/g	0.060	UJ	0.050	U	0.060	UJ	0.030	UJ	0.030	UJ	0.040	UJ
RADIUM-226	pCi/g	0.280		0.240		0.510		0.520		0.580		0.700	
THORIUM-228	pCi/g	0.550		0.460		1.100		0.820		1.000		1.400	
THORIUM-232	pCi/g	0.510		0.340		0.750		0.790		0.950		1.100	
EUROPIUM-155	pCi/g	N/R		N/R		N/R		N/R		N/R		N/R	
MANGANESE-54	pCi/g	N/R		N/R		N/R		N/R		N/R		N/R	
TECHNETIUM-99	pCi/g	N/R		N/R		N/R		N/R		N/R		N/R	
URANIUM-238 GAMMA SCAN	pCi/g	N/R		N/R		N/R		N/R		N/R		N/R	
COBALT-58	pCi/g	N/R		N/R		N/R		N/R		N/R		N/R	
CERIUM-144	pCi/g	N/R		N/R		N/R		N/R		N/R		N/R	
NEPTUNIUM-237	pCi/g	N/R		N/R		N/R		N/R		N/R		N/R	
THORIUM-231	pCi/g	N/R		N/R		N/R		N/R		N/R		N/R	
THORIUM-234	pCi/g	N/R		N/R		N/R		N/R		N/R		N/R	
RADIUM-228	pCi/g	N/R		N/R		N/R		N/R		N/R		N/R	
RADIUM-223	pCi/g	N/R		N/R		N/R		N/R		N/R		N/R	

Parameter	Samp# / Date / Site / Depth / Type	B07ND0 11-17-92 SITE D/N 0.00 - 6.00		B07NC9 11-17-92 SITE D/N 12.00 - 18.00		B07NF0 11-19-92 SITE D4 0.00 - 6.00		B07NF1 11-19-92 SITE D5 0.00 - 6.00		B07NF2 11-19-92 SITE D5 12.00 - 18.00		B07NH1 11-23-92 SITE DA1 0.00 - 6.00	
	Units	Result	Q	Result	Q	Result	Q	Result	Q	Result	Q	Result	Q
Radionuclides													
GROSS ALPHA	pCi/g	8.000	UJ	16.000	J	8.700	J	5.700	J	8.000	U	7.700	J
GROSS BETA	pCi/g	12.000		20.000		12.000		9.000	J	12.000		14.000	
URANIUM-233/234	pCi/g	0.820		0.990		0.840		0.440		0.370		0.908	
URANIUM-235	pCi/g	0.200	U	0.085	J	0.200	UR	0.300	UR	0.200	UR	0.200	U
URANIUM-238	pCi/g	0.680		0.950		0.690		0.440		0.580		0.980	
PLUTONIUM-238	pCi/g	0.090	UR	0.040	U	0.040	U	0.060	U	0.020	U	0.040	U
PLUTONIUM-239	pCi/g	0.050	UR	0.020	U	0.030	U	0.020	U	0.020	U	0.020	U
AMERICIUM-241	pCi/g	0.030	UR	0.030	UR	0.030	U	0.040	U	0.030	U	0.040	U
STRONTIUM-90	pCi/g	0.900	U	0.900	U	0.200	U	0.200	U	0.200	U	1.000	U
POTASSIUM-40	pCi/g	11.000		14.000		8.400		12.000		13.000		14.000	
IRON-59	pCi/g	0.300	U	0.300	U	0.400	U	0.300	U	0.400	U	0.600	U
CHROMIUM-51	pCi/g	2.000	U	2.000	U	3.000	U	2.000	U	3.000	U	4.000	U
COBALT-60	pCi/g	0.062		8.130		0.330		0.200		0.089		0.100	
ZINC-65	pCi/g	0.100	U	0.200	U	0.200	U	0.200	U	0.200	U	0.200	U
RUTHENIUM-106	pCi/g	0.400	U	0.400	U	0.500	U	0.500	U	0.500	U	0.700	U
CESIUM-134	pCi/g	0.060	U	0.060	U	0.070	U	0.060	U	0.060	U	0.089	
CESIUM-137	pCi/g	0.240	J	0.071	J	0.560	J	0.480	J	1.300	J	0.910	
EUROPIUM-152	pCi/g	0.118		0.370		0.410	J	0.350	J	0.900	J	0.790	
EUROPIUM-154	pCi/g	N/R		0.200	U	0.300	UJ	0.200	UJ	0.400	UJ	0.300	U
RADIUM-226	pCi/g	0.770		1.000		0.550		0.540		0.610		0.980	
THORIUM-228	pCi/g	1.200		1.700		0.840		0.910		0.950		1.500	
THORIUM-232	pCi/g	1.200		1.600		0.710		0.740		0.930		1.200	
EUROPIUM-155	pCi/g	N/R		0.180		N/R		N/R		N/R		N/R	
MANGANESE-54	pCi/g	N/R		N/R		0.057		N/R		N/R		N/R	
TECHNETIUM-99	pCi/g	N/R		N/R		N/R		N/R		N/R		N/R	
URANIUM-238 GAMMA SCAN	pCi/g	N/R		N/R		N/R		N/R		N/R		N/R	
COBALT-58	pCi/g	N/R		N/R		N/R		N/R		N/R		N/R	
CERIUM-144	pCi/g	N/R		N/R		N/R		N/R		N/R		N/R	
NEPTUNIUM-237	pCi/g	N/R		N/R		N/R		N/R		N/R		N/R	
THORIUM-231	pCi/g	N/R		N/R		N/R		N/R		N/R		N/R	
THORIUM-234	pCi/g	N/R		N/R		N/R		N/R		N/R		N/R	
RADIUM-228	pCi/g	N/R		N/R		N/R		N/R		N/R		N/R	
RADIUM-223	pCi/g	N/R		N/R		N/R		N/R		N/R		N/R	

Parameter	Samp# / Date / Site / Depth / Type	B07NH2 11-23-92 SITE DA1 12.00 - 20.00		B07ND4 11-19-92 SITE DI1 0.00 - 6.00		B07ND7 11-19-92 SITE DI1 0.00 - 6.00 Duplicate		B07ND6 11-19-92 SITE DI2 0.00 - 6.00		B07ND8 11-19-92 SITE DI2 12.00 - 20.00		B07NH5 11-24-92 SITE DI3 0.00 - 6.00	
	Units	Result	Q	Result	Q	Result	Q	Result	Q	Result	Q	Result	Q
Radionuclides													
GROSS ALPHA	pCi/g	11.000		4.900	J	4.500	J	6.200	J	7.500	J	5.300	J
GROSS BETA	pCi/g	22.000		17.000		13.000		14.000		18.000		17.000	
URANIUM-233/234	pCi/g	2.600		0.580		0.440		0.290	J	0.460		0.490	
URANIUM-235	pCi/g	0.200	U	0.200	UR	0.200	UR	0.300	UR	0.200	UR	0.200	U
URANIUM-238	pCi/g	2.000		0.680		0.440		0.490		0.460		0.300	
PLUTONIUM-238	pCi/g	0.050	U	0.050	U	0.030	U	0.030	U	0.050	U	0.050	U
PLUTONIUM-239	pCi/g	0.020	U	0.030	U	0.010	U	0.020	U	0.030	U	0.020	U
AMERICIUM-241	pCi/g	0.040	U	0.060	U	0.030	U	0.030	U	0.040	U	0.030	U
STRONTIUM-90	pCi/g	1.000	U	0.200	U	0.200	U	0.200	U	0.200	U	0.700	U
POTASSIUM-40	pCi/g	15.000		14.000		13.000		15.000		17.000		15.000	
IRON-59	pCi/g	0.500	U	0.300	U	0.300	U	0.300	U	0.300	U	0.400	U
CHROMIUM-51	pCi/g	4.000	U	2.000	U	2.000	U	2.000	U	2.000	U	2.000	U
COBALT-60	pCi/g	0.060	U	0.180		0.190		0.060	U	0.050	U	0.250	
ZINC-65	pCi/g	0.200	U	0.200	U	0.200	U	0.100	U	0.200	U	0.200	U
RUTHENIUM-106	pCi/g	0.700	U	0.400	U	0.400	U	0.400	U	0.400	U	0.500	U
CESIUM-134	pCi/g	0.090	U	0.050	U	0.060	U	0.060	U	0.060	U	0.060	U
CESIUM-137	pCi/g	0.070	U	0.560	J	0.620	J	0.100	J	0.040	UJ	0.500	
EUROPIUM-152	pCi/g	0.200	U	0.220	J	0.250	J	0.100	UJ	0.090	UJ	0.320	
EUROPIUM-154	pCi/g	0.100	U	0.100	UJ	0.200	UJ	0.070	UJ	0.060	UJ	0.200	U
RADIUM-226	pCi/g	1.300		0.460		0.480		0.580		0.500		0.590	
THORIUM-228	pCi/g	2.500		0.500		0.530		0.880		0.690		0.780	
THORIUM-232	pCi/g	2.300		0.580		0.500		0.840		0.890		0.510	
EUROPIUM-155	pCi/g	N/R		N/R		N/R		N/R		N/R		N/R	
MANGANESE-54	pCi/g	N/R		N/R		N/R		N/R		N/R		N/R	
TECHNETIUM-99	pCi/g	N/R		N/R		N/R		N/R		N/R		N/R	
URANIUM-230 GAMMA SCAN	pCi/g	N/R		N/R		N/R		N/R		N/R		N/R	
COBALT-58	pCi/g	N/R		N/R		N/R		N/R		N/R		N/R	
CERIUM-144	pCi/g	N/R		N/R		N/R		N/R		N/R		N/R	
NEPTUNIUM-237	pCi/g	N/R		N/R		N/R		N/R		N/R		N/R	
THORIUM-231	pCi/g	N/R		N/R		N/R		N/R		N/R		N/R	
THORIUM-234	pCi/g	N/R		N/R		N/R		N/R		N/R		N/R	
RADIUM-228	pCi/g	N/R		N/R		N/R		N/R		N/R		N/R	
RADIUM-223	pCi/g	N/R		N/R		N/R		N/R		N/R		N/R	

Parameter	Sampl# / Date / Site / Depth / Type	B07NH6 11-24-92 SITE D13 0.00 - 6.00 Duplicate		B07NH7 11-24-92 SITE D13 0.00 - 6.00 Split		B07NB7 11-12-92 SITE F2 0.00 - 6.00		B07NB8 11-12-92 SITE F3 0.00 - 6.00		B07NB9 11-12-92 SITE F3 12.00 - 24.00		B07NC4 11-16-92 SITE F4 0.00 - 6.00	
	Units	Result	Q	Result	Q	Result	Q	Result	Q	Result	Q	Result	Q
Radionuclides													
GROSS ALPHA	pCi/g	5.000	U	N/R		5.000	UJ	9.800	J	21.000	J	33.000	J
GROSS BETA	pCi/g	16.000		15.700	J	15.000		17.000		23.000		25.000	
URANIUM-233/234	pCi/g	0.440		N/R		1.100		0.790		1.000		1.600	
URANIUM-235	pCi/g	0.200	U	0.017	J	0.200	U	0.200	U	0.100	U	0.200	U
URANIUM-238	pCi/g	0.360		0.365	UJ	0.930		0.640		1.300		2.000	
PLUTONIUM-238	pCi/g	0.070	U	N/R		0.070	UR	0.040	U	0.080	U	0.080	U
PLUTONIUM-239	pCi/g	0.030	U	0.187	UJ	0.030	UR	0.040	U	0.060	U	0.040	U
AMERICIUM-241	pCi/g	0.060	U	0.242	J	0.040	UR	0.030	UR	0.070	UR	0.030	UR
STRONTIUM-90	pCi/g	0.700	U	0.837	UJ	0.900	U	0.900	U	0.800	U	1.000	U
POTASSIUM-40	pCi/g	13.000		17.800	J	16.000		14.000		15.000		14.000	
IRON-59	pCi/g	0.400	U	0.054	UJ	0.400	U	0.300	U	0.300	U	0.400	U
CHROMIUM-51	pCi/g	3.000	U	N/R		2.000	U	2.000	U	2.000	U	3.000	U
COBALT-60	pCi/g	0.200		0.216	J	0.080	U	0.090	U	0.050	U	0.080	U
ZINC-65	pCi/g	0.200	U	N/R		0.200	U	0.200	U	0.100	U	0.200	U
RUTHENIUM-106	pCi/g	0.500	U	N/R		0.600	U	0.500	U	0.500	U	0.800	U
CESIUM-134	pCi/g	0.060	U	0.006	UJ	0.090	U	0.060	U	0.060	U	0.100	U
CESIUM-137	pCi/g	0.540		0.519	J	0.330	J	0.260		0.190	J	0.140	J
EUROPIUM-152	pCi/g	0.320		0.269	J	0.280		0.180		0.200		0.200	U
EUROPIUM-154	pCi/g	0.200	U	0.041	J	0.300	U	0.200	U	0.200	U	0.100	U
RADIUM-226	pCi/g	0.540		N/R		0.920		0.780		0.980		1.700	
THORIUM-228	pCi/g	0.590		N/R		1.700		1.100		2.000		4.400	
THORIUM-232	pCi/g	0.600		N/R		1.800		1.200		1.900		3.200	
EUROPIUM-155	pCi/g	N/R		0.043	J	N/R		N/R		N/R		N/R	
MANGANESE-54	pCi/g	N/R		N/R		N/R		N/R		N/R		N/R	
TECHNETIUM-99	pCi/g	N/R		N/R		N/R		0.300	U	0.200	U	N/R	
URANIUM-238 GAMMA SCAN	pCi/g	N/R		N/R		N/R		N/R		N/R		N/R	
COBALT-58	pCi/g	N/R		0.014	UJ	N/R		N/R		N/R		N/R	
CERIUM-144	pCi/g	N/R		0.049	UJ	N/R		N/R		N/R		N/R	
NEPTUNIUM-237	pCi/g	N/R		0.482	J	N/R		N/R		N/R		N/R	
THORIUM-231	pCi/g	N/R		0.294	J	N/R		N/R		N/R		N/R	
THORIUM-234	pCi/g	N/R		0.687	J	N/R		N/R		N/R		N/R	
RADIUM-228	pCi/g	N/R		0.542	J	N/R		N/R		N/R		N/R	
RADIUM-223	pCi/g	N/R		0.033	UJ	N/R		N/R		N/R		N/R	

Parameter	Samp# / Date / Site / Depth / Type	B07NC5 11-16-92 SITE F4 12.00 - 16.00		B07NH3 11-23-92 SITE FF1 0.00 - 6.00		B07NH4 11-23-92 SITE FF1 12.00 - 20.00		B07NG9 11-23-92 SITE F11 0.00 - 6.00		B07NH0 11-23-92 SITE F11 12.00 - 18.00		B07NC0 11-13-92 SITE N1 0.00 - 6.00	
	Units	Result	Q	Result	Q	Result	Q	Result	Q	Result	Q	Result	Q
Radionuclides													
GROSS ALPHA	pCi/g	6.900	J	7.400	J	5.000	U	4.700	J	5.000	U	6.000	UJ
GROSS BETA	pCi/g	16.000		12.000		19.000		10.000		18.000		18.000	
URANIUM-233/234	pCi/g	1.400		0.510		0.800		0.770		0.880		0.790	
URANIUM-235	pCi/g	0.200	U	0.200	U	0.100	U	0.200	U	0.200	U	0.200	U
URANIUM-238	pCi/g	0.840		0.750		0.690		0.490		0.700		0.770	
PLUTONIUM-238	pCi/g	0.040	U	0.060	U	0.050	U	0.070	U	0.050	U	0.070	U
PLUTONIUM-239	pCi/g	0.020	U	0.020	U	0.020	U	0.040	U	0.020	U	0.040	U
AMERICIUM-241	pCi/g	0.010	UR	0.020	U	0.030	U	0.040	U	0.040	U	0.030	UR
STRONTIUM-90	pCi/g	1.000	U	0.900	U	0.800	U	0.800	U	1.000	U	0.800	U
POTASSIUM-40	pCi/g	15.000		15.000		17.000		15.000		15.000		14.000	
IRON-59	pCi/g	0.300	U	0.300	U	0.500	U	0.500	U	0.400	U	0.400	U
CHROMIUM-51	pCi/g	2.000	U	2.000	U	3.000	U	3.000	U	3.000	U	3.000	U
COBALT-60	pCi/g	0.060	U	0.060	U	0.060	U	0.360		0.076		0.380	
ZINC-65	pCi/g	0.100	U	0.100	U	0.200	U	0.200	U	0.200	U	0.200	U
RUTHENIUM-106	pCi/g	0.500	U	0.500	U	0.500	U	0.600	U	0.500	U	0.600	U
CESIUM-134	pCi/g	0.050	U	0.100	U	0.070	U	0.070	U	0.070	U	0.070	U
CESIUM-137	pCi/g	0.050	UJ	0.050	U	0.070	U	0.830		0.160		4.600	J
EUROPIUM-152	pCi/g	0.100	U	0.100	U	0.100	U	0.920		0.300		1.800	
EUROPIUM-154	pCi/g	0.090	U	0.070	U	0.070	U	0.160		0.200	U	0.240	
RADIUM-226	pCi/g	0.810		0.670		0.820		0.690		0.670		0.850	
THORIUM-228	pCi/g	1.600		0.940		1.100		1.100		0.990		0.900	
THORIUM-232	pCi/g	1.500		0.830		1.000		0.980		0.920		0.960	
EUROPIUM-155	pCi/g	N/R		N/R		N/R		N/R		N/R		N/R	
MANGANESE-54	pCi/g	N/R		N/R		N/R		N/R		N/R		N/R	
TECHNETIUM-99	pCi/g	N/R		N/R		N/R		N/R		N/R		N/R	
URANIUM-238 GAMMA SCAN	pCi/g	N/R		N/R		N/R		N/R		N/R		N/R	
COBALT-58	pCi/g	N/R		N/R		N/R		N/R		N/R		N/R	
CERIUM-144	pCi/g	N/R		N/R		N/R		N/R		N/R		N/R	
NEPTUNIUM-237	pCi/g	N/R		N/R		N/R		N/R		N/R		N/R	
THORIUM-231	pCi/g	N/R		N/R		N/R		N/R		N/R		N/R	
THORIUM-234	pCi/g	N/R		N/R		N/R		N/R		N/R		N/R	
RADIUM-228	pCi/g	N/R		N/R		N/R		N/R		N/R		N/R	
RADIUM-223	pCi/g	N/R		N/R		N/R		N/R		N/R		N/R	

Parameter	Samp# / Date / Site / Depth / Type	B07NC1 11-13-92 SITE N1 12.00 - 18.00		B07NC2 11-13-92 SITE N2 0.00 - 6.00		B07NC3 11-13-92 SITE N3 0.00 - 6.00		B07NC6 11-16-92 SITE NAN1 0.00 - 6.00		B07NC7 11-16-92 SITE NAN1 12.00 - 16.00		B07ND2 11-17-92 SITE RAN2 0.00 - 6.00	
	Units	Result	Q	Result	Q	Result	Q	Result	Q	Result	Q	Result	Q
Radionuclides													
GROSS ALPHA	pCi/g	26.000	J	27.000	J	13.000	J	9.000	J	6.300	J	6.000	UJ
GROSS BETA	pCi/g	23.000		20.000		21.000		19.000		21.000		16.000	
URANIUM-233/234	pCi/g	2.300		1.200		1.400		0.600		0.850		0.730	
URANIUM-235	pCi/g	0.100	U	0.200	U	0.200	U	0.200	U	0.200	U	0.110	J
URANIUM-238	pCi/g	2.300		1.200		1.200		0.480		0.870		0.750	
PLUTONIUM-238	pCi/g	0.060	U	0.100	UR	0.050	U	0.040	U	0.060	UR	0.070	U
PLUTONIUM-239	pCi/g	0.030	U	0.070	UR	0.030	U	0.020	U	0.040	UR	0.040	U
AMERICIUM-241	pCi/g	0.020	UR	0.020	UR	0.050	UR	0.020	UR	0.040	UR	0.040	UR
STRONTIUM-90	pCi/g	0.900	U	0.900	U	1.000	U	1.000	U	0.800	U	0.900	U
POTASSIUM-40	pCi/g	13.000		14.000		14.000		16.000		17.000		14.000	
IRON-59	pCi/g	0.300	U	0.400	U	0.300	U	0.300	U	0.300	U	0.300	U
CHROMIUM-51	pCi/g	2.000	U	3.000	U	2.000	U	2.000	U	2.000	U	2.000	U
COBALT-60	pCi/g	0.050	U	0.090		0.070	U	0.070	U	0.060	U	0.056	
ZINC-65	pCi/g	0.200	U	0.200	U	0.200	U	0.200	U	0.200	U	0.200	U
RUTHENIUM-106	pCi/g	0.500	U	0.500	U	0.500	U	0.500	U	0.500	U	0.500	U
CESIUM-134	pCi/g	0.070	U	0.090	U	0.070	U	0.060	U	0.070	U	0.070	U
CESIUM-137	pCi/g	0.520	J	0.430	J	0.330	J	0.074	J	0.060	UJ	1.800	J
EUROPIUM-152	pCi/g	20.000	U	0.470		0.230		0.100	U	0.100	U	0.820	
EUROPIUM-154	pCi/g	0.100	U	0.200	U	0.200	U	0.070	U	0.080	U	0.170	
RADIUM-226	pCi/g	1.400		1.000		0.690		0.670		0.840		0.810	
THORIUM-228	pCi/g	3.000		1.900		1.300		1.100		1.800		1.400	
THORIUM-232	pCi/g	2.500		1.800		1.300		1.200		1.100		1.000	
EUROPIUM-155	pCi/g	N/R		N/R		N/R		N/R		N/R		N/R	
MANGANESE-54	pCi/g	N/R		N/R		N/R		N/R		N/R		N/R	
TECHNETIUM-99	pCi/g	N/R		N/R		N/R		N/R		N/R		N/R	
URANIUM-238 GAMMA SCAN	pCi/g	8.800		N/R		N/R		N/R		N/R		N/R	
COBALT-58	pCi/g	N/R		N/R		N/R		N/R		N/R		N/R	
CERIUM-144	pCi/g	N/R		N/R		N/R		N/R		N/R		N/R	
NEPTUNIUM-237	pCi/g	N/R		N/R		N/R		N/R		N/R		N/R	
THORIUM-231	pCi/g	N/R		N/R		N/R		N/R		N/R		N/R	
THORIUM-234	pCi/g	N/R		N/R		N/R		N/R		N/R		N/R	
RADIUM-228	pCi/g	N/R		N/R		N/R		N/R		N/R		N/R	
RADIUM-223	pCi/g	N/R		N/R		N/R		N/R		N/R		N/R	

Parameter	Samp# / Date / Site / Depth / Type	B07ND3 11-17-92 SITE HAN2 12.00 - 18.00		B07NG3 11-22-92 SITE HU1 0.00 - 6.00		B07NG6 11-22-92 SITE HU1 0.00 - 6.00 Duplicate		B07NG5 11-22-92 SITE HU1 12.00 - 18.00		B07NG7 11-22-92 SITE HU1 12.00 - 18.00 Split		B07NG1 11-21-92 SITE K2 0.00 - 3.00	
	Units	Result	Q	Result	Q	Result	Q	Result	Q	Result	Q	Result	Q
Radionuclides													
GROSS ALPHA	pCi/g	11.000	J	6.000	U	5.000	U	5.000	U	N/R		6.000	U
GROSS BETA	pCi/g	19.000		14.000		9.300	J	13.000		16.000	J	14.000	
URANIUM-233/234	pCi/g	1.300		0.450	R	0.850		0.490		N/R		0.450	
URANIUM-235	pCi/g	0.300	U	0.300	UR	0.200	U	0.100	U	0.022	J	0.200	UR
URANIUM-238	pCi/g	1.000		0.750	R	0.710		0.410		0.464	UJ	0.670	
PLUTONIUM-238	pCi/g	0.050	U	0.040	U	0.040	U	0.040	U	N/R		0.050	U
PLUTONIUM-239	pCi/g	0.030	U	0.020	U	0.020	U	0.020	U	0.071		0.020	U
AMERICIUM-241	pCi/g	0.070	UR	0.030	U	0.040	U	0.040	U	0.080	UJ	0.020	U
STRONTIUM-90	pCi/g	1.000	U	0.800	U	0.800	U	0.900	U	0.914	UJ	0.800	U
POTASSIUM-40	pCi/g	17.000		15.000		14.000		14.000		15.200	J	13.000	
IRON-59	pCi/g	0.300	U	0.500	U	0.500	U	0.500	U	0.054	UJ	0.300	U
CHROMIUM-51	pCi/g	2.000	U	3.000	U	4.000	U	3.000	U	N/R		2.000	U
COBALT-60	pCi/g	0.060	U	0.380		0.370		0.120		0.111	J	0.040	U
ZINC-65	pCi/g	0.200	U	0.200	U	0.200	U	0.200	U	N/R		0.100	U
RUTHENIUM-106	pCi/g	0.500	U	0.600	U	0.600	U	0.600	U	N/R		0.300	U
CESIUM-134	pCi/g	0.080	U	0.070	U	0.080	U	0.070	U	0.008	UJ	0.050	U
CESIUM-137	pCi/g	0.060	UJ	0.760		0.790		1.500		1.610	J	0.110	J
EUROPIUM-152	pCi/g	0.100	U	0.500		0.560		1.500		1.330	J	0.090	UJ
EUROPIUM-154	pCi/g	0.080	U	0.200	U	0.200	U	0.210		0.141	J	0.060	UJ
RADIUM-226	pCi/g	1.200		0.640		0.660		0.650		N/R		0.660	
THORIUM-228	pCi/g	2.100		0.850		0.900		0.880		N/R		1.100	
THORIUM-232	pCi/g	2.100		0.840		0.940		0.930		N/R		0.910	
EUROPIUM-155	pCi/g	N/R		N/R		N/R		N/R		0.035	UJ	N/R	
MANGANESE-54	pCi/g	N/R		N/R		N/R		N/R		N/R		N/R	
TECHNETIUM-99	pCi/g	N/R		N/R		N/R		N/R		N/R		N/R	
URANIUM-238 GAMMA SCAN	pCi/g	N/R		N/R		N/R		N/R		N/R		N/R	
COBALT-58	pCi/g	N/R		N/R		N/R		N/R		0.017	UJ	N/R	
CERIUM-144	pCi/g	N/R		N/R		N/R		N/R		0.060	UJ	N/R	
NEPTUNIUM-237	pCi/g	N/R		N/R		N/R		N/R		0.606	J	N/R	
THORIUM-231	pCi/g	N/R		N/R		N/R		N/R		0.454	J	N/R	
THORIUM-234	pCi/g	N/R		N/R		N/R		N/R		0.012	J	N/R	
RADIUM-228	pCi/g	N/R		N/R		N/R		N/R		N/R		N/R	
RADIUM-223	pCi/g	N/R		N/R		N/R		N/R		6.960	UJ	N/R	

Parameter	Sampl#	B07NG2		B07NG0		B07NF9		B07NG4		B07NF5		B07NF6	
	Date	11-21-92		11-21-92		11-22-92		11-22-92		11-20-92		11-20-92	
	Site	SITE K3		SITE KU1		SITE KU1		SITE N		SITE VBU1		SITE VBU1	
	Depth	0.00 - 6.00		0.00 - 6.00		12.00 - 18.00		0.00 - 3.00		0.00 - 6.00		12.00 - 22.00	
	Type												
	Units	Result	Q	Result	Q	Result	Q	Result	Q	Result	Q	Result	Q
Radionuclides													
GROSS ALPHA	pCi/g	15.000		5.200	J	5.400	J	5.000	U	8.300	J	6.100	J
GROSS BETA	pCi/g	16.000		13.000		12.000		15.000		16.000		14.000	
URANIUM-233/234	pCi/g	0.980		0.530		0.770		0.350	R	0.850		0.530	
URANIUM-235	pCi/g	0.200	UR	0.200	UR	0.200	U	0.300	UR	0.200	UR	0.100	UR
URANIUM-238	pCi/g	0.680		0.570		0.960		0.530	R	0.540		0.740	
PLUTONIUM-238	pCi/g	0.020	U	0.040	U	0.030	U	0.030	U	0.100	UR	0.100	UR
PLUTONIUM-239	pCi/g	0.010	U	0.020	U	0.020	U	0.020	U	0.040	UR	0.050	UR
AMERICIUM-241	pCi/g	0.030	U	0.030	U	0.020	U	0.040	U	0.020	U	0.080	UR
STRONTIUM-90	pCi/g	0.900	U	0.900	U	0.800	U	0.900	U	0.700	U	0.900	U
POTASSIUM-40	pCi/g	15.000		13.000		13.000		15.000		16.000		14.000	
IRON-59	pCi/g	0.200	U	0.300	U	0.500	U	0.500	U	0.300	U	0.400	U
CHROMIUM-51	pCi/g	2.000	U	2.000	U	3.000	U	3.000	U	2.000	U	2.000	U
COBALT-60	pCi/g	0.040	U	0.050	U	0.070	U	0.070	U	0.060	U	0.060	U
ZINC-65	pCi/g	0.100	U	0.100	U	0.200	U	0.200	U	0.100	U	0.200	U
RUTHENIUM-106	pCi/g	0.400	U	0.800	U	0.600	U	0.600	U	0.500	U	0.600	U
CESIUM-134	pCi/g	0.050	U	0.060	U	0.080	U	0.070	U	0.070	U	0.080	U
CESIUM-137	pCi/g	0.040	UJ	0.270	J	0.450		0.190		0.050	UJ	0.082	J
EUROPIUM-152	pCi/g	0.080	UJ	0.090	UJ	0.320		0.100	U	0.100	UJ	0.100	UJ
EUROPIUM-154	pCi/g	0.060	UJ	0.060	UJ	0.200	U	0.090	U	0.070	UJ	0.080	UJ
RADIUM-226	pCi/g	0.950		0.710		0.900		0.900		0.780		1.200	
THORIUM-228	pCi/g	1.900		0.910		1.400		1.300		1.300		2.500	
THORIUM-232	pCi/g	1.500		0.890		0.910		1.200		1.200		2.500	
EUROPIUM-155	pCi/g	N/R		N/R		N/R		N/R		N/R		N/R	
MANGANESE-54	pCi/g	N/R		N/R		N/R		N/R		N/R		N/R	
TECHNETIUM-99	pCi/g	N/R		N/R		N/R		N/R		N/R		N/R	
URANIUM-238 GAMMA SCAN	pCi/g	N/R		N/R		N/R		N/R		N/R		N/R	
COBALT-58	pCi/g	N/R		N/R		N/R		N/R		N/R		N/R	
CERIUM-144	pCi/g	N/R		N/R		N/R		N/R		N/R		N/R	
NEPTUNIUM-237	pCi/g	N/R		N/R		N/R		N/R		N/R		N/R	
THORIUM-231	pCi/g	N/R		N/R		N/R		N/R		N/R		N/R	
THORIUM-234	pCi/g	N/R		N/R		N/R		N/R		N/R		N/R	
RADIUM-228	pCi/g	N/R		N/R		N/R		N/R		N/R		N/R	
RADIUM-223	pCi/g	N/R		N/R		N/R		N/R		N/R		N/R	

Parameter	Samp# / Date / Site / Depth / Type	B07NF7 11-20-92 SITE VBU2 0.00 - 6.00		B07NF8 11-20-92 SITE VBU3 0.00 - 3.00		B07NB6 11-12-92 SITE F1 0.00 - 6.00		B07ND5 11-19-92 SITE D11 12.00 - 18.00	
	Units	Result	Q	Result	Q	Result	Q	Result	Q
Radionuclides									
GROSS ALPHA	pCi/g	8.400	J	7.500	J	7.000	UJ	4.000	U
GROSS BETA	pCi/g	15.000		16.000		22.000		20.000	
URANIUM-233/234	pCi/g	1.000		1.000		0.670		0.490	
URANIUM-235	pCi/g	0.200	UR	0.100	UR	0.100	U	0.200	UR
URANIUM-238	pCi/g	0.580		0.800		0.880		0.360	
PLUTONIUM-238	pCi/g	0.050	U	0.060	U	0.070	U	0.040	U
PLUTONIUM-239	pCi/g	0.020	U	0.030	U	0.030	U	0.020	U
AMERICIUM-241	pCi/g	0.020	U	0.030	U	0.060	UR	0.040	U
STRONTIUM-90	pCi/g	0.900	U	0.800	U	0.900	U	0.200	U
POTASSIUM-40	pCi/g	15.000		12.000		16.000		15.000	
IRON-59	pCi/g	0.300	U	0.300	U	0.400	U	0.400	U
CHROMIUM-51	pCi/g	2.000	U	2.000	U	2.000	U	2.000	U
COBALT-60	pCi/g	0.050	U	0.040	U	0.060	U	0.410	
ZINC-65	pCi/g	0.100	U	0.100	U	0.200	U	0.200	U
RUTHENIUM-106	pCi/g	0.400	U	0.400	U	0.600	U	0.500	U
CESIUM-134	pCi/g	0.060	U	0.060	U	0.070	U	0.050	U
CESIUM-137	pCi/g	0.040	UJ	0.140	J	0.180	J	0.740	J
EUROPIUM-152	pCi/g	0.100	UJ	0.090	UJ	0.100		0.480	J
EUROPIUM-154	pCi/g	0.060	UJ	0.060	UJ	0.200	U	0.200	UJ
RADIUM-226	pCi/g	0.630		0.600		0.740		0.420	
THORIUM-228	pCi/g	1.300		1.100		1.200		0.460	
THORIUM-232	pCi/g	1.000		0.990		1.100		0.500	
EUROPIUM-155	pCi/g	N/R		N/R		N/R		N/R	
MANGANESE-54	pCi/g	N/R		N/R		N/R		N/R	
TECHNETIUM-99	pCi/g	N/R		N/R		N/R		N/R	
URANIUM-238 GAMMA SCAN	pCi/g	N/R		N/R		N/R		N/R	
COBALT-58	pCi/g	N/R		N/R		N/R		N/R	
CERIUM-144	pCi/g	N/R		N/R		N/R		N/R	
NEPTUNIUM-237	pCi/g	N/R		N/R		N/R		N/R	
THORIUM-231	pCi/g	N/R		N/R		N/R		N/R	
THORIUM-234	pCi/g	N/R		N/R		N/R		N/R	
RADIUM-228	pCi/g	N/R		N/R		N/R		N/R	
RADIUM-223	pCi/g	N/R		N/R		N/R		N/R	

9413096.0738

APPENDIX D - GRAIN SIZE ANALYSIS PLOTS

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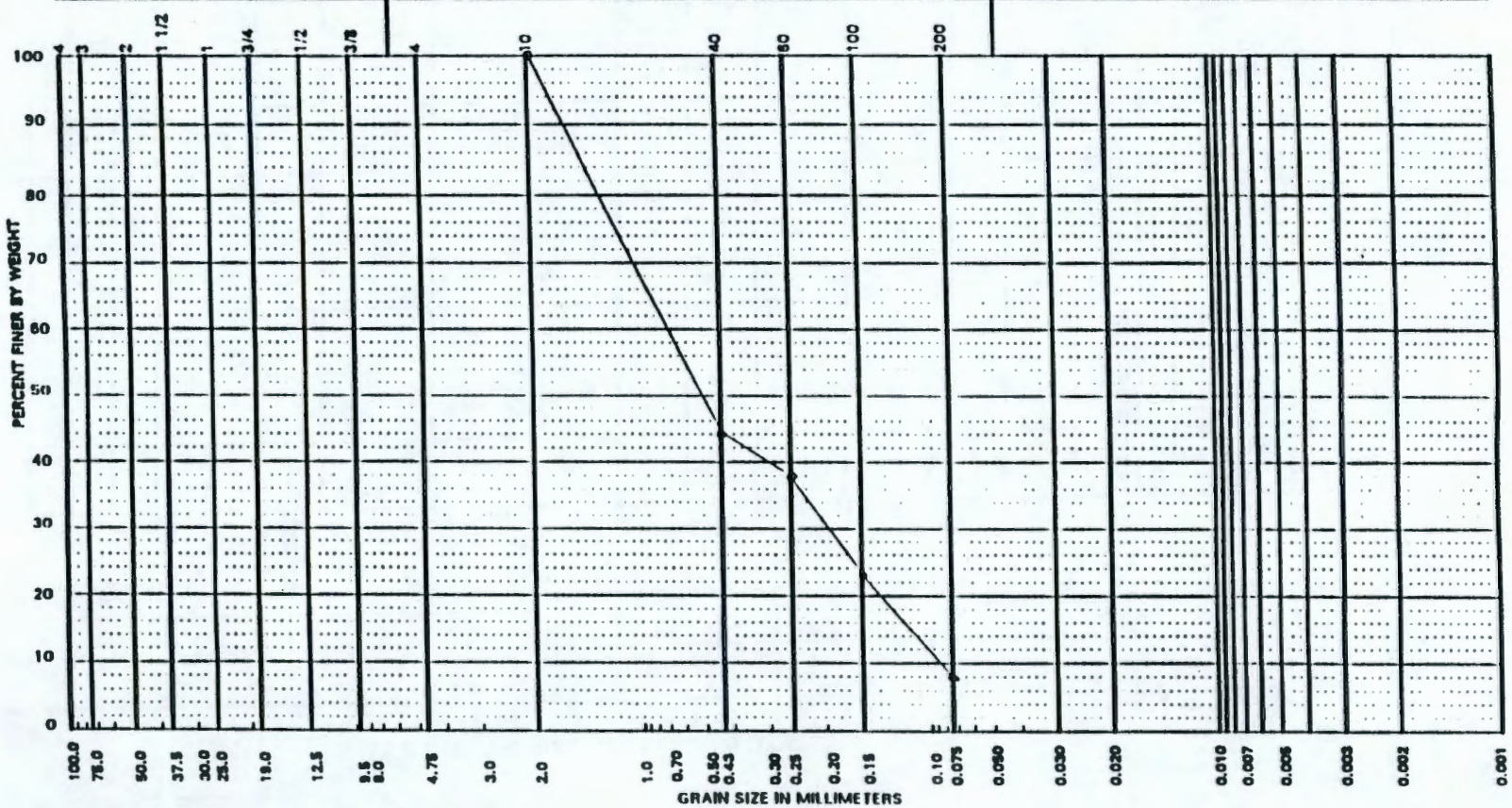
GEL-07 GRAIN SIZE ANALYSIS PLOT

Sample No. 3 0245

Page ____ of ____

Remarks BOZWF5 VERNITA

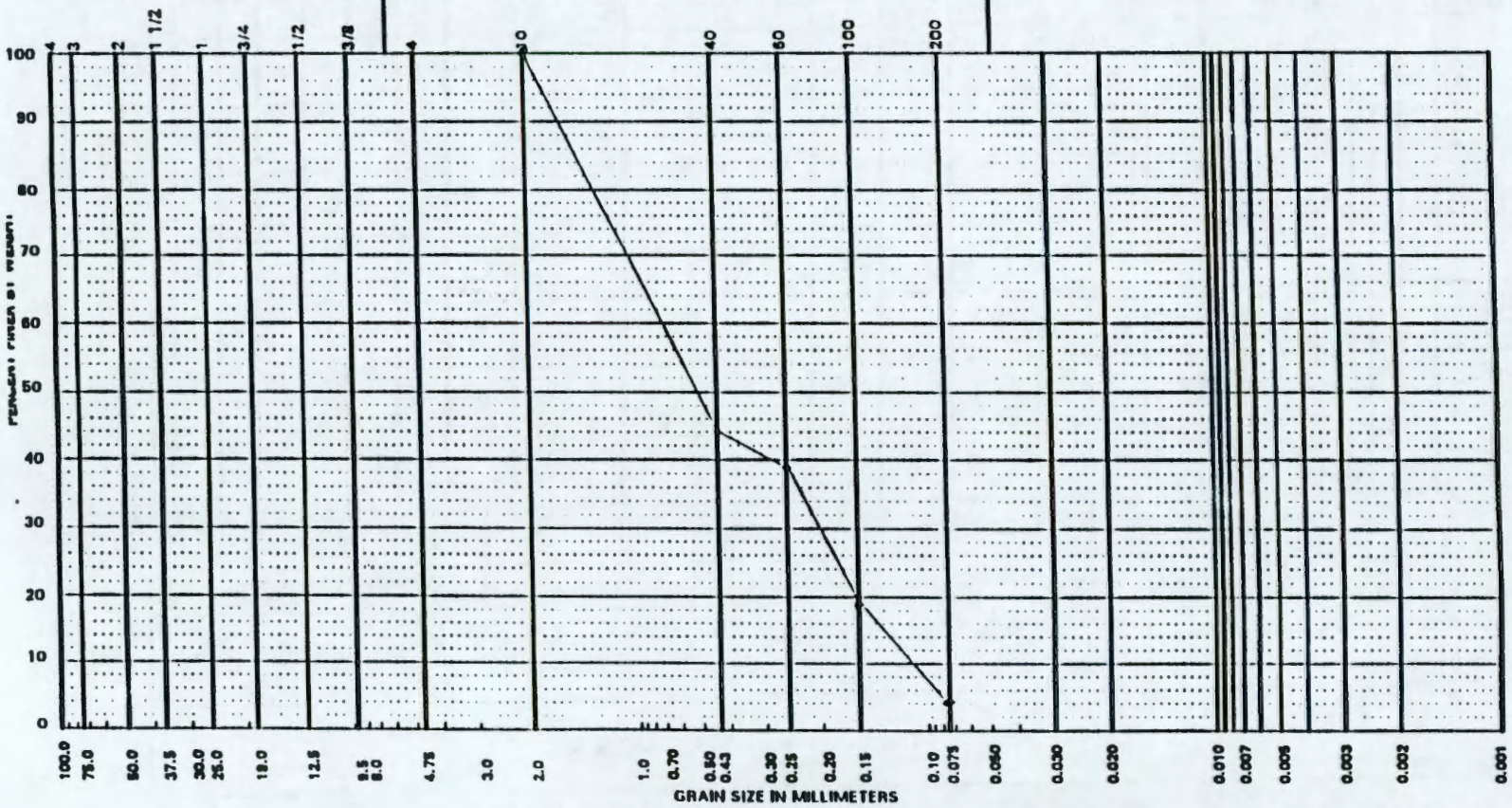


GEL-07 GRAIN SIZE ANALYSIS PLOT

Sample No. 3 0246

Page _____ of _____

Remarks BOZNEG VERWITA

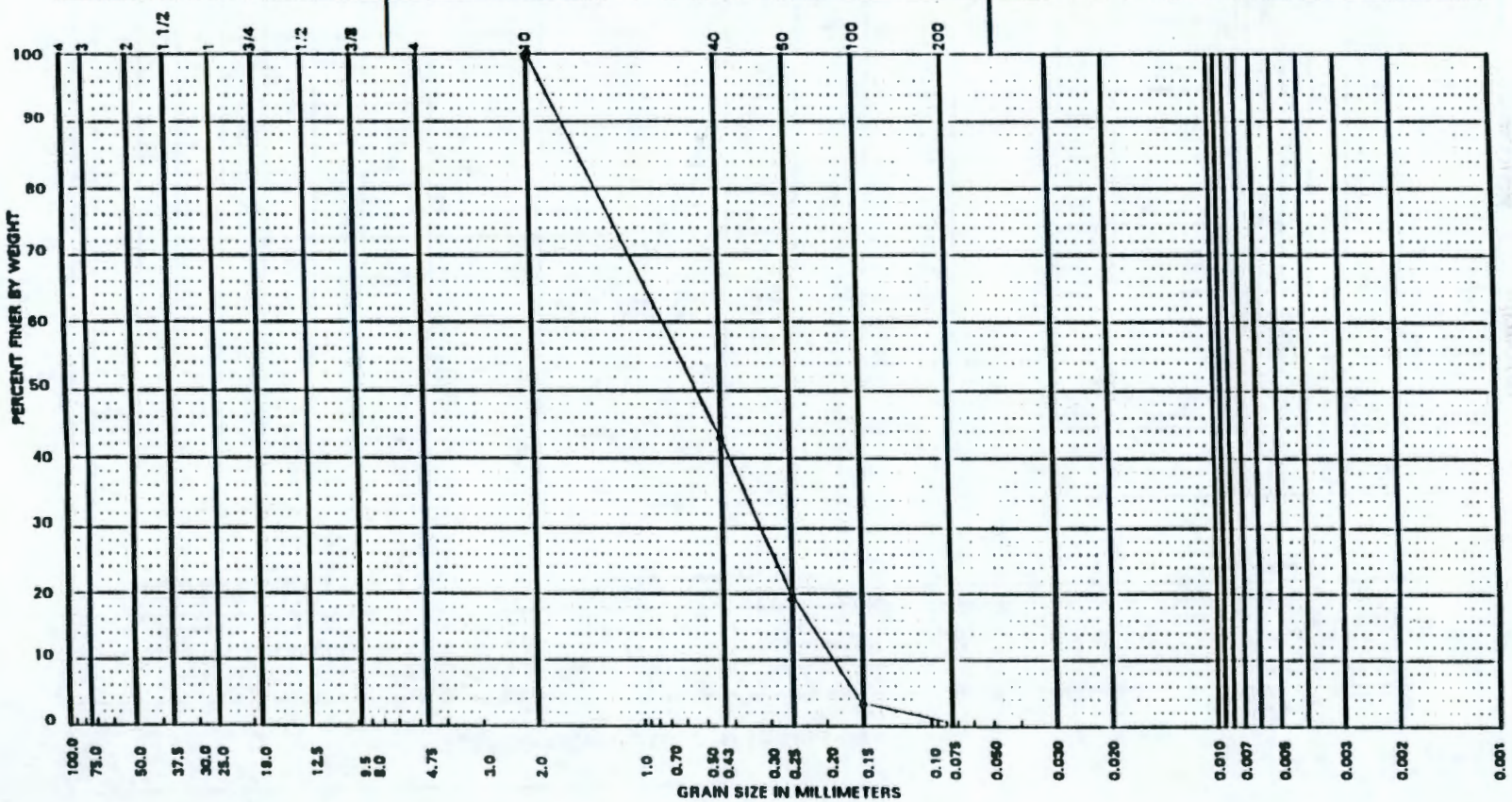


GEL-07 GRAIN SIZE ANALYSIS PLOT

Sample No. 3 0247

Page ____ of ____

Remarks BUZHEZ VERRITA

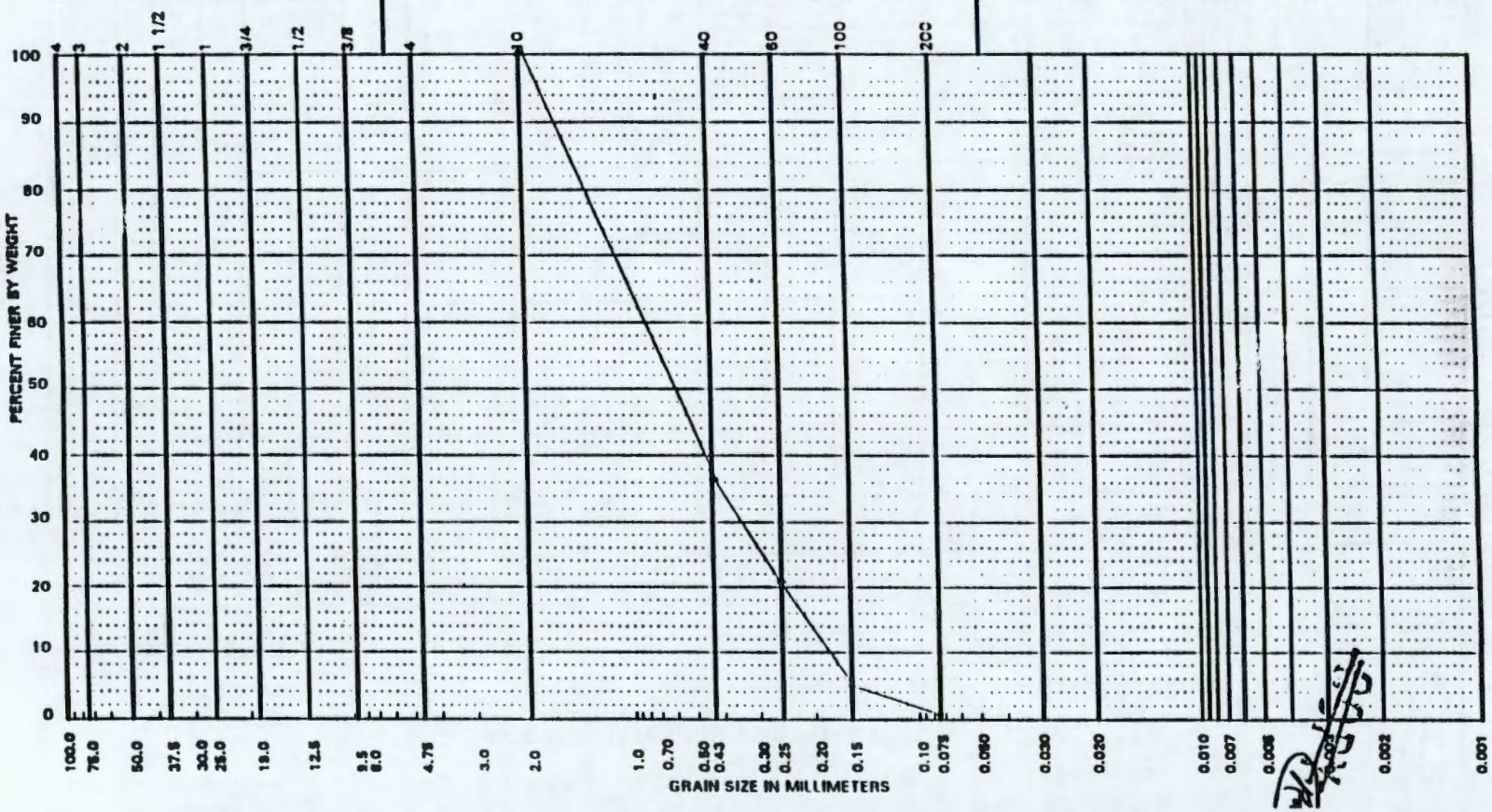


GEL-07 GRAIN SIZE ANALYSIS PLOT

Sample No. 3 0218

Page ____ of ____

Remarks B07HF8 VERHITA

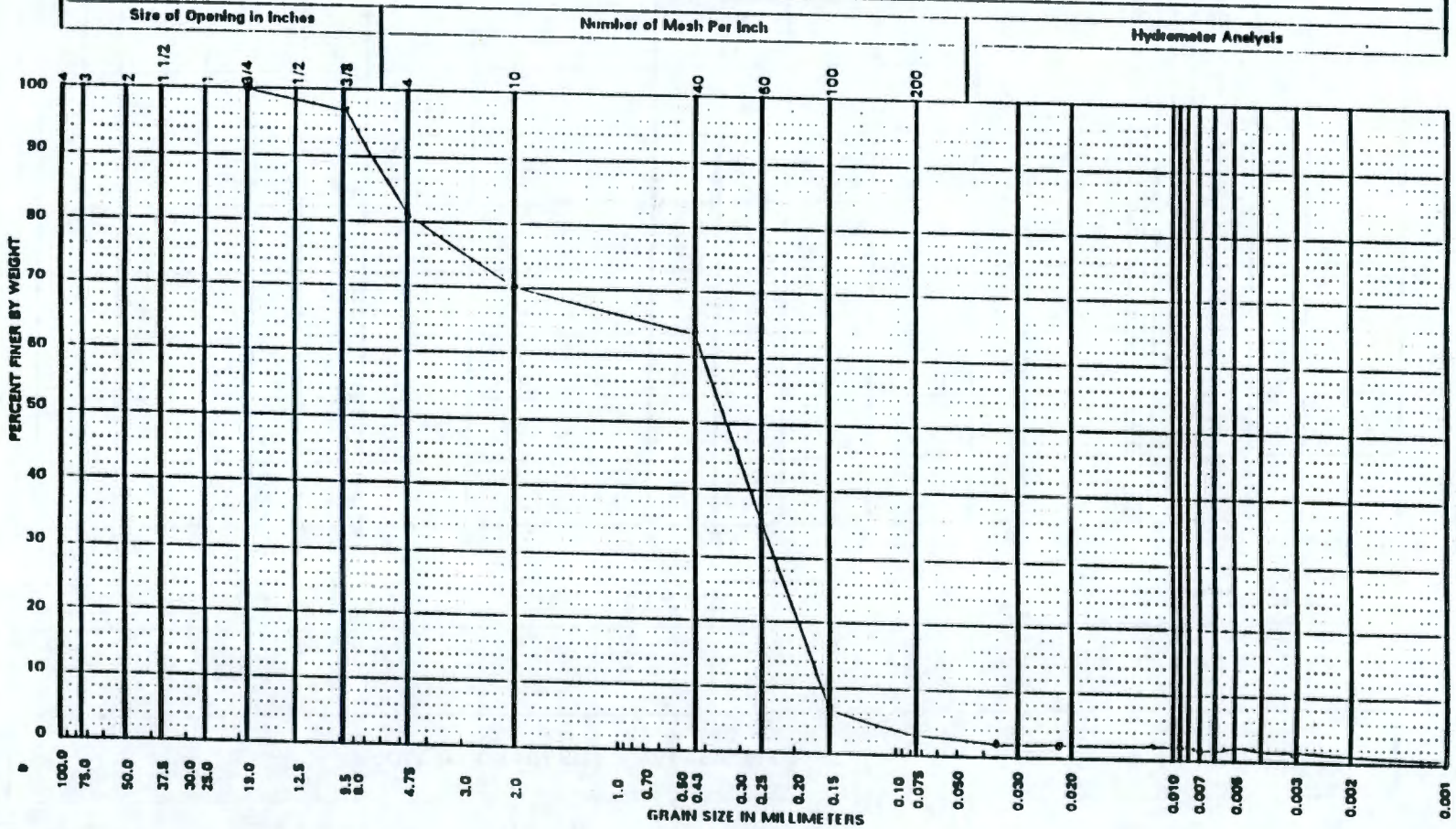


GEL-07 GRAIN SIZE ANALYSIS PLOT

Sample No. 3-0231

Page ____ of ____

Remarks: B Area 0-6" B07ND1 B/C

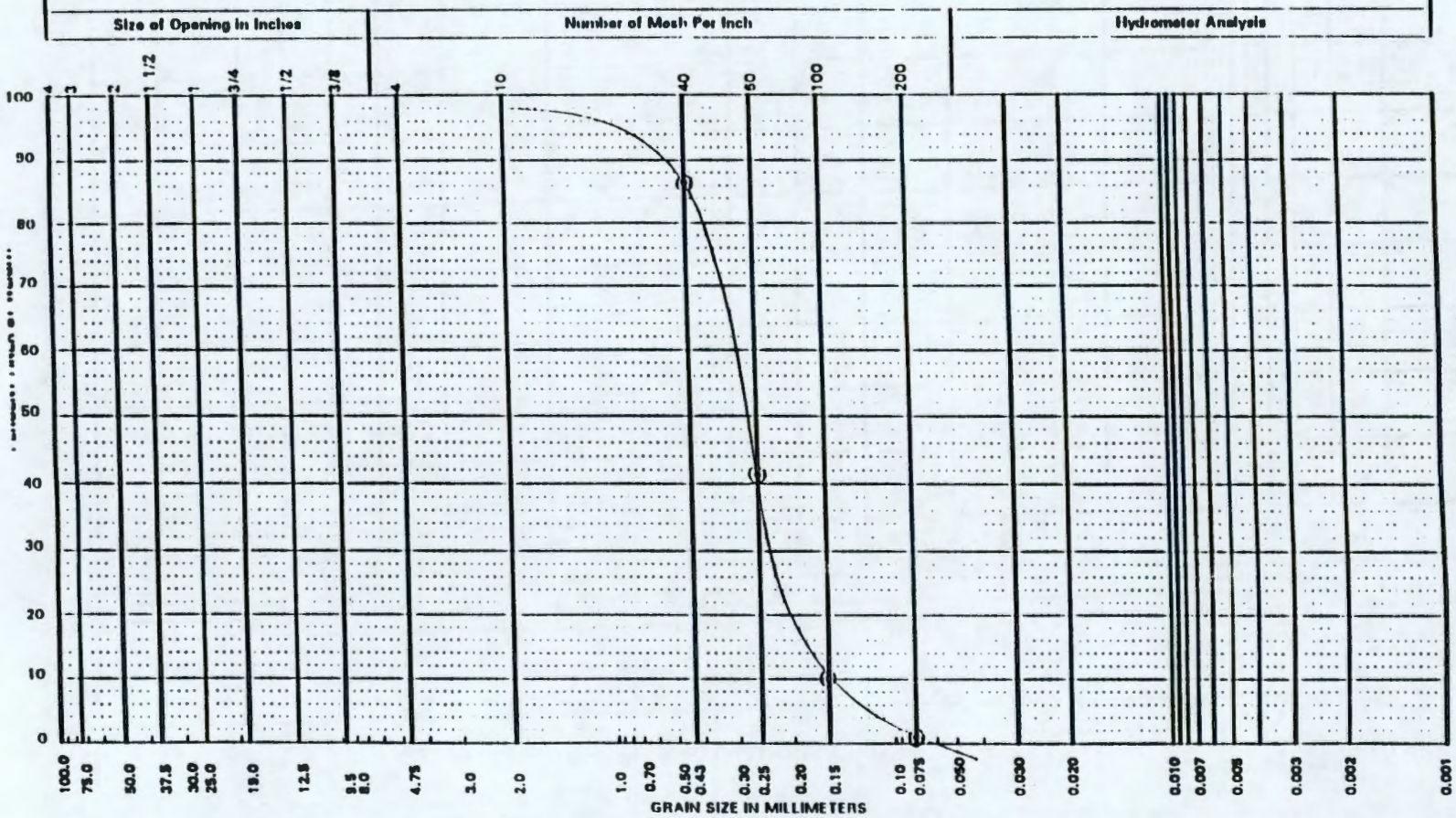


GEL-07 GRAIN SIZE ANALYSIS PLOT

Sample No. 3-0239

Page ____ of ____

Remarks D07HD9 B/C

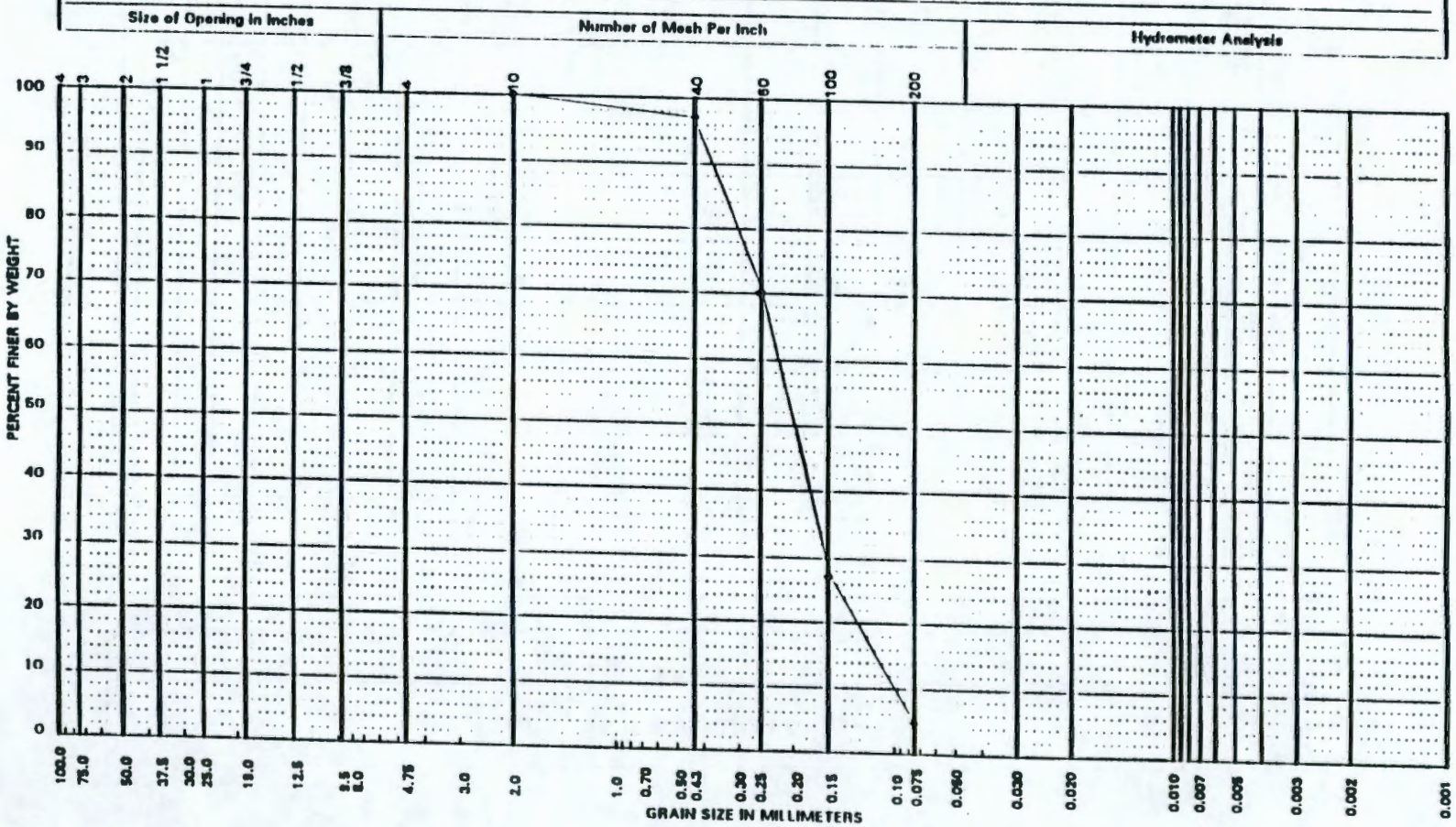


GEL-07 GRAIN SIZE ANALYSIS PLOT

Sample No. 3 0243

Page ____ of ____

Remarks BUZWF3 B/C

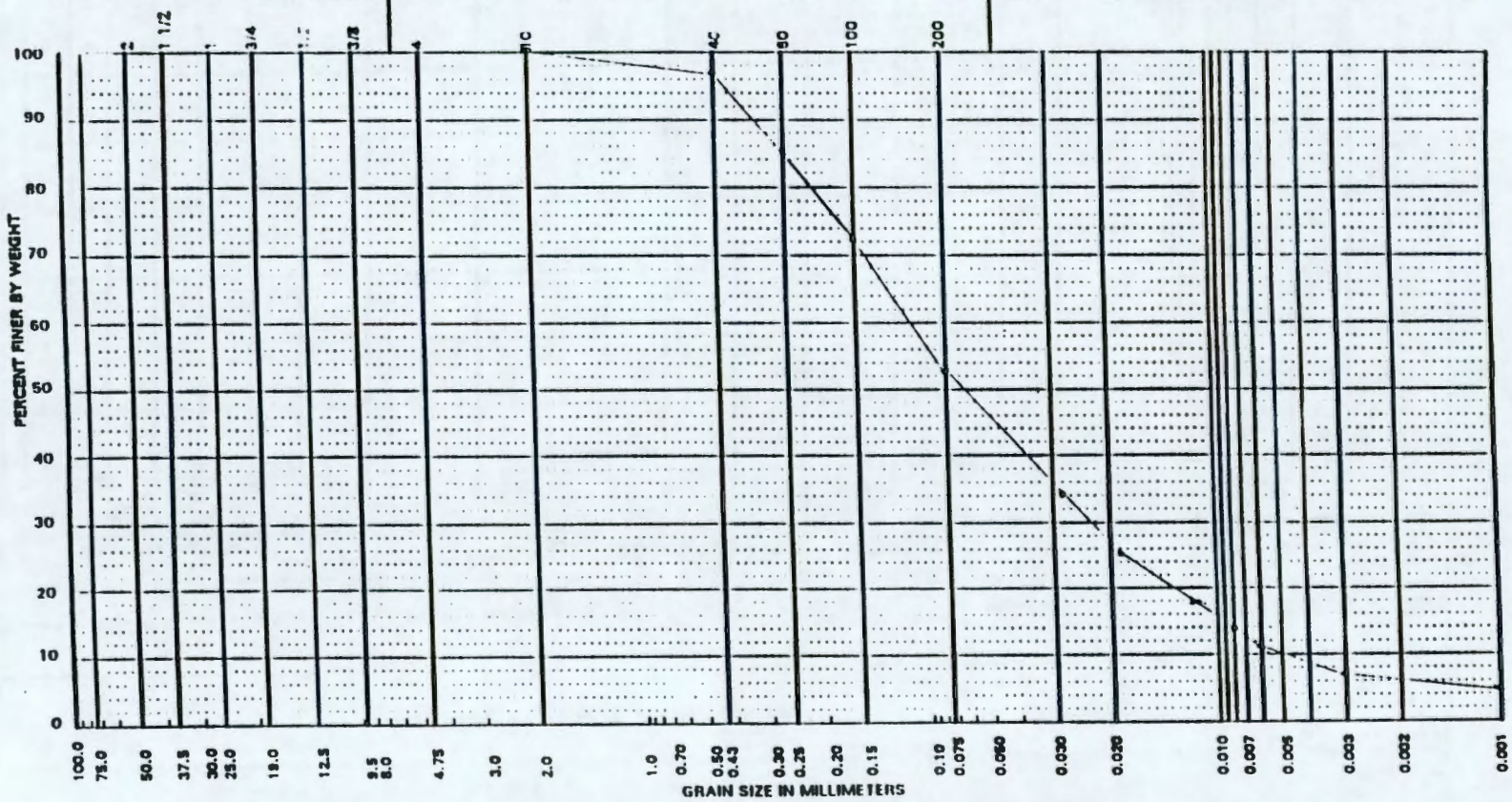


GEL-07 GRAIN SIZE ANALYSIS PLOT

Sample No. 3-0244

Page 1 of

Remarks B07HF4 B/C

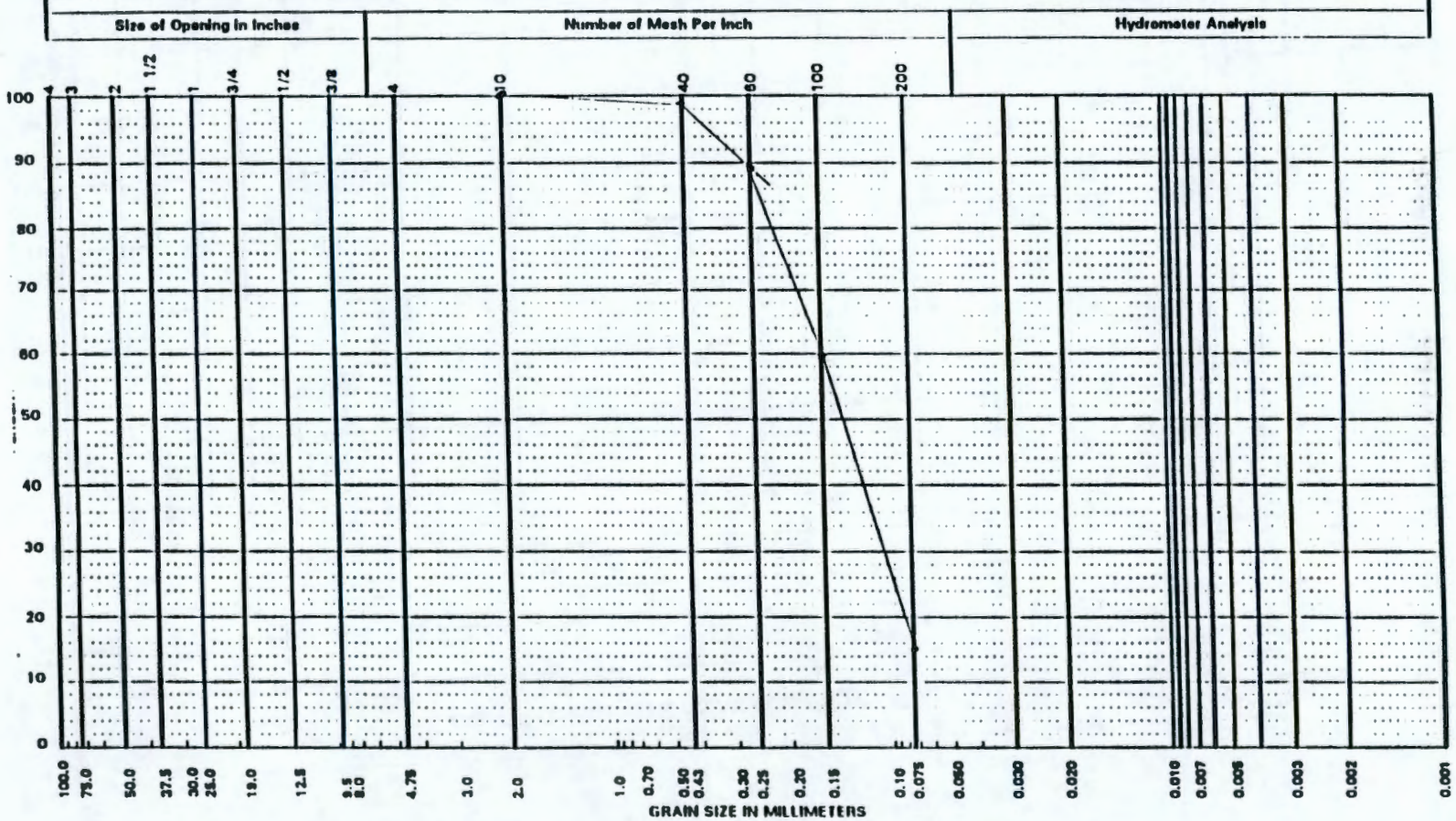


GEL-07 GRAIN SIZE ANALYSIS PLOT

Sample No. 3 0258

Page _____ of _____

Remarks BUZHGO KU1



GEL-07 GRAIN SIZE ANALYSIS PLOT

Sample No. 3 0275

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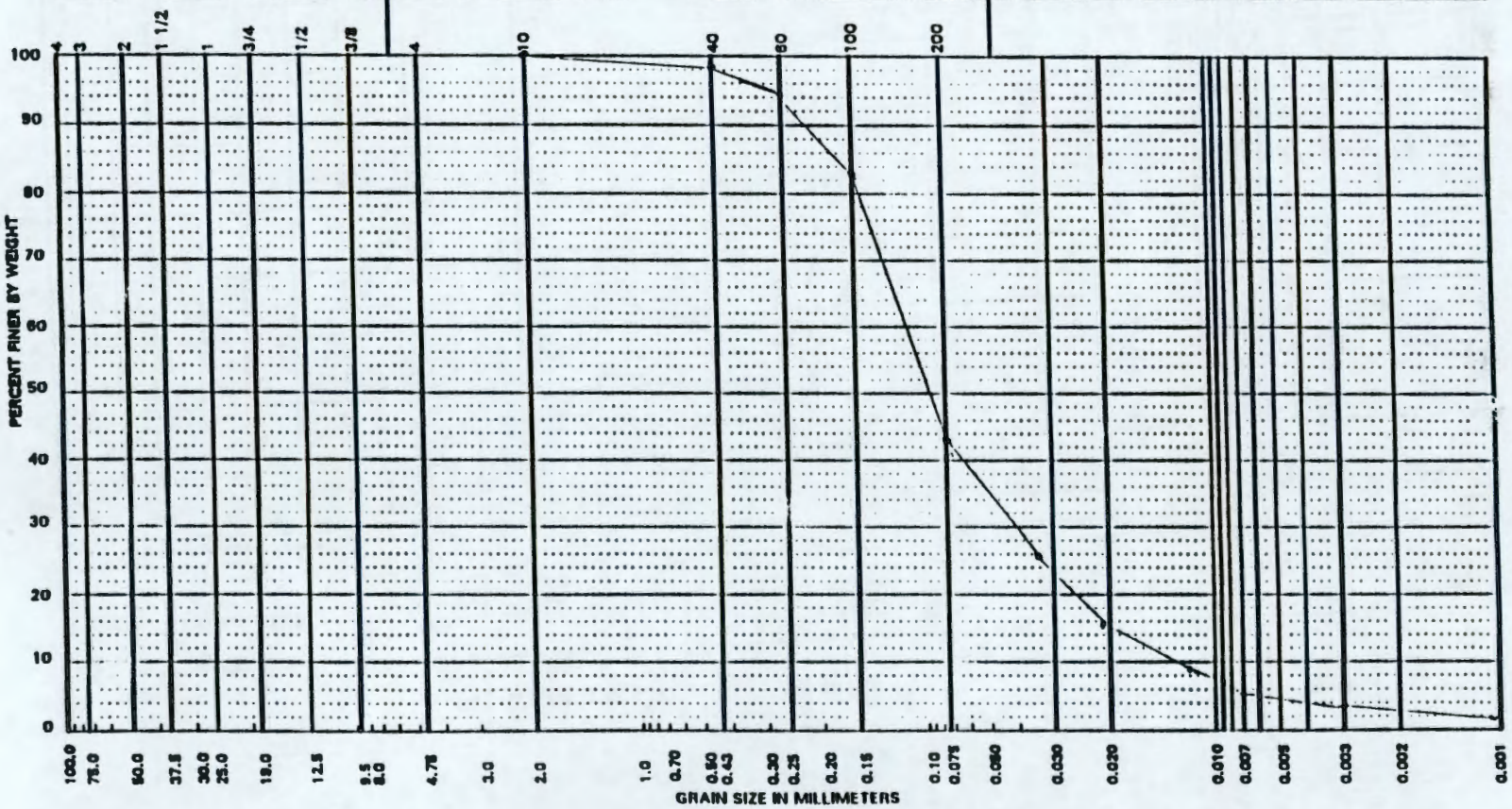
Remarks B07NF9 K11

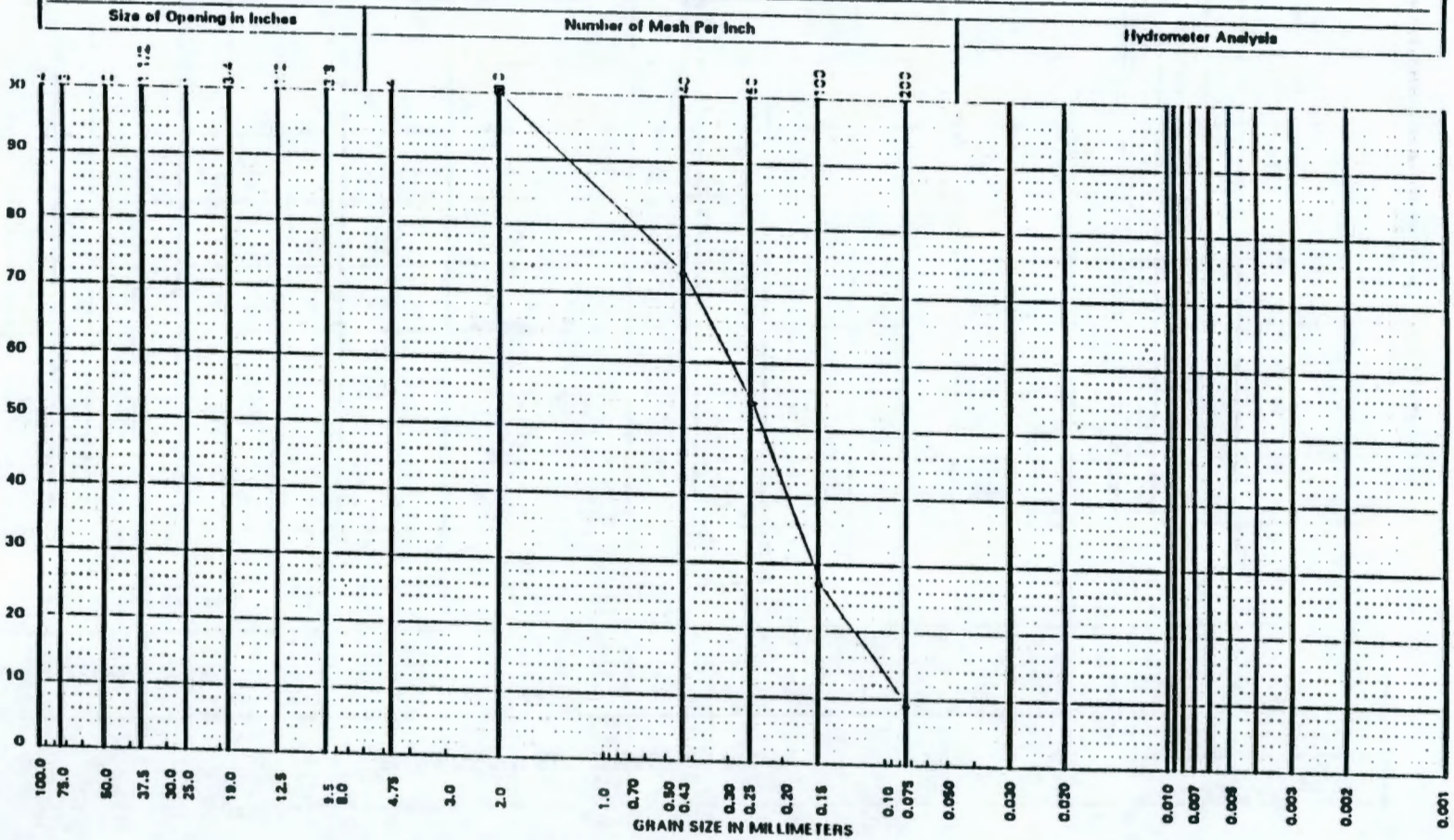


GEL-07 GRAIN SIZE ANALYSIS PLOT

Sample No. 3 0260

Page ____ of ____

Remarks B07HG2 K3



GEL-07 GRAIN SIZE ANALYSIS PLOT

Sample No. 3 0259

Page ____ of ____

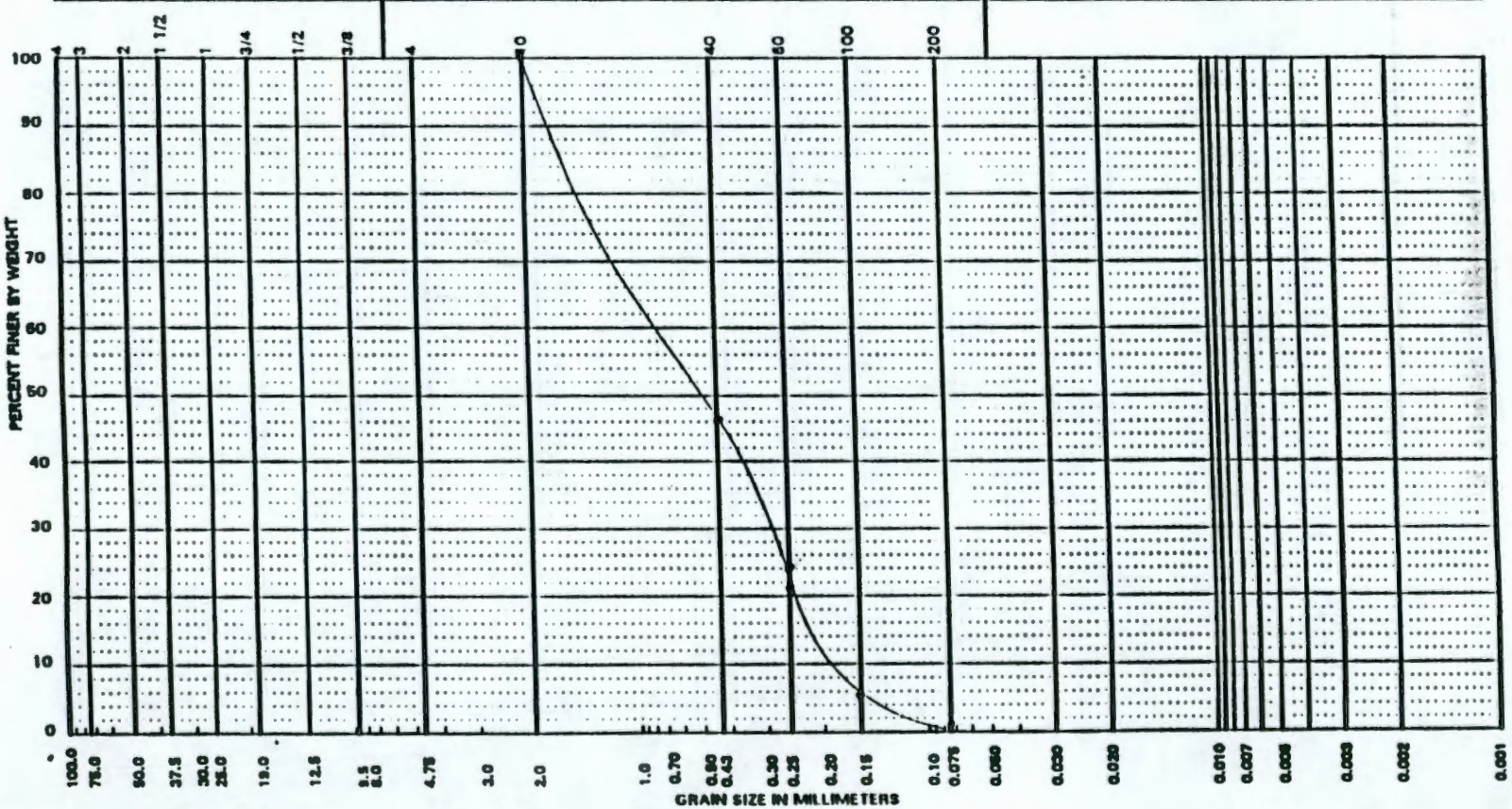
Remarks B07NG1 K2

GEL-07 GRAIN SIZE ANALYSIS PLOT

Sample No. 0262

Page 1 of 1

Remarks BUZHG4 "N"

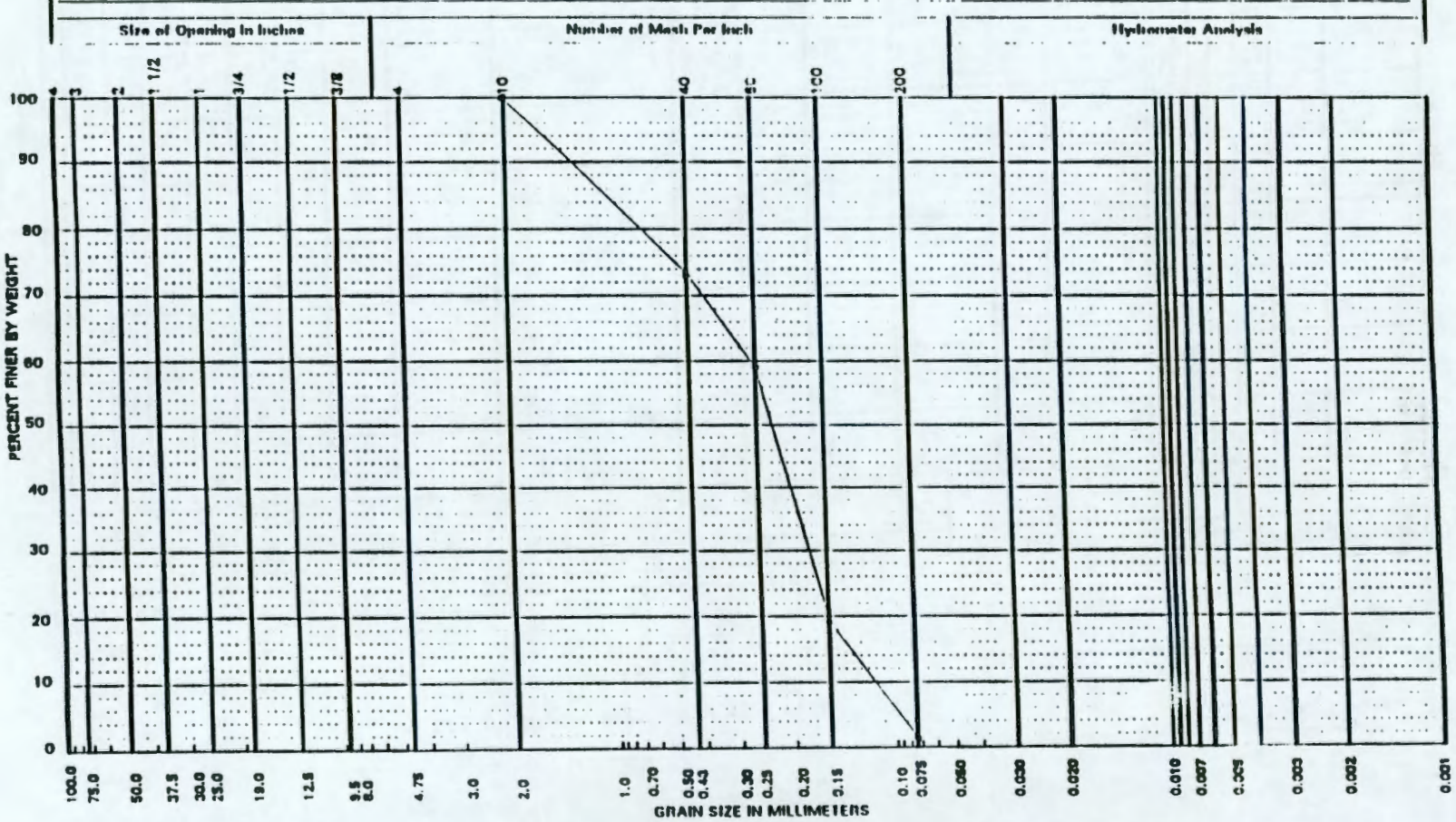


GEL-07 GRAIN SIZE ANALYSIS PLOT

Sample No. 3-0241

Page ____ of ____

Remarks B07WF1 D5

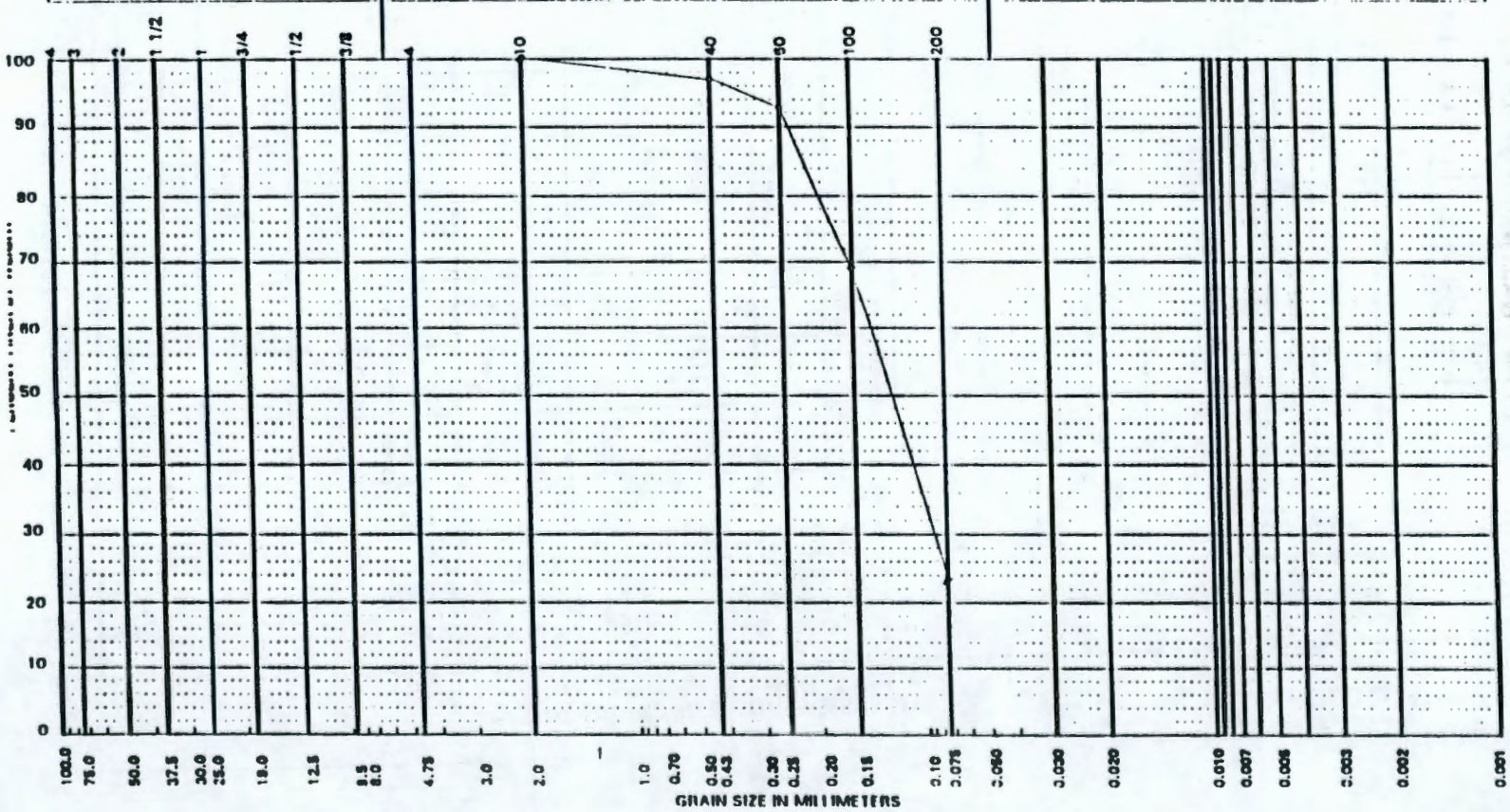


GEL-07 GRAIN SIZE ANALYSIS PLOT

Sample No. 3 0242

Page ____ of ____

Remarks B07HF2 D5

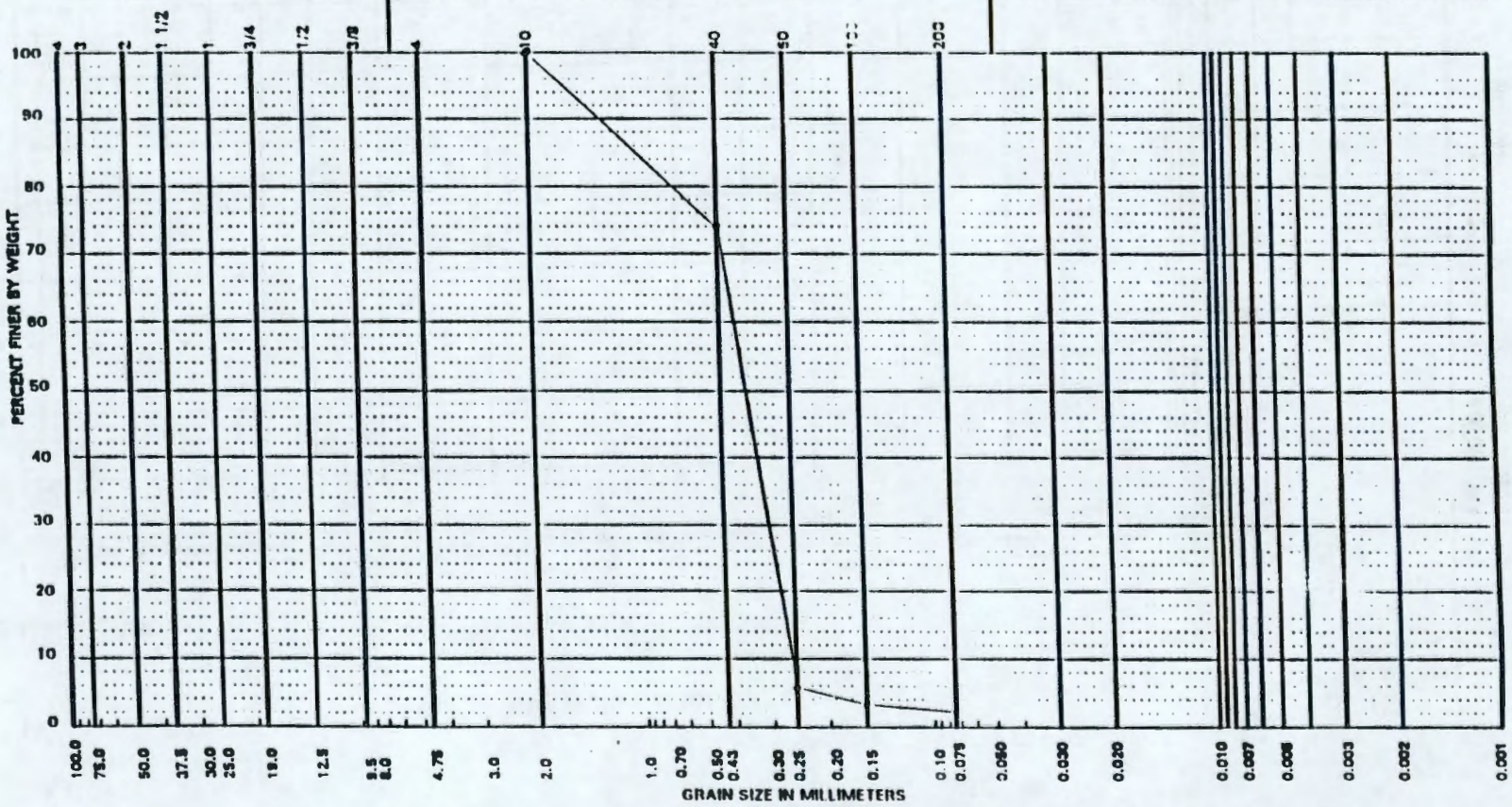


GEL-07 GRAIN SIZE ANALYSIS PLOT

Sample No. 3-0234

Page ____ of ____

Remarks D ISLAND 6" B07HD4 D11

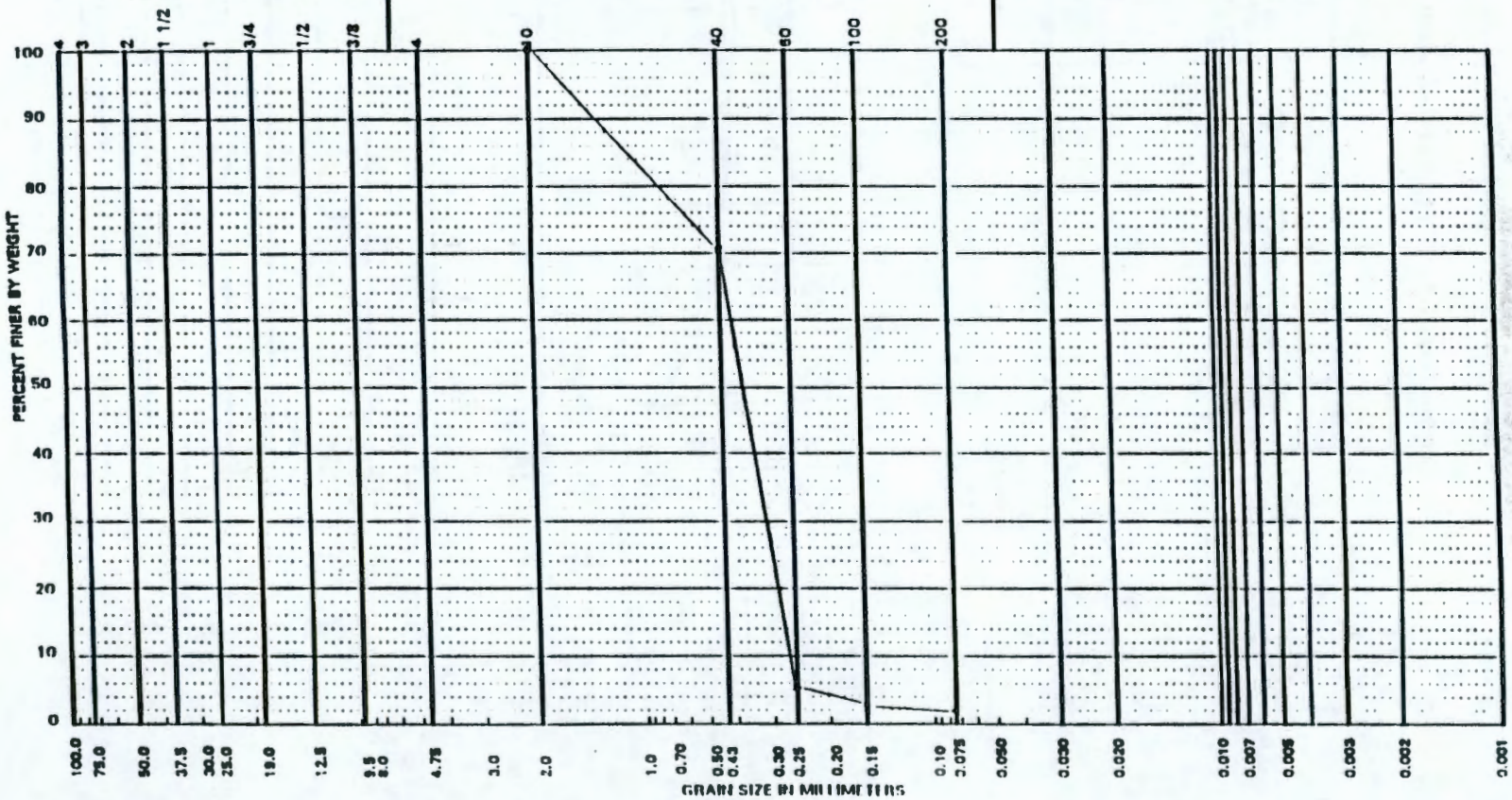


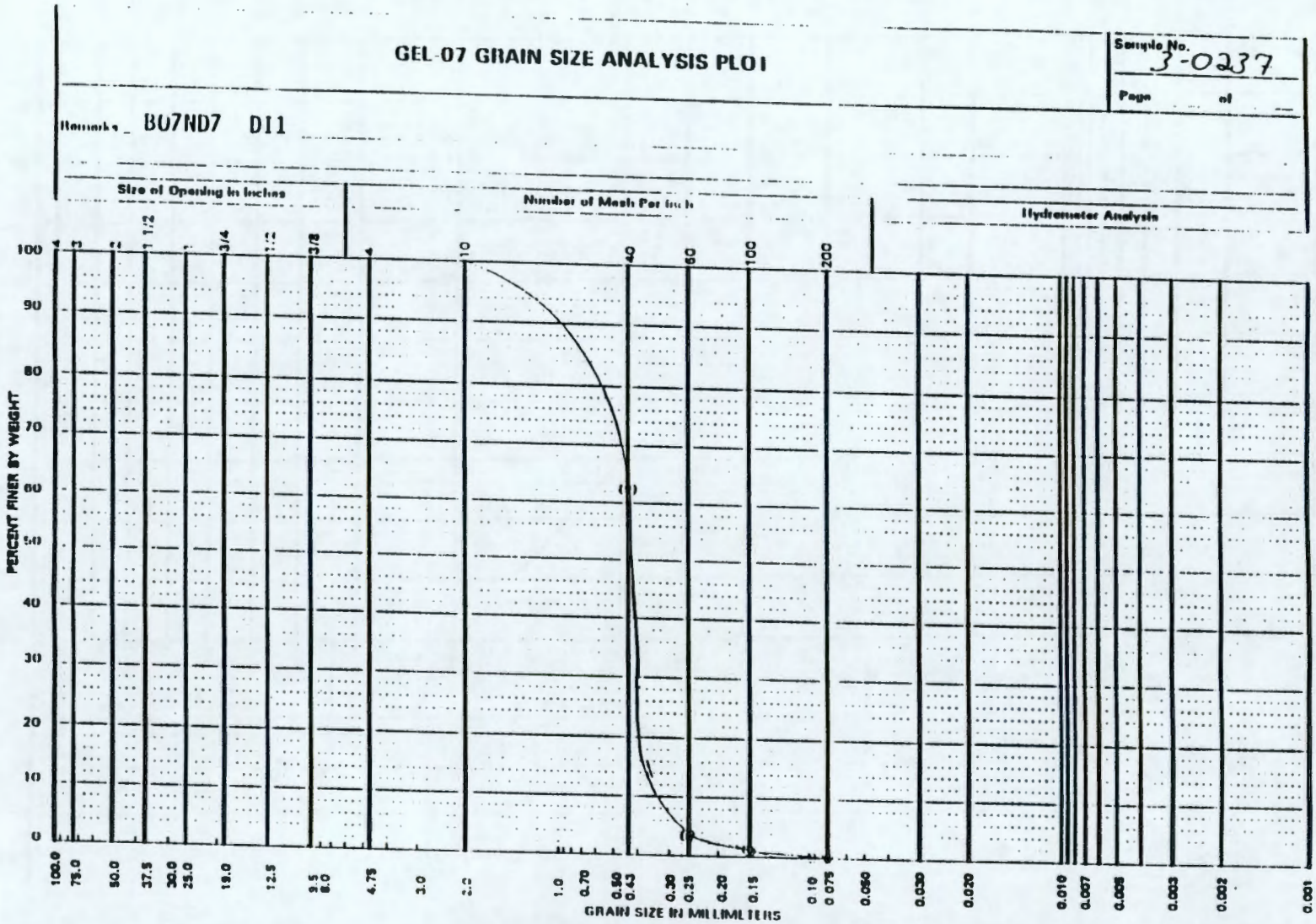
GEL-07 GRAIN SIZE ANALYSIS PLOT

Sample No. 3-0235

Page ___ of ___

Remarks D Island B07HD5 D11



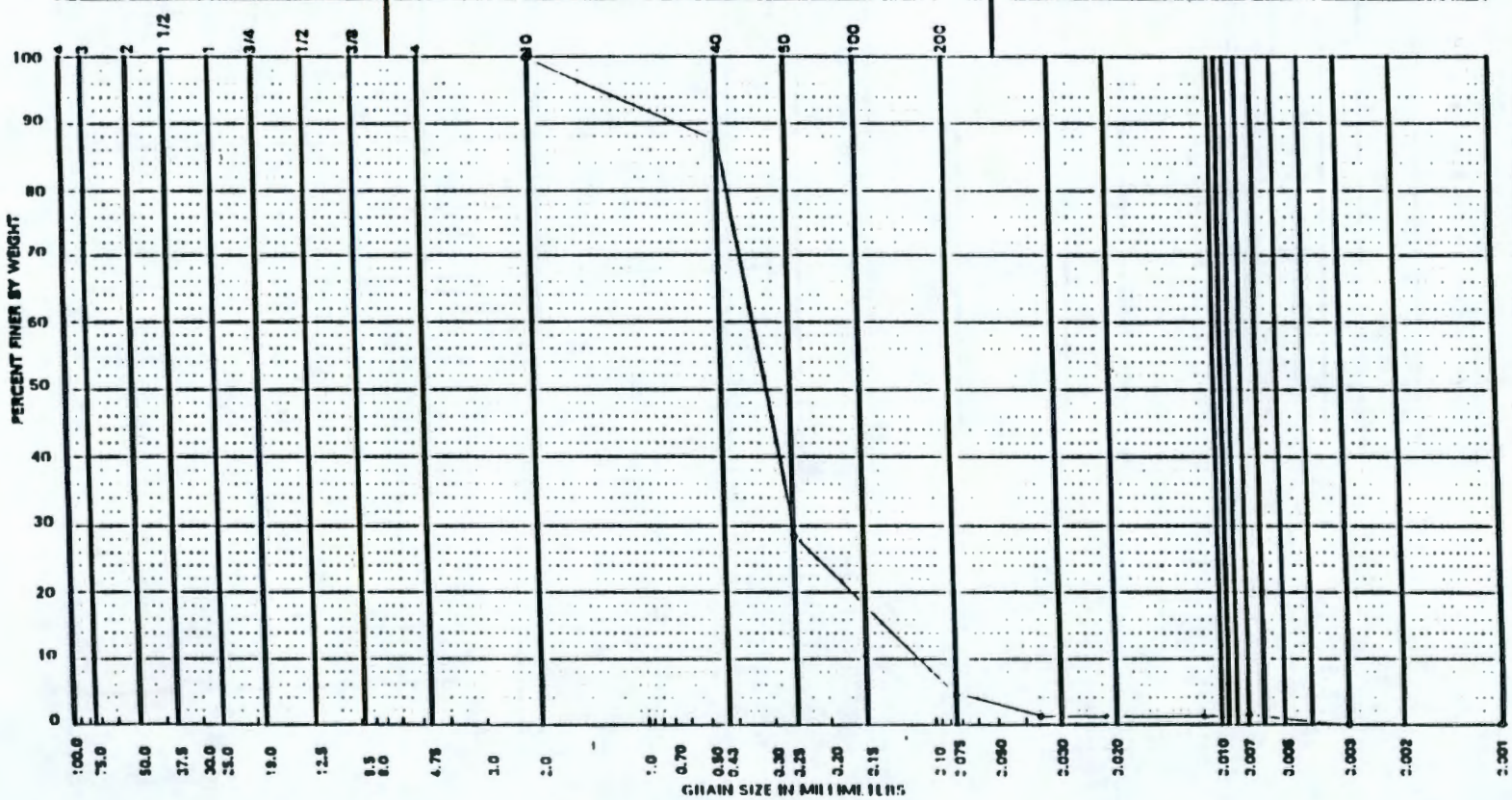

GEL-07 GRAIN SIZE ANALYSIS PLOT
Sample No. 3-0237
Page of
Remarks B07ND7 D11
Size of Opening in Inches
Number of Mesh Per Inch
Hydrometer Analysis
PERCENT FINER BY WEIGHT
GRAIN SIZE IN MILLIMETERS

GEL-07 GRAIN SIZE ANALYSIS PLOT

Sample No. 3-0236

Page ____ of ____

Remarks D Island 0-6" B07ND6 DI2

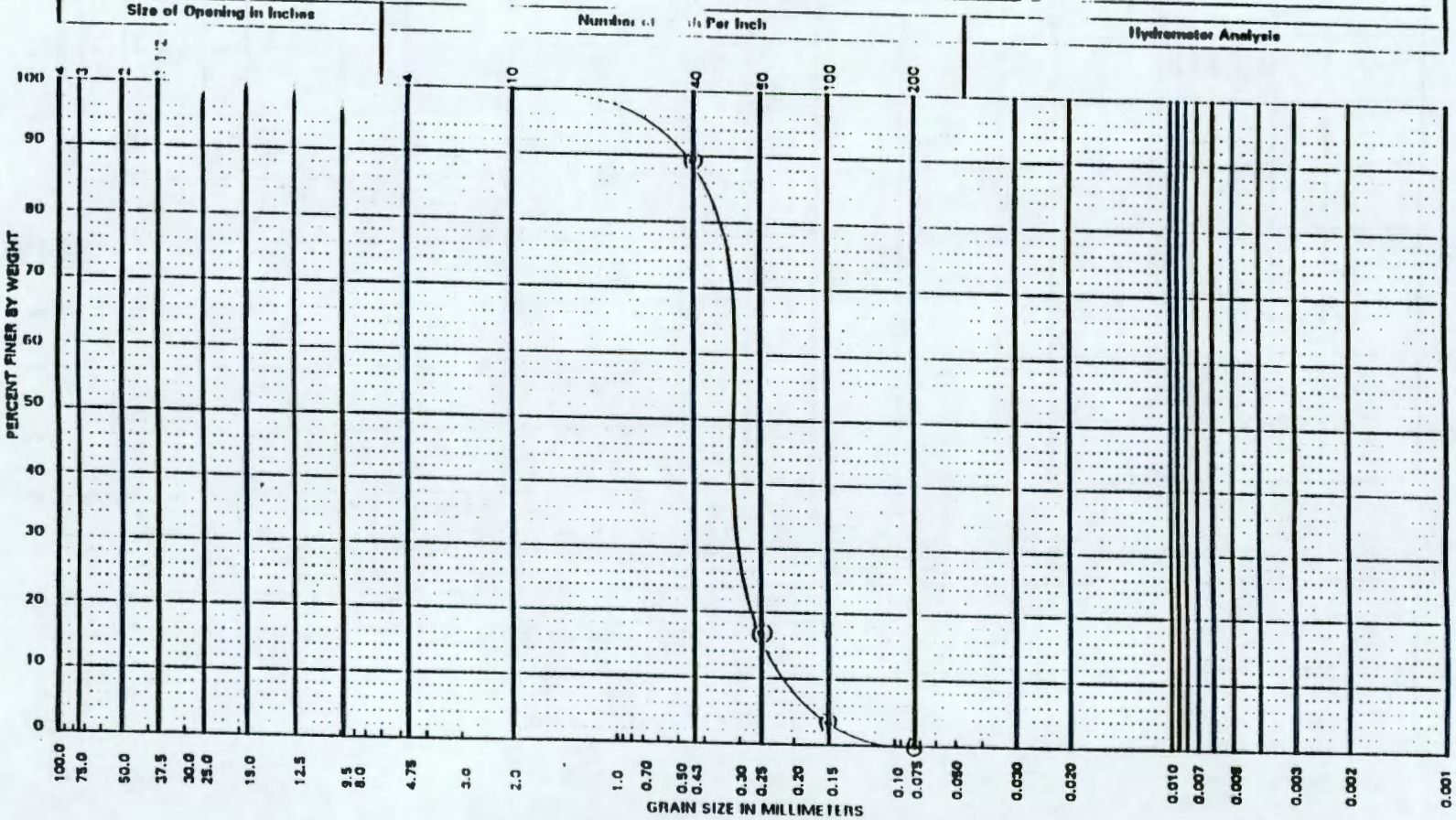


GEL-07 GRAIN SIZE ANALYSIS PLOT

Sample No. 3-0238

Page ____ of ____

Remarks B07HD8 -D12

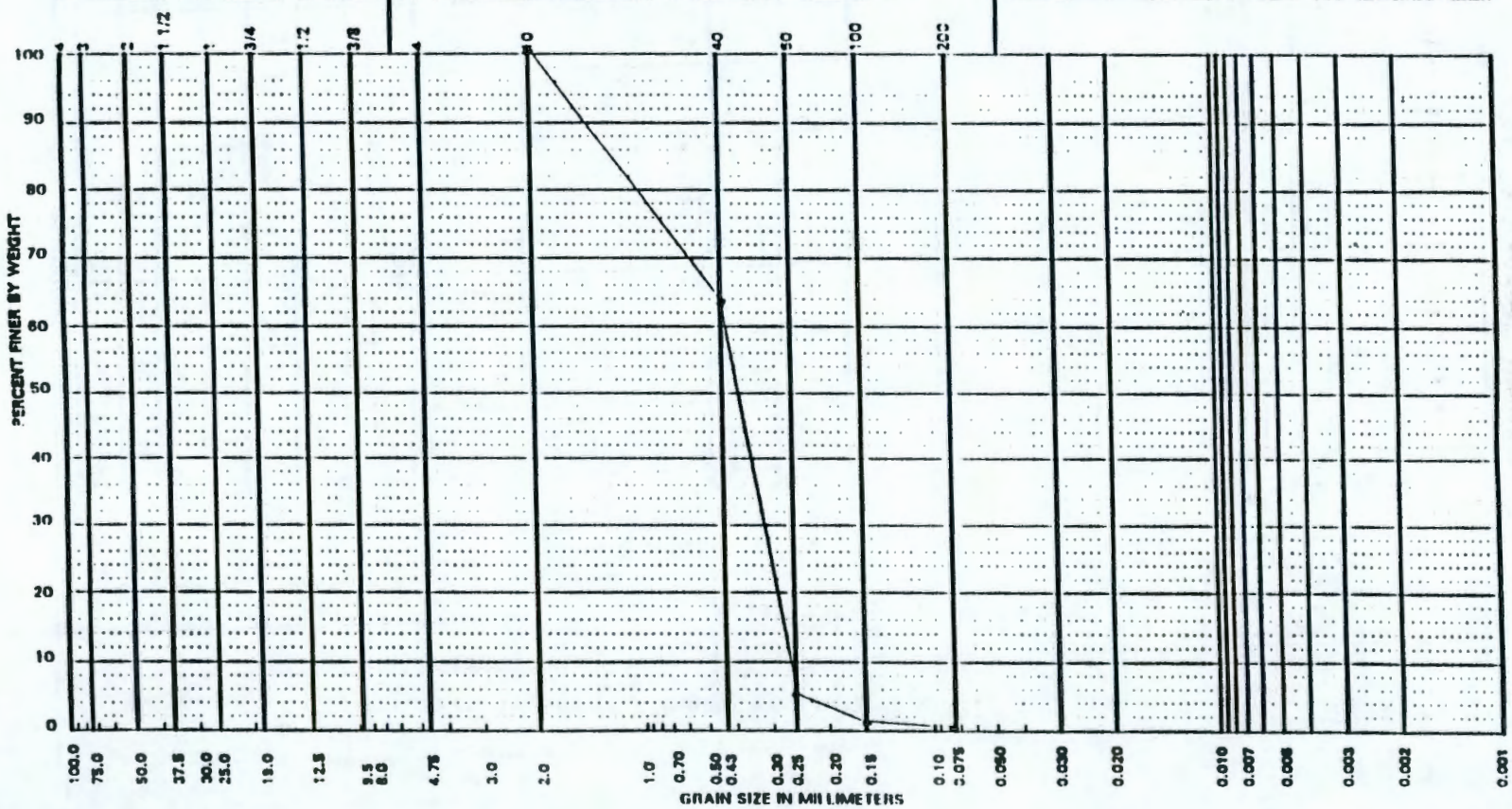


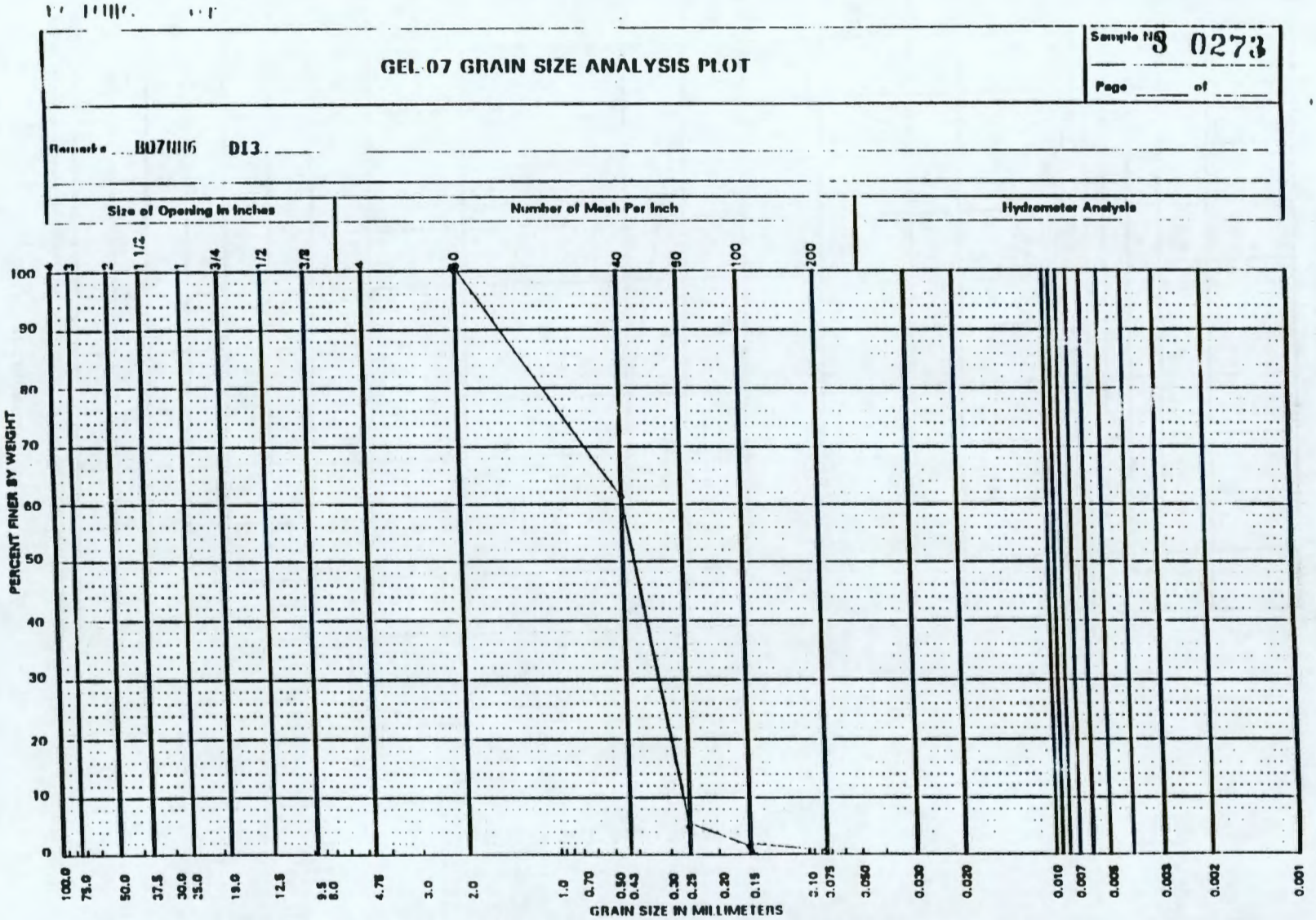
GEL-07 GRAIN SIZE ANALYSIS PLOT

Sample No. 3 0272

Page ____ of ____

Remarks B0ZW05 D13



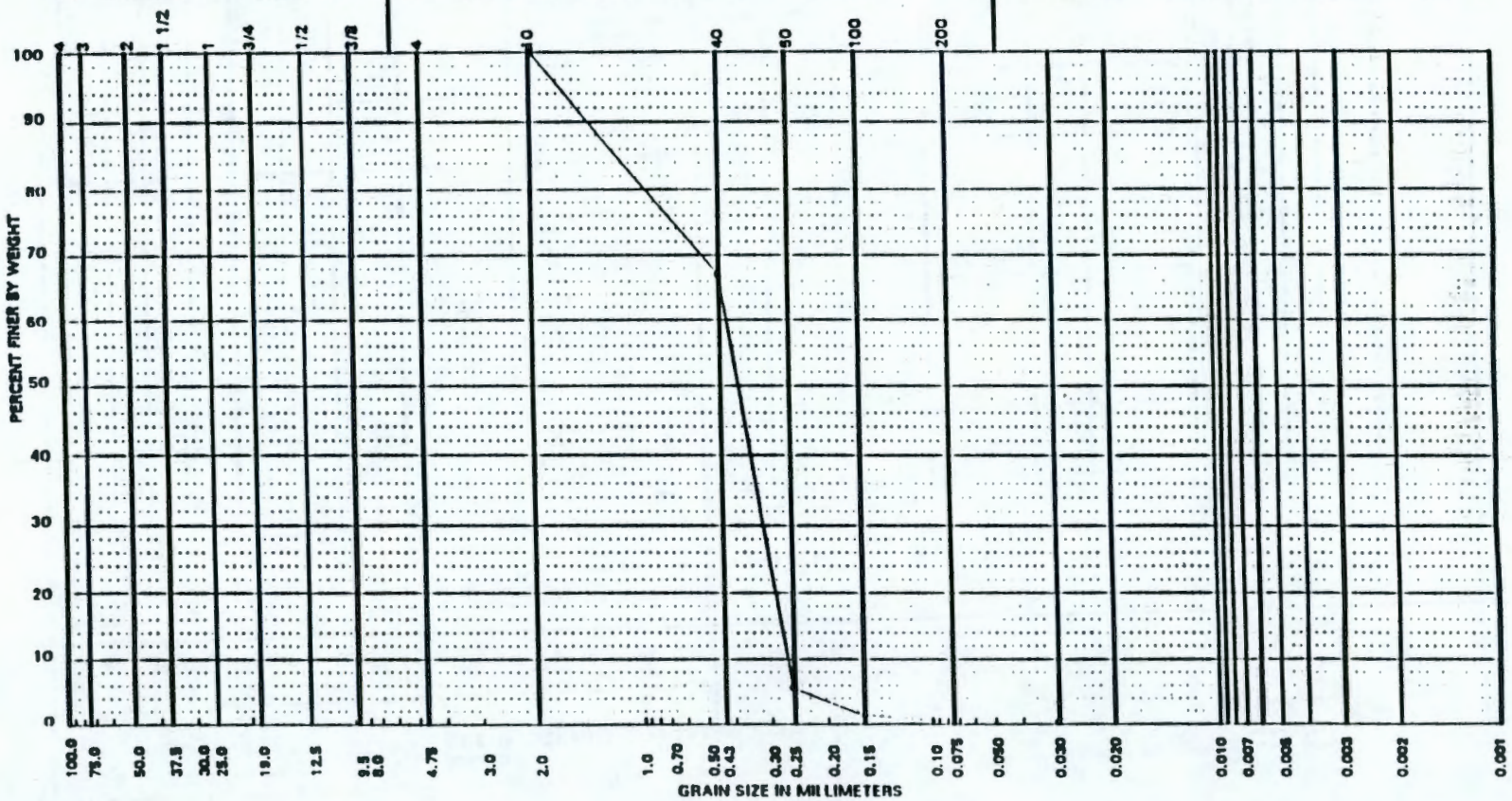

GEL-07 GRAIN SIZE ANALYSIS PLOT
Sample No. 3 0273
Page ____ of ____
Remarks B07B06 D13
Size of Opening in Inches
Number of Mesh Per Inch
Hydrometer Analysis
PERCENT FINER BY WEIGHT
GRAIN SIZE IN MILLIMETERS

GEL-07 GRAIN SIZE ANALYSIS PLOT

Sample No. 3 0274

Page _____ of _____

Remarks B07NH7 D13

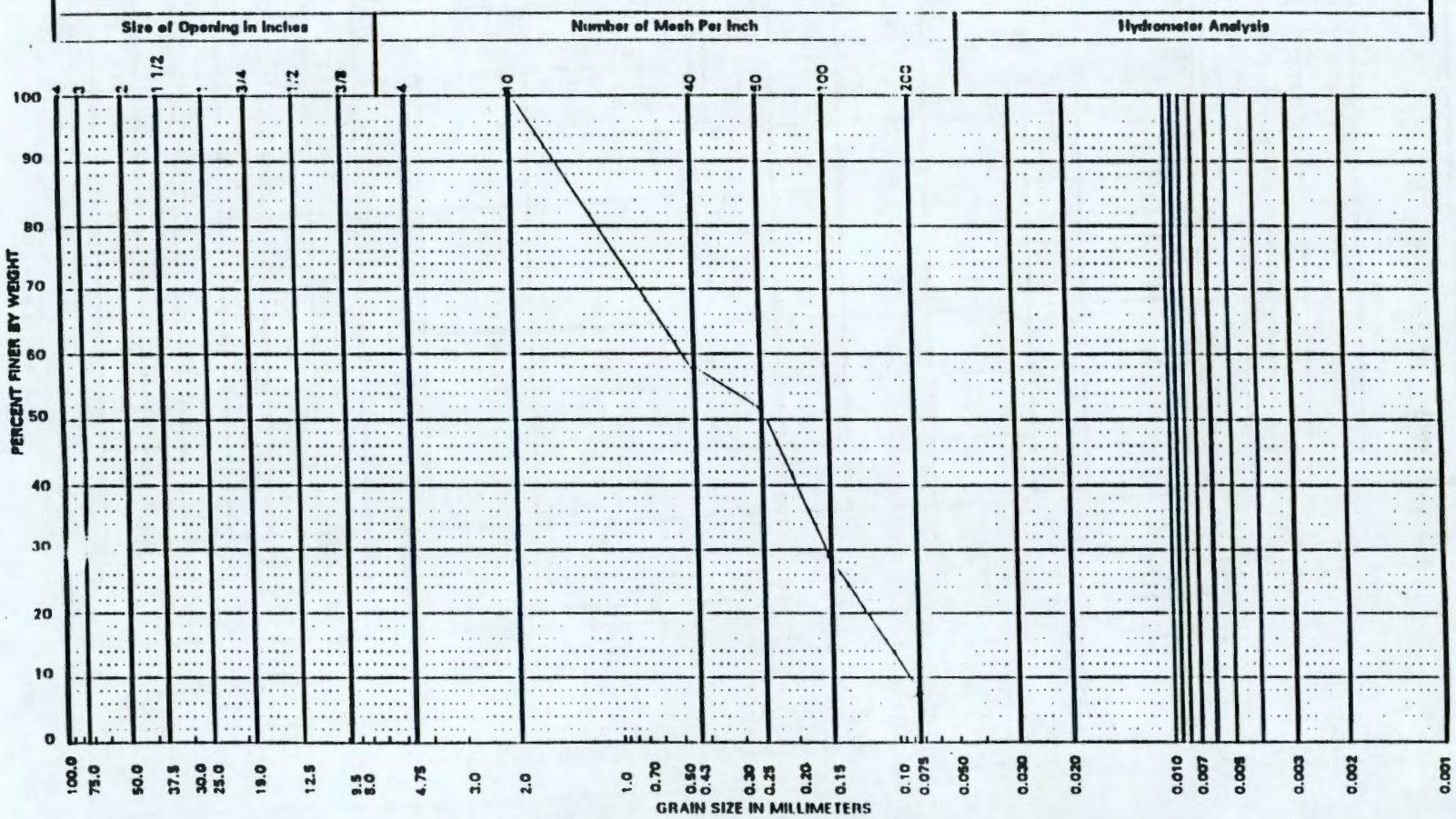


GEL-07 GRAIN SIZE ANALYSIS PLOT

Sample No. 3-0240

Page ____ of ____

Remarks BUZHFU ISLAND 385

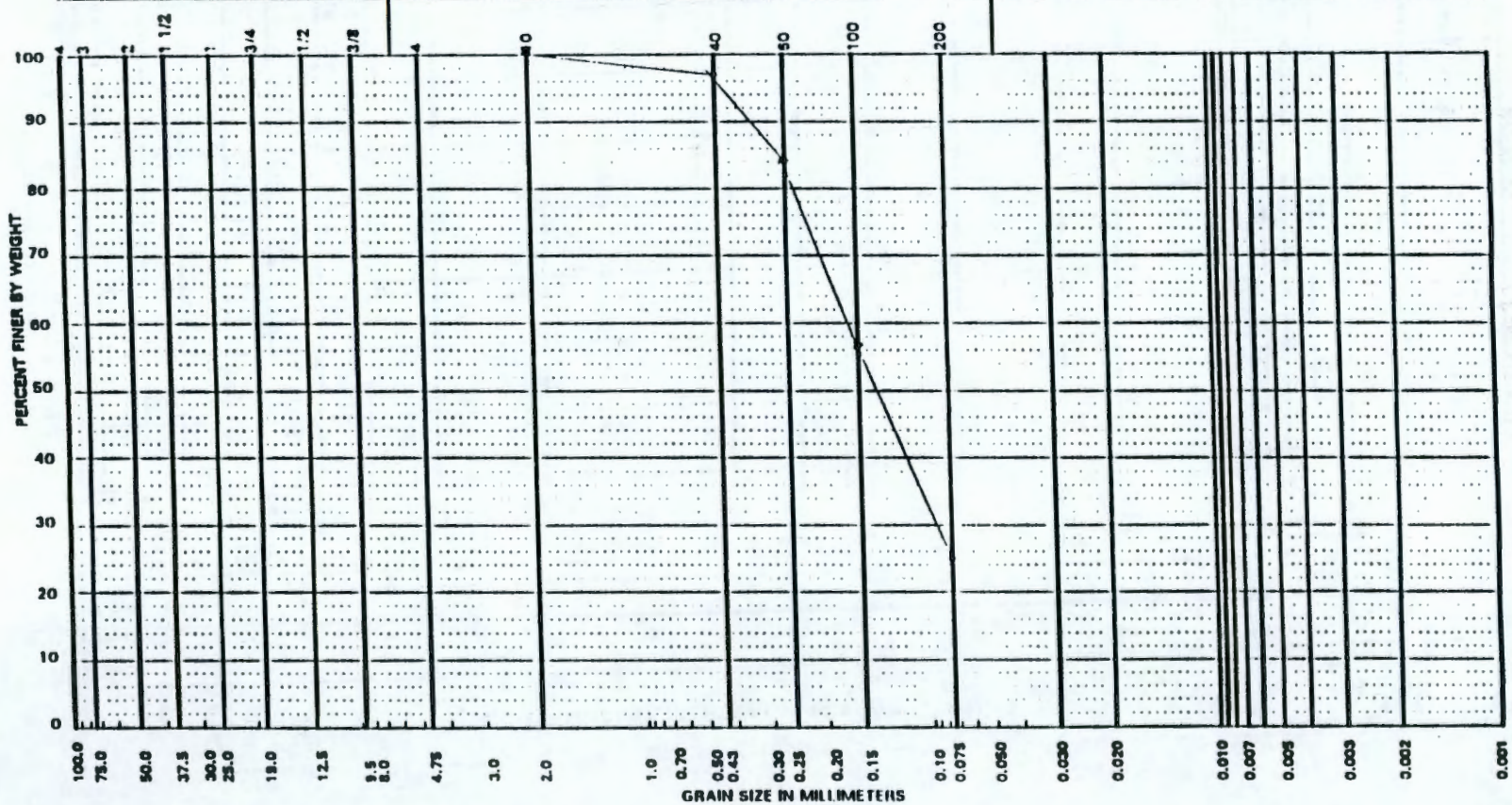


GEL-07 GRAIN SIZE ANALYSIS PLOT

Sample No. 3 0268

Page _____ of _____

Remarks B07HH1 DA1

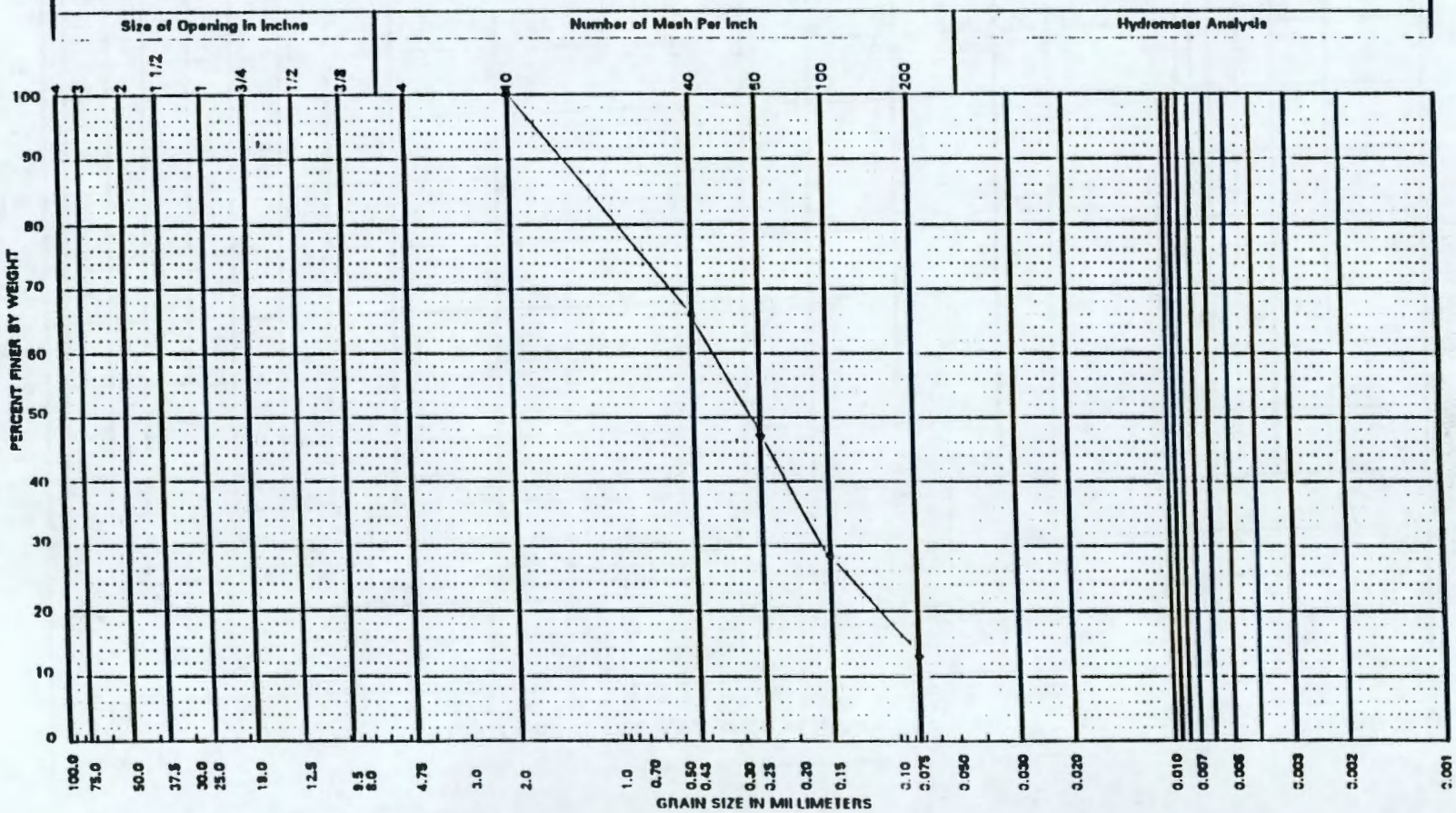


GEL-07 GRAIN SIZE ANALYSIS PLOT

Sample No. 3 0269

Page ____ of ____

Remarks B07H02 DA1

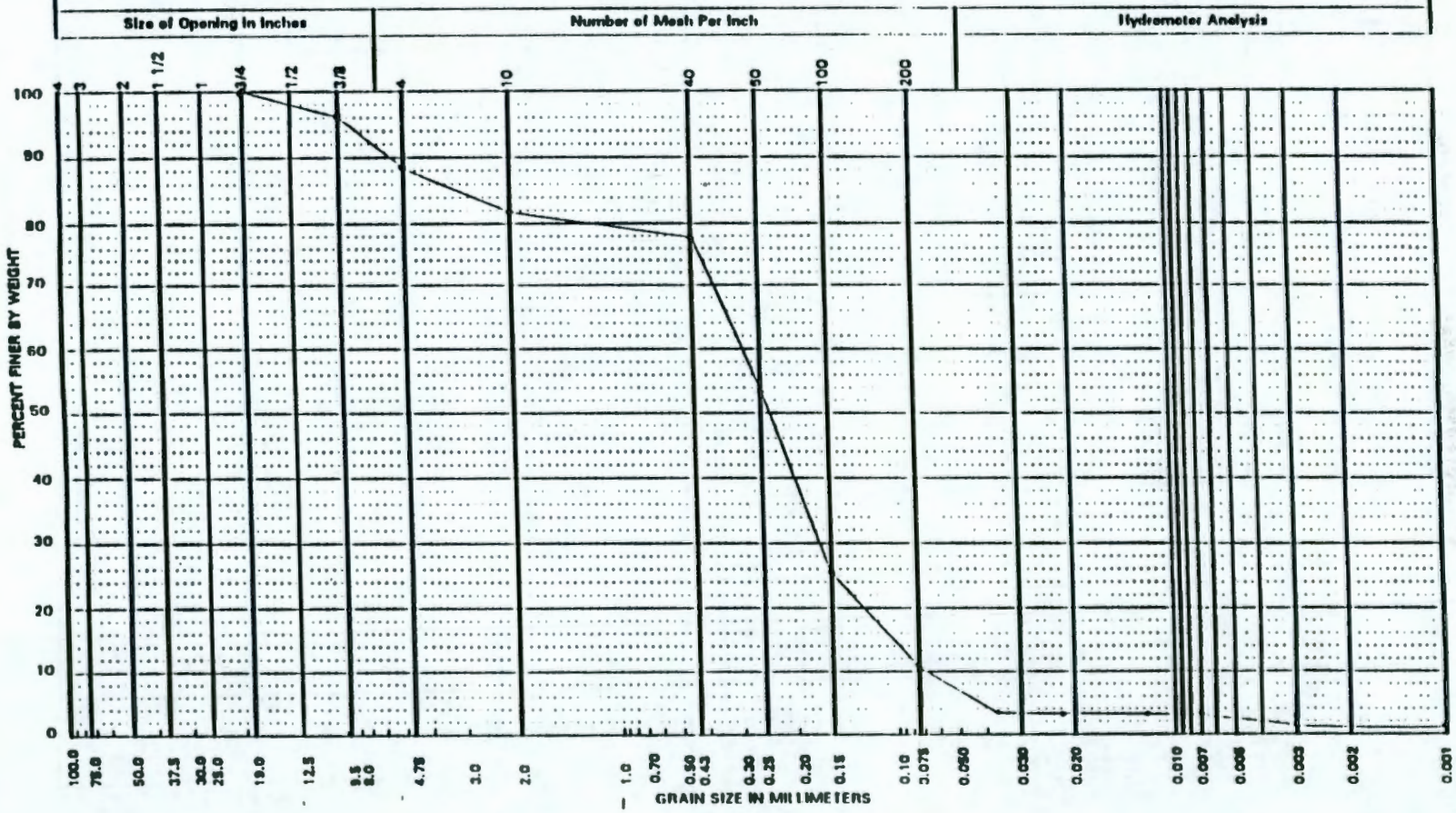


GEL-07 GRAIN SIZE ANALYSIS PLOT

Sample No. 3-0229

Page ____ of ____

Remarks HCEN B07NC9 D/H

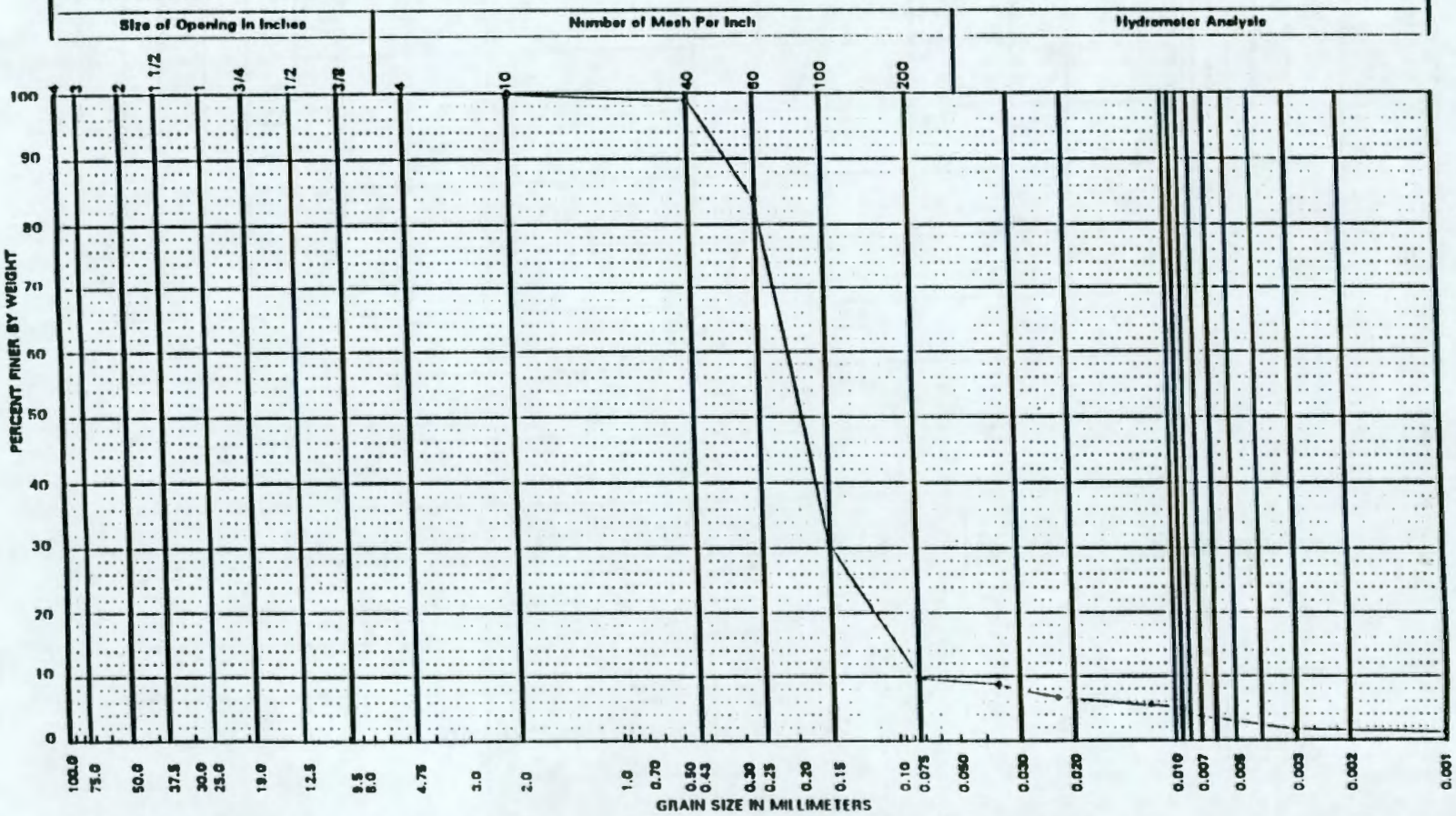


GEL-07 GRAIN SIZE ANALYSIS PLOT

Sample No. 3-0230

Page _____ of _____

Remarks HORS B07HD0 D/U

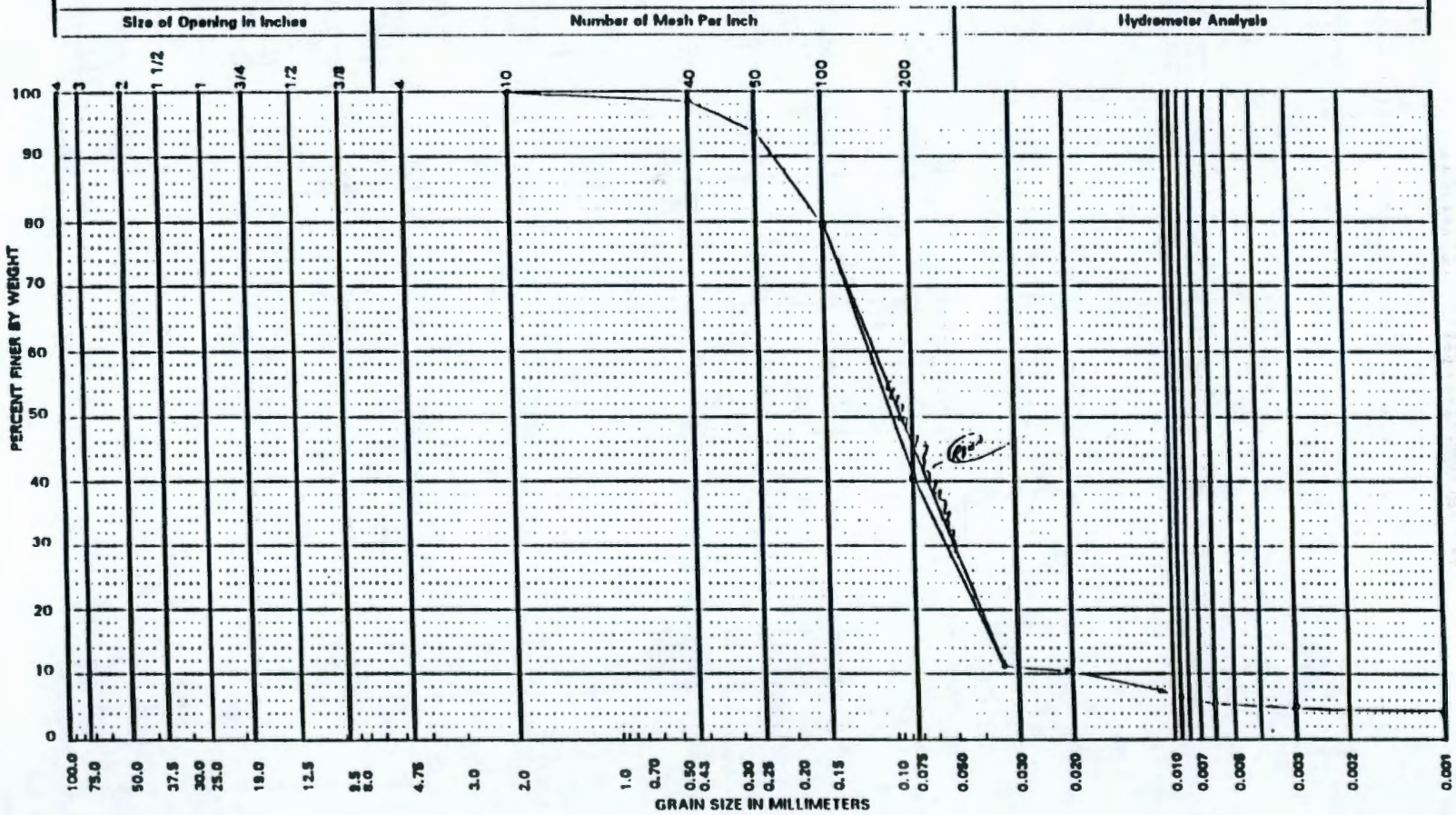


GEL-07 GRAIN SIZE ANALYSIS PLOT

Sample No. 3-0221

Page ____ of ____

Remarks 100 H Area 0-6" BOZNCO H1

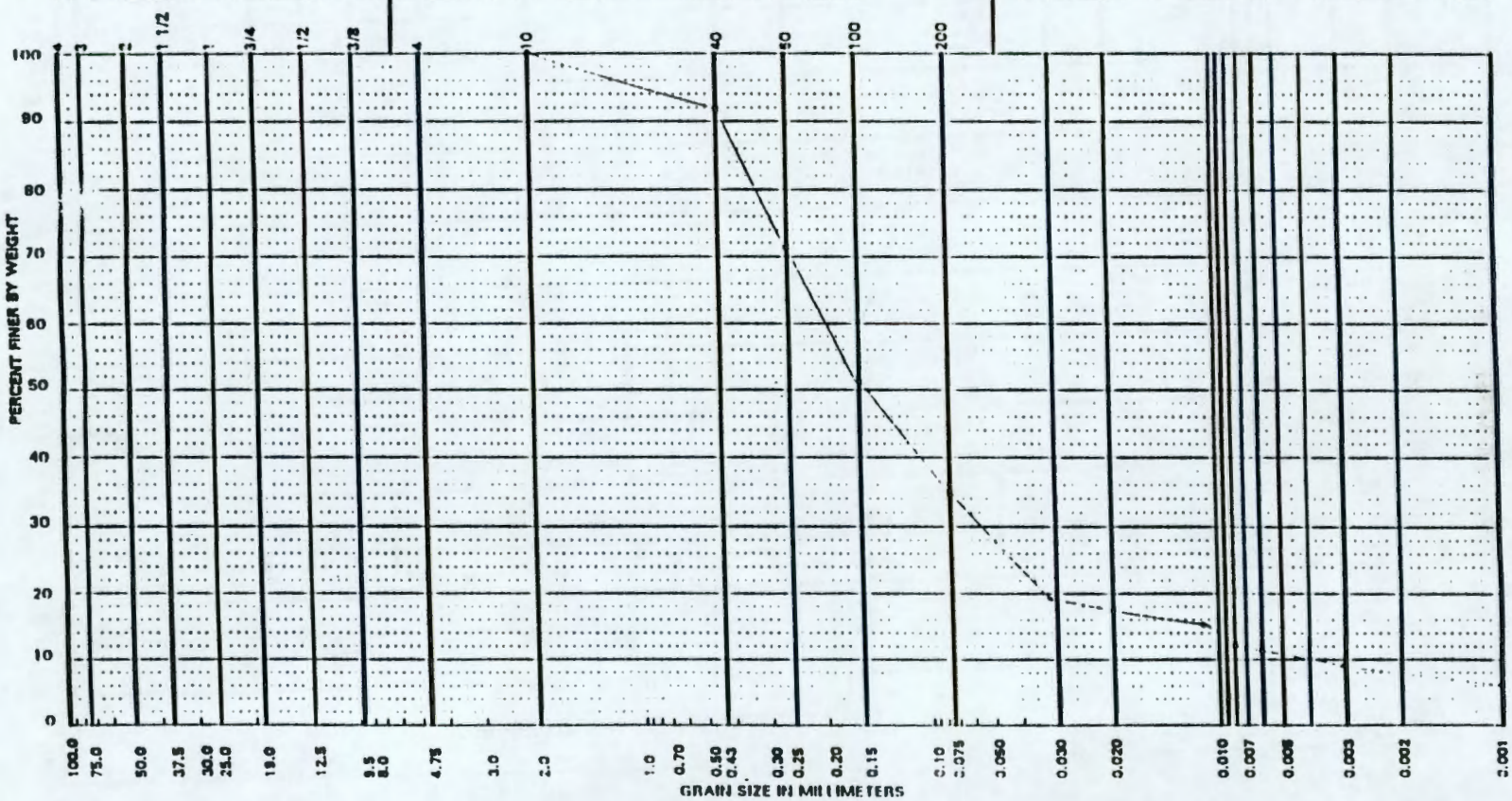


GEL-07 GRAIN SIZE ANALYSIS PLOT

Sample No. 3-0222

Page ____ of ____

Remarks: 14 SLOUGH 12"-14" BOZNCI HI

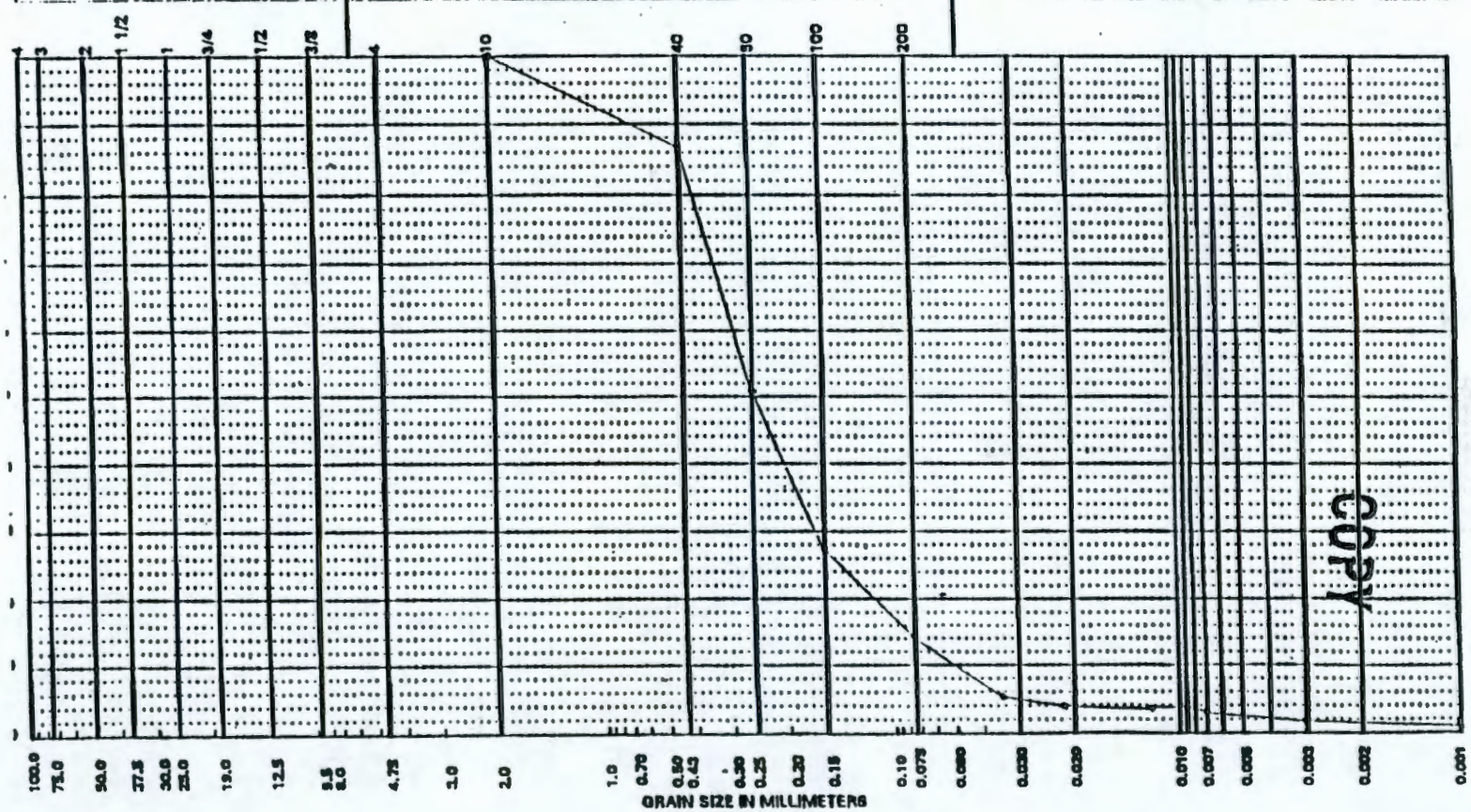


GEL-07 GRAIN SIZE ANALYSIS PLOT

Sample No. 3-0223

Page ____ of ____

Remarks: H Slough 0-6" B07HC2 H2



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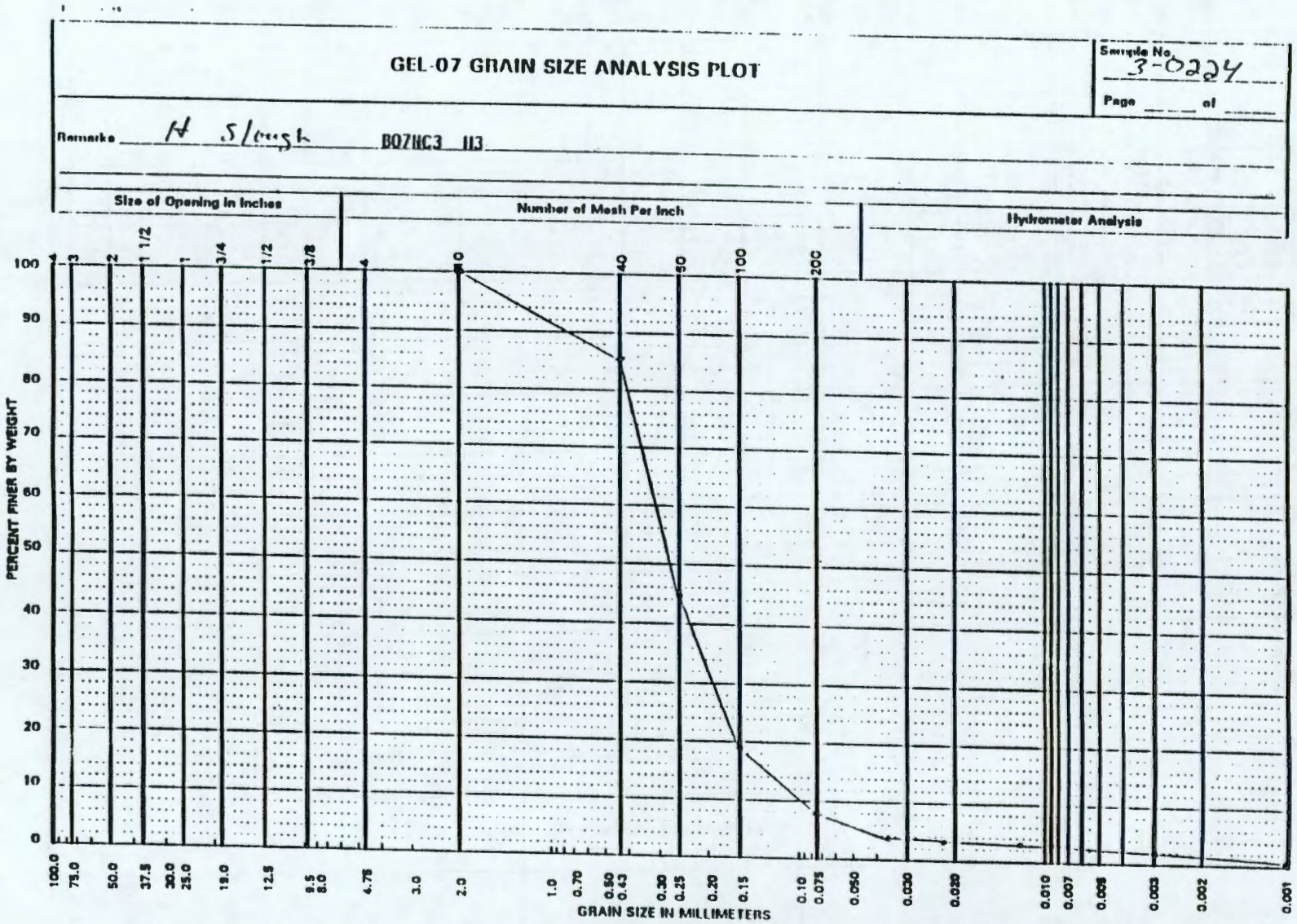
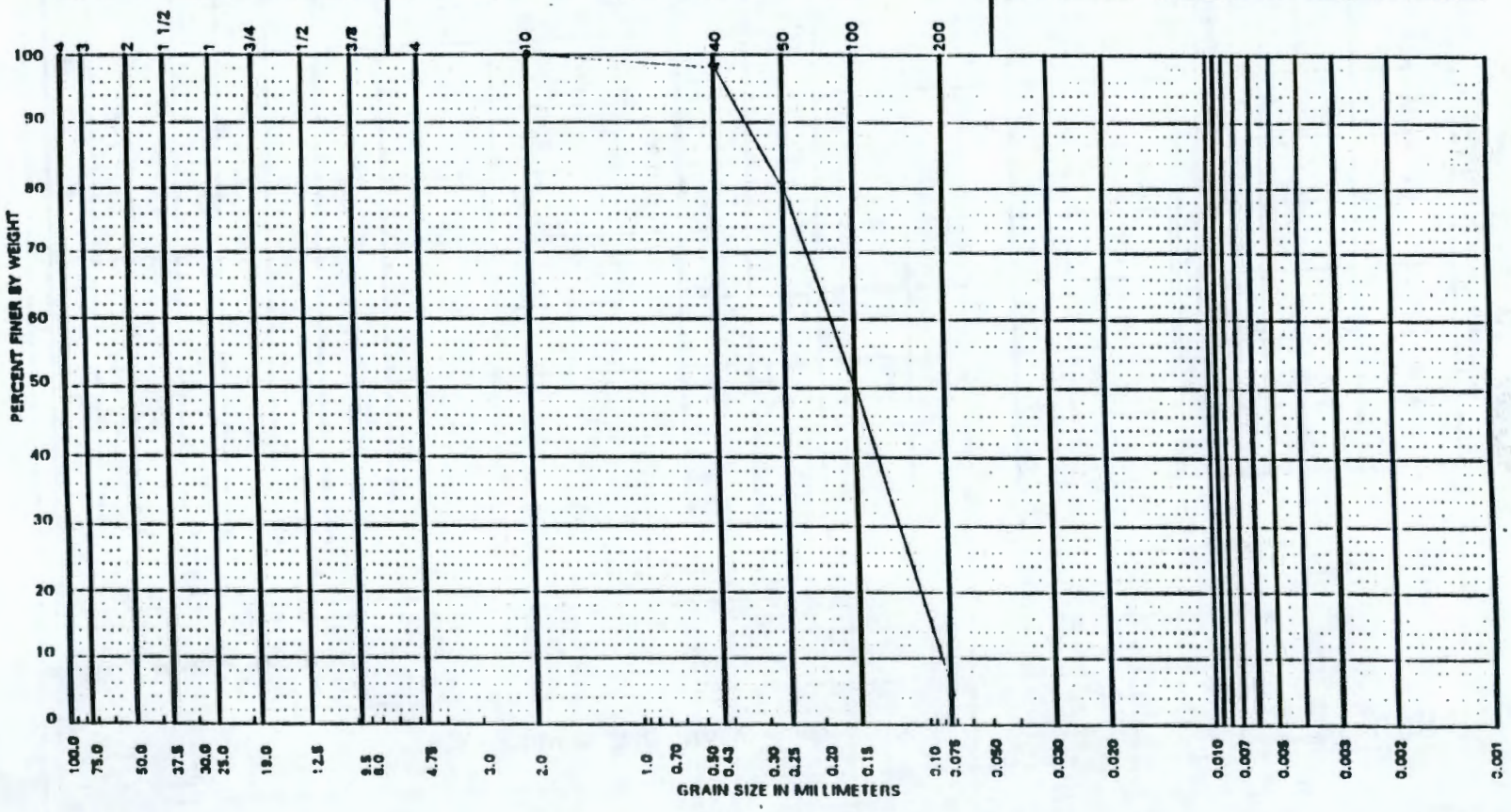

GEL-07 GRAIN SIZE ANALYSIS PLOT
Sample No. 3-0224
Page ____ of ____
Remarks H Slough B07HC3 113
Size of Opening in Inches
Number of Mesh Per Inch
Hydrometer Analysis
PERCENT FINER BY WEIGHT
GRAIN SIZE IN MILLIMETERS

GEL-07 GRAIN SIZE ANALYSIS PLOT

Sample No. 3 0261

Page ____ of ____

Remarks B07HG3 HU1 0-6"

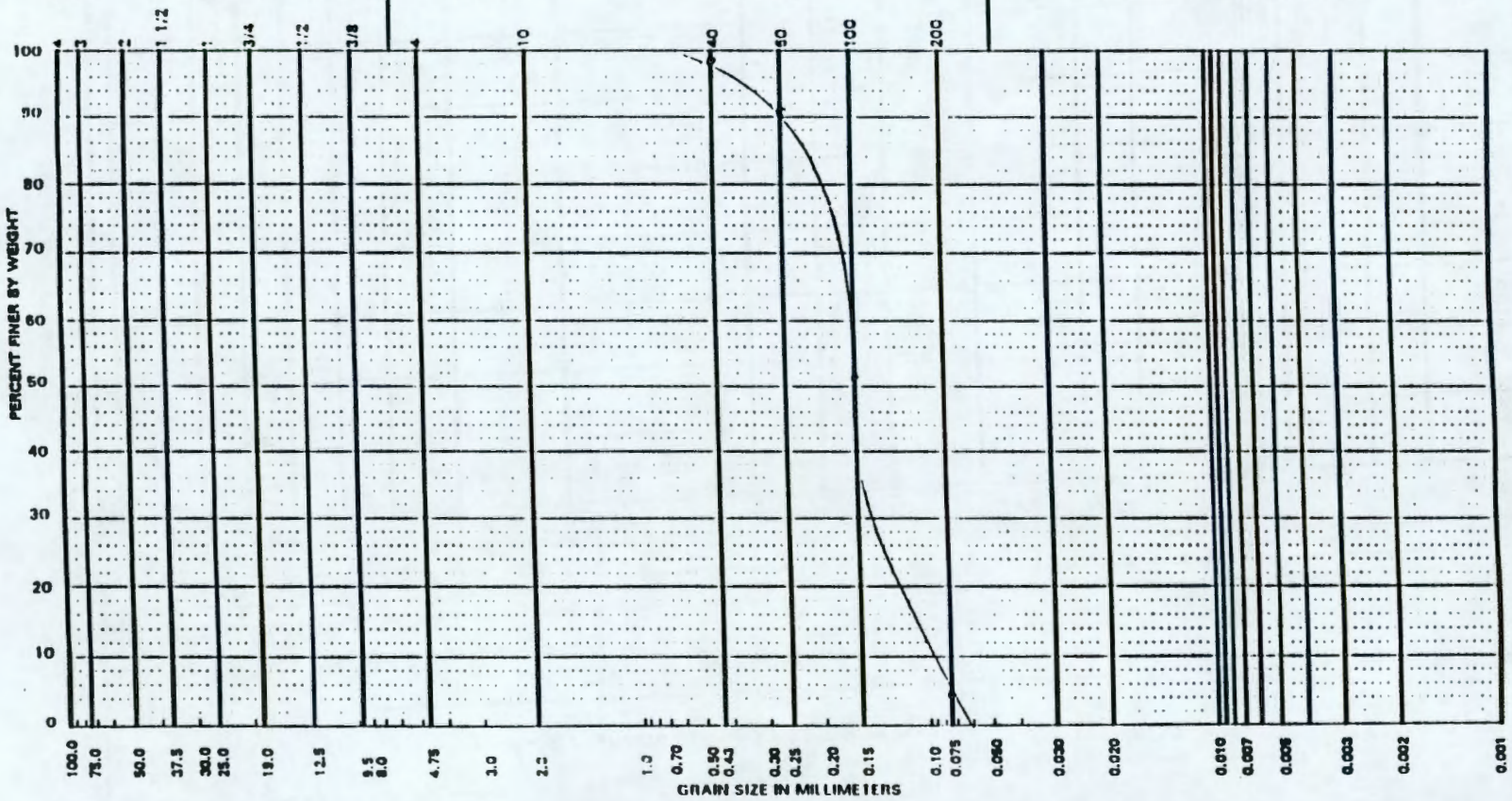


GEL-07 GRAIN SIZE ANALYSIS PLOT

Sample No. 3 0264

Page ____ of ____

Remarks BOZHG6 H01 0-6"

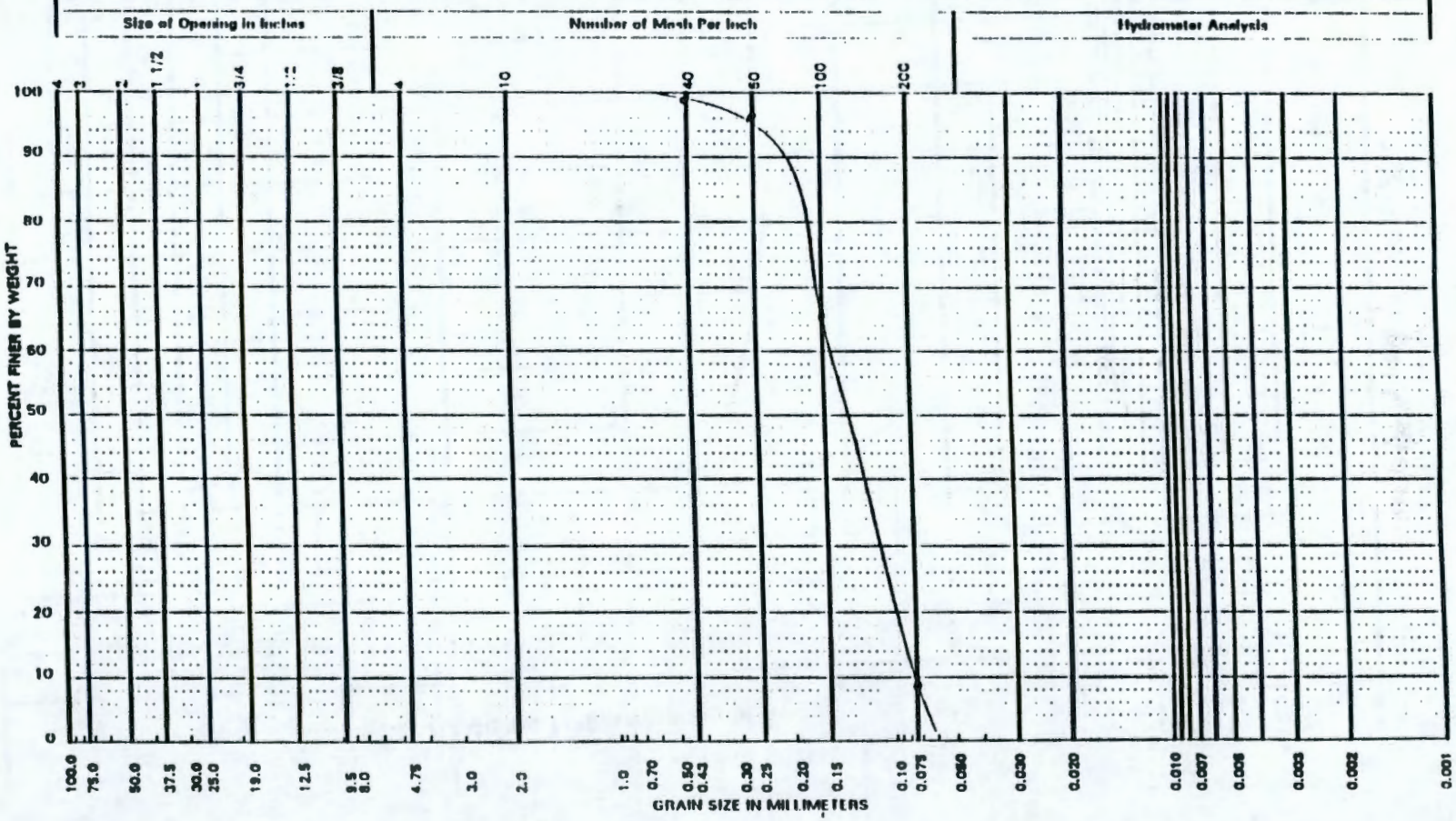


GEL-07 GRAIN SIZE ANALYSIS PLOT

Sample No. 3 0263

Page ____ of ____

Remarks BOZNG5 HU1 12-18"

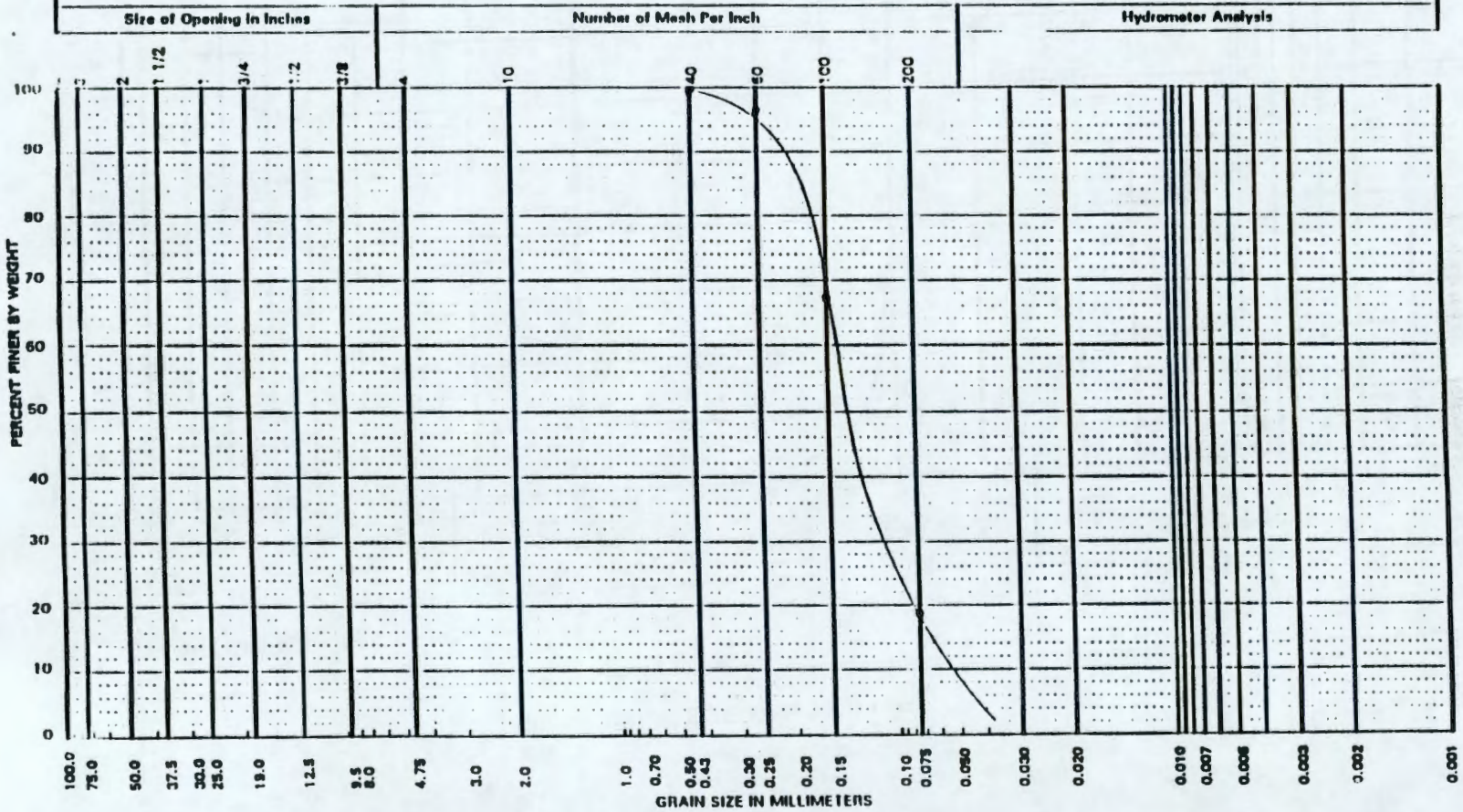


GEL-07 GRAIN SIZE ANALYSIS PLOT

Sample No. 3 0265

Page ____ of ____

Remarks B07HG7 HU1 12-18"

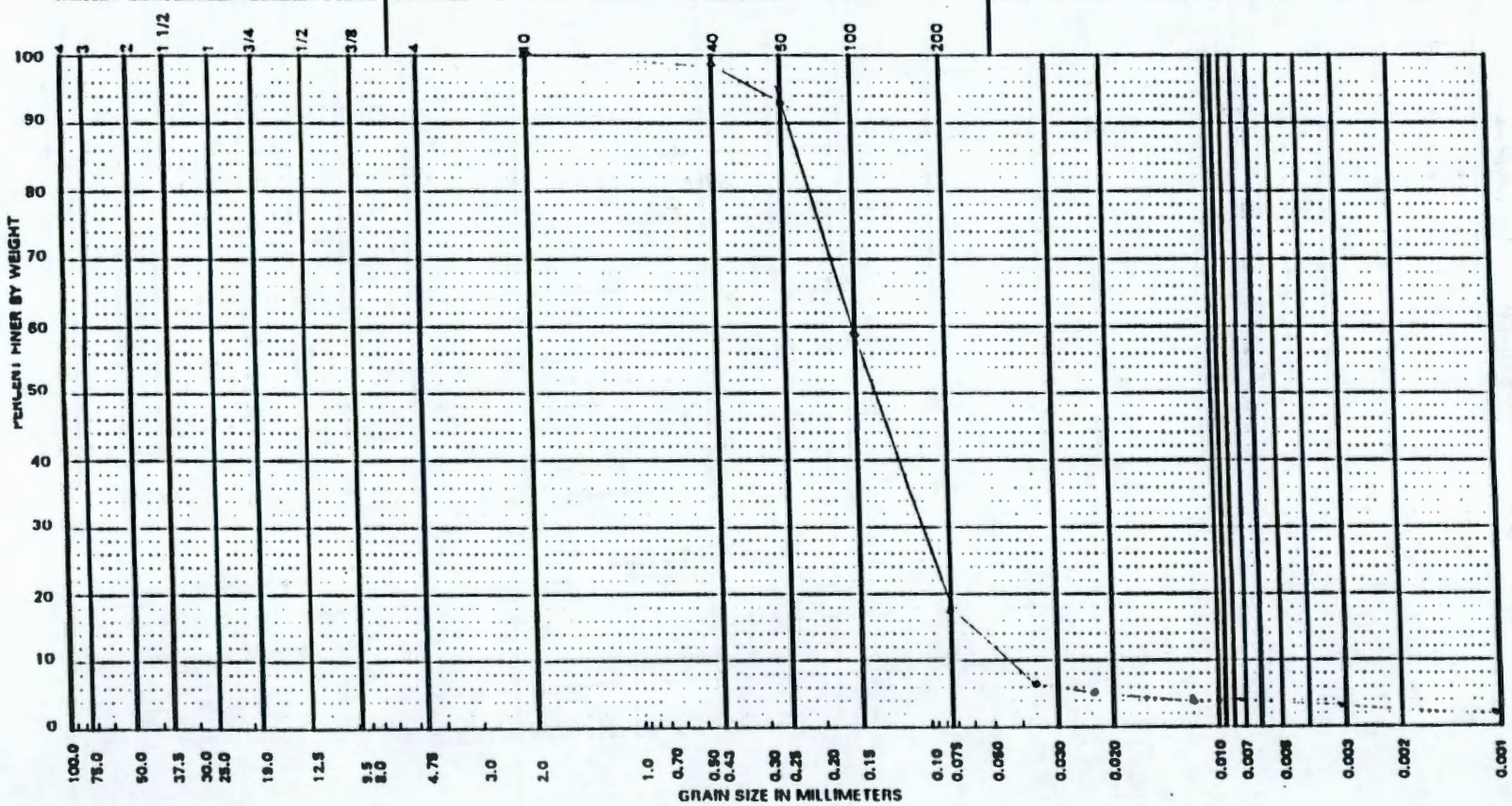


GEL-07 GRAIN SIZE ANALYSIS PLOT

Sample No. 3-0217

Page 1 of 1

Remarks B0ZHB6 F1

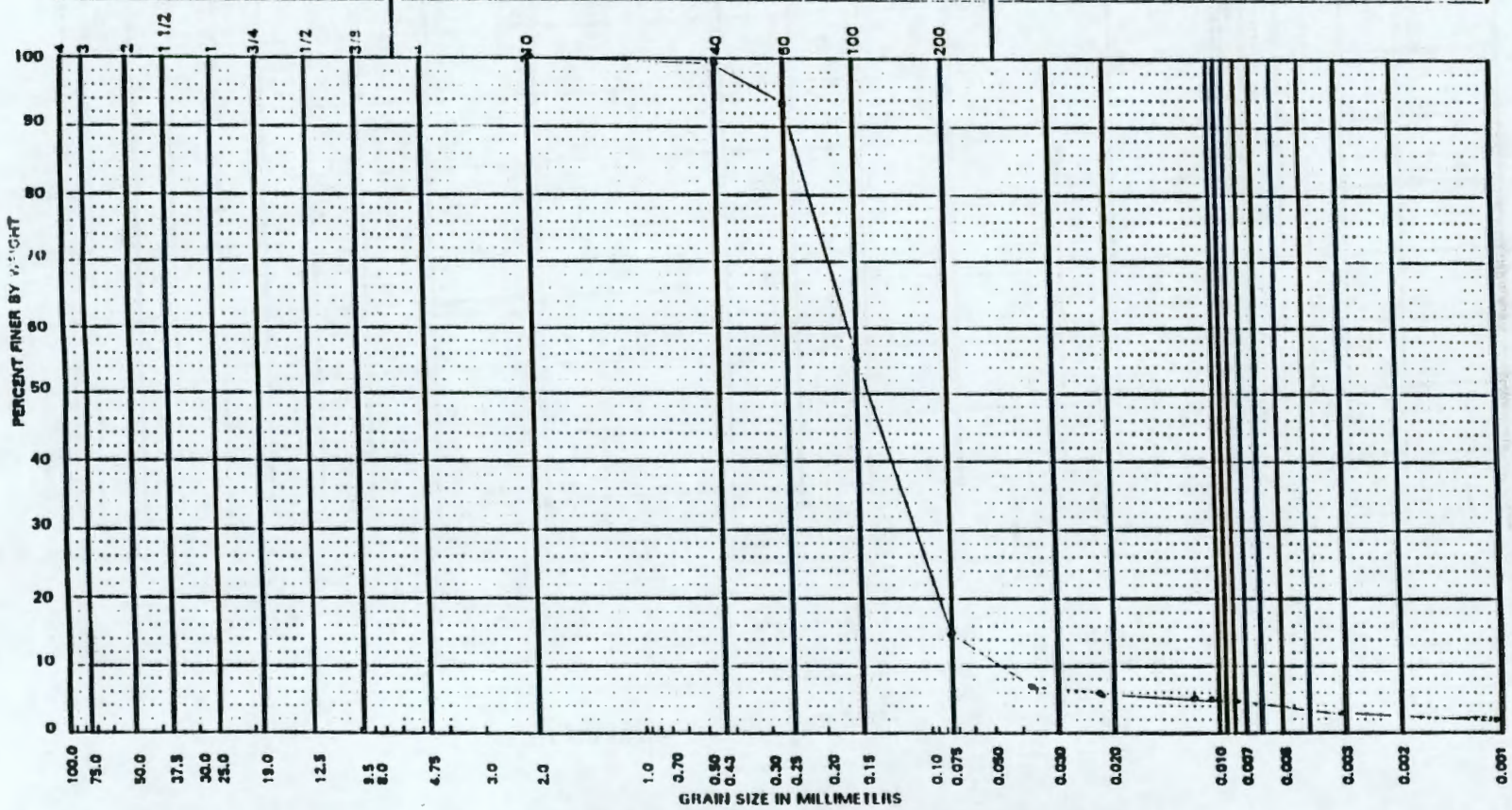


GEL-07 GRAIN SIZE ANALYSIS PLOT

Sample No. 3-0218

Page 1 of 1

Remarks B07NB7 E2

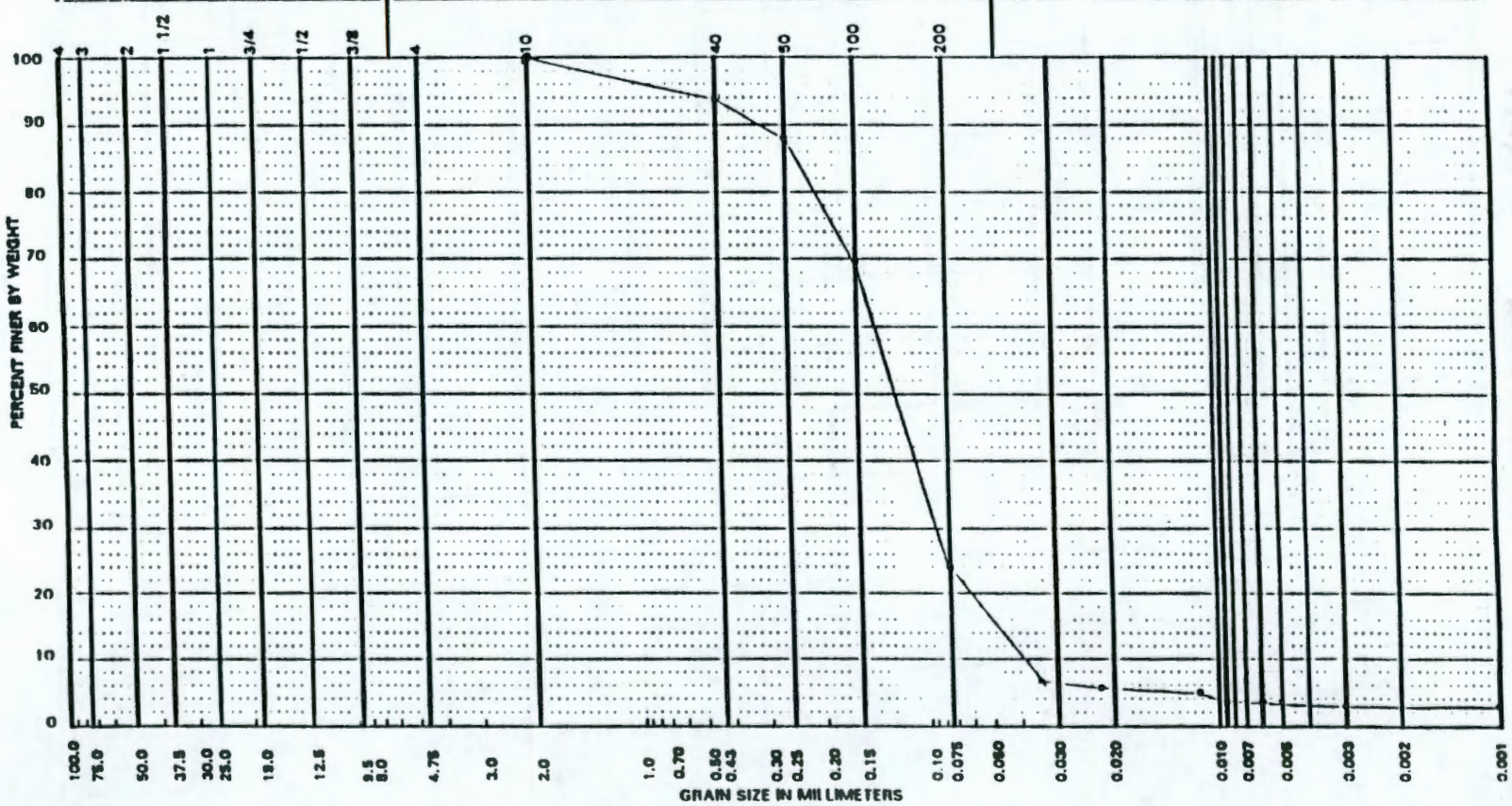


GEL-07 GRAIN SIZE ANALYSIS PLOT

Sample No. 3-0219

Page 1 of 1

Remarks 100 F Slough Sand-silt 0-6" B07N88 E3

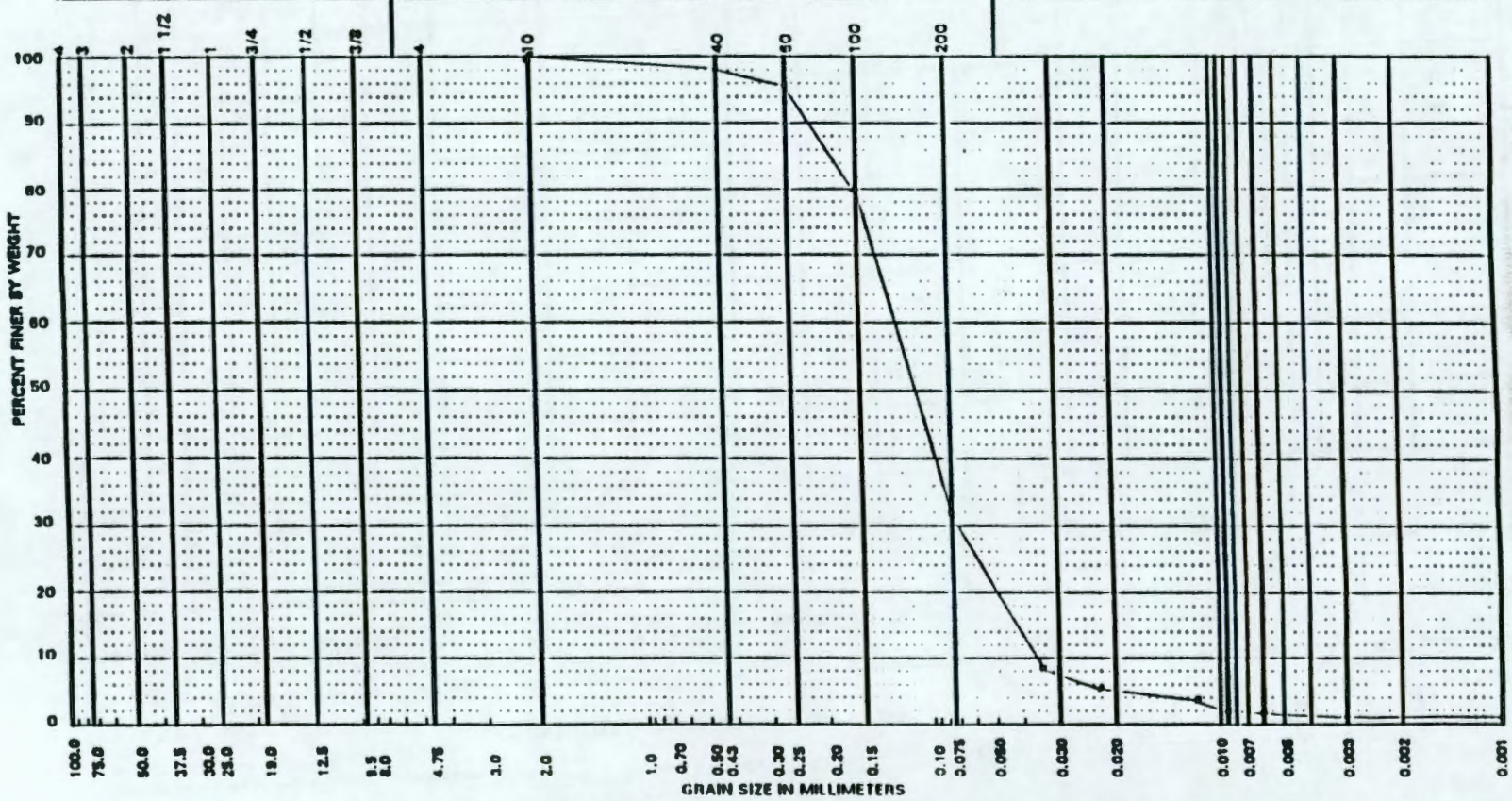


GEL-07 GRAIN SIZE ANALYSIS PLOT

Sample No. 3-0220

Page 1 of 1

Remarks F Slough 12"–2... BU7NB9 F3

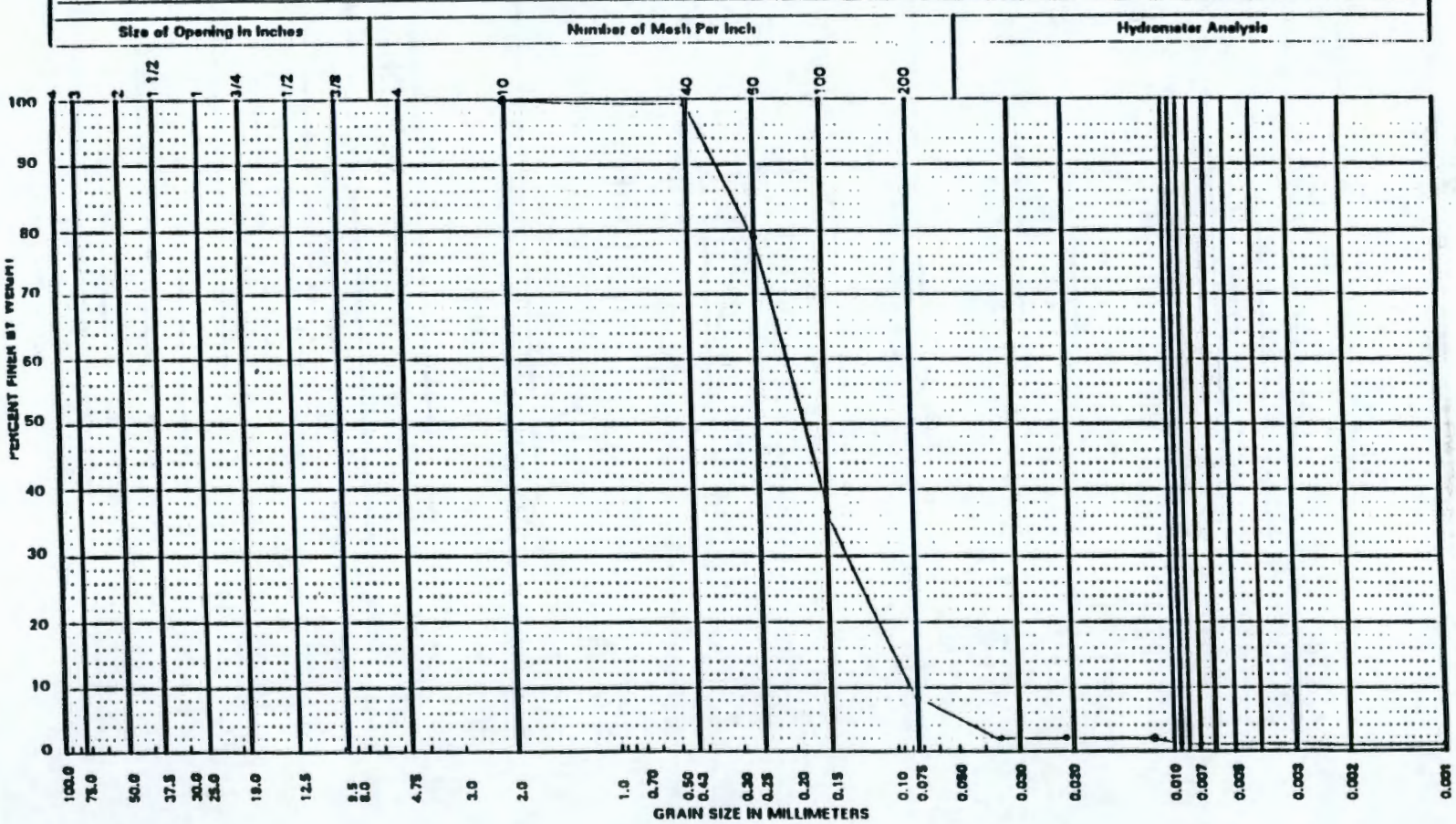


GEL-07 GRAIN SIZE ANALYSIS PLOT

Sample No. 3-0225

Page ____ of ____

Remarks WEW F4 0-6" B07NC4 F4

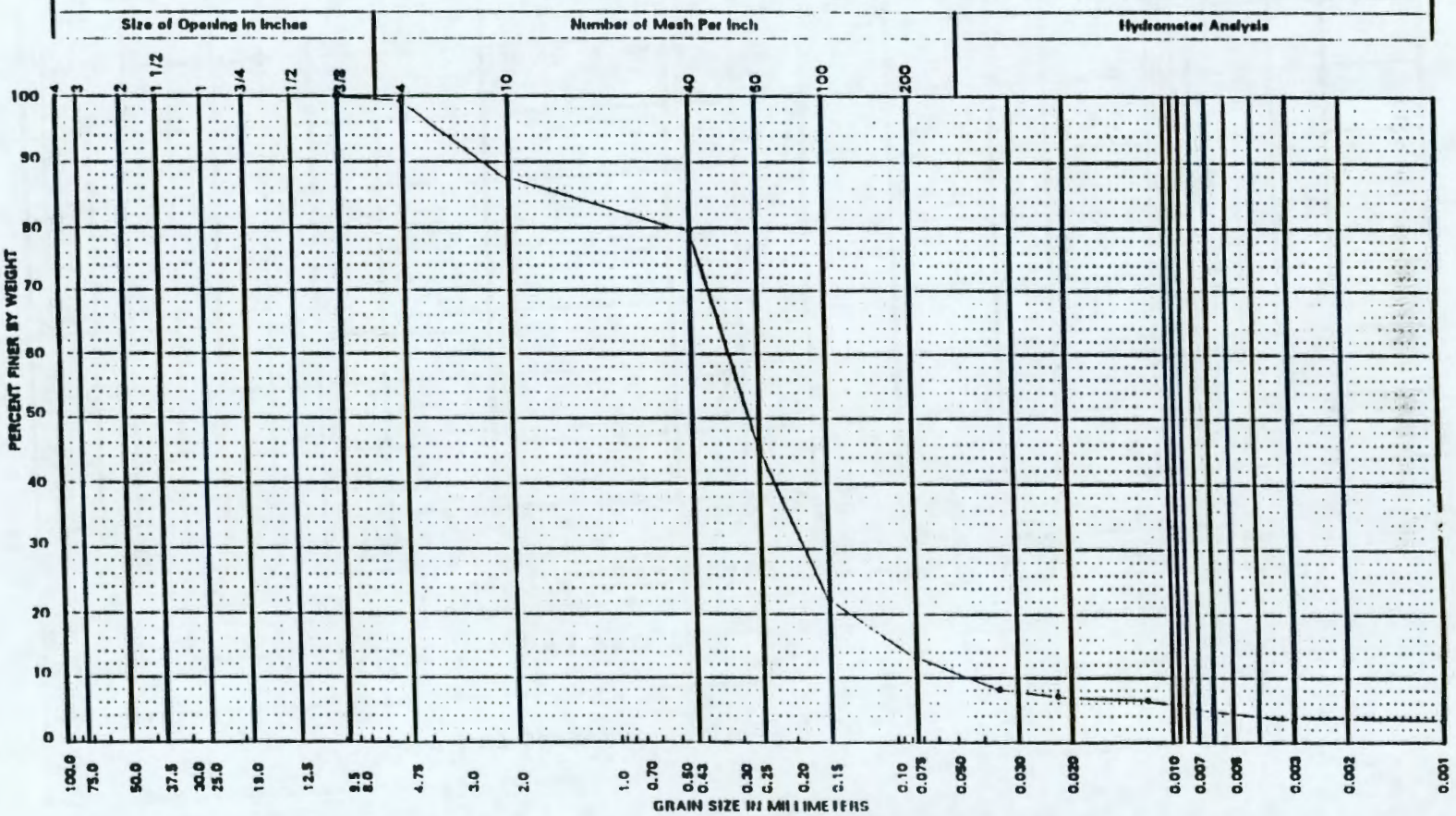


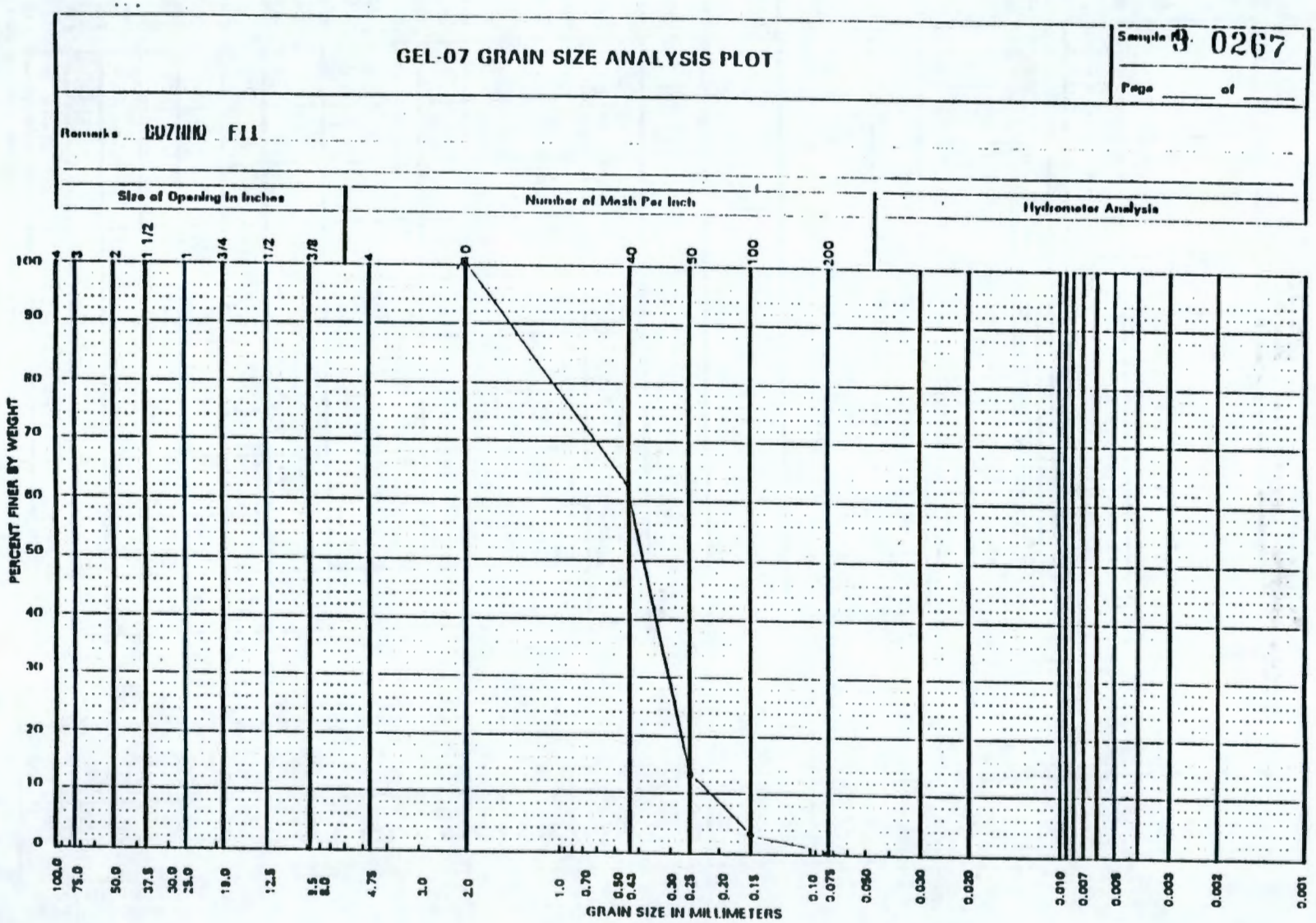
GEL-07 GRAIN SIZE ANALYSIS PLOT

Sample No. 3-0227.6

Page ____ of ____

Remarks well F4 12-16" B07NC5 E4



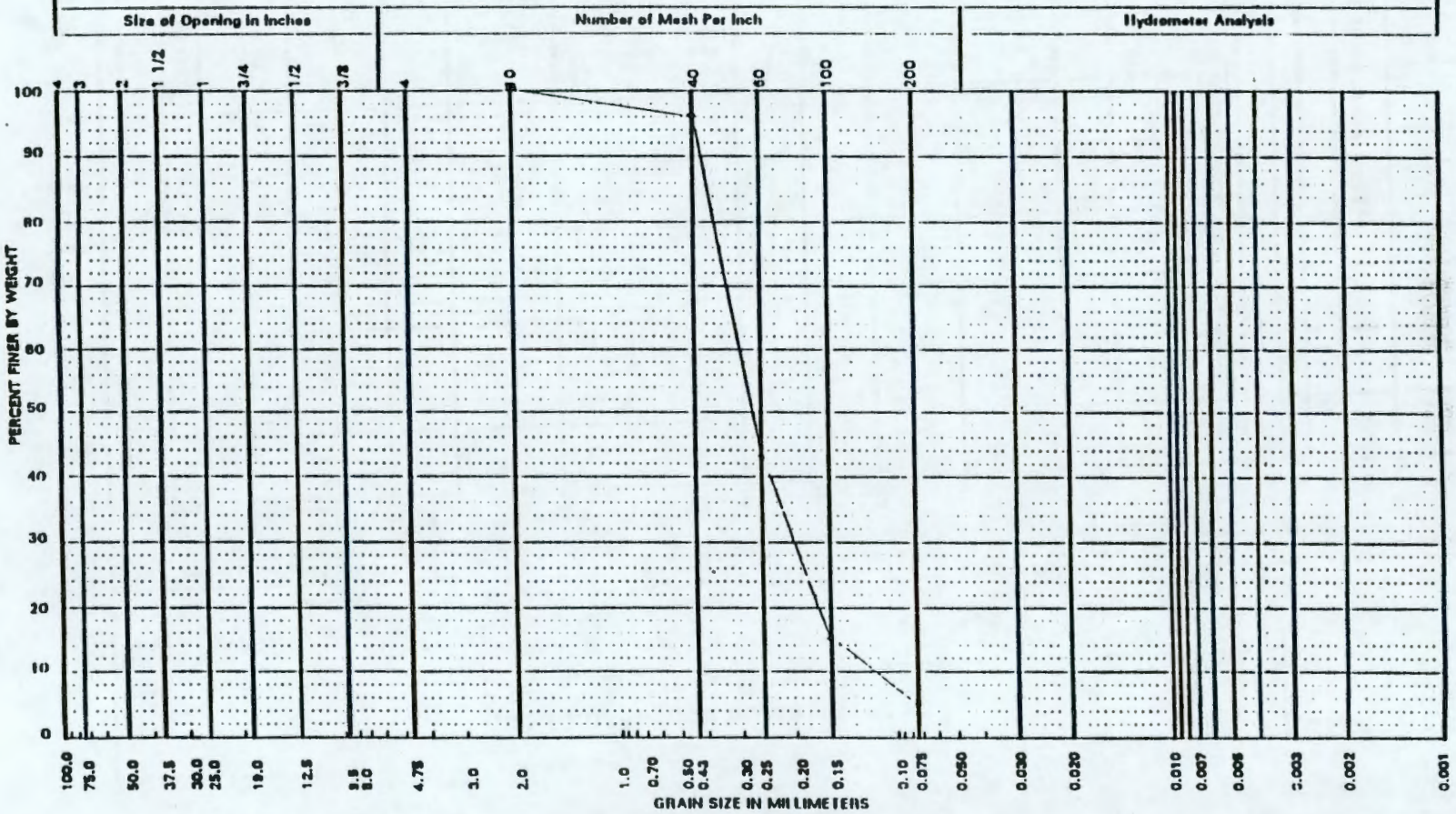

GEL-07 GRAIN SIZE ANALYSIS PLOT
Sample # 9 0267
Page ____ of ____
Remarks ... 60ZHKD FI1
Size of Opening in Inches
Number of Mesh Per Inch
Hydrometer Analysis
PERCENT FINER BY WEIGHT
GRAIN SIZE IN MILLIMETERS

GEL-07 GRAIN SIZE ANALYSIS PLOT

Sample No. 3 0266

Page ____ of ____

Remarks B07H69 F11

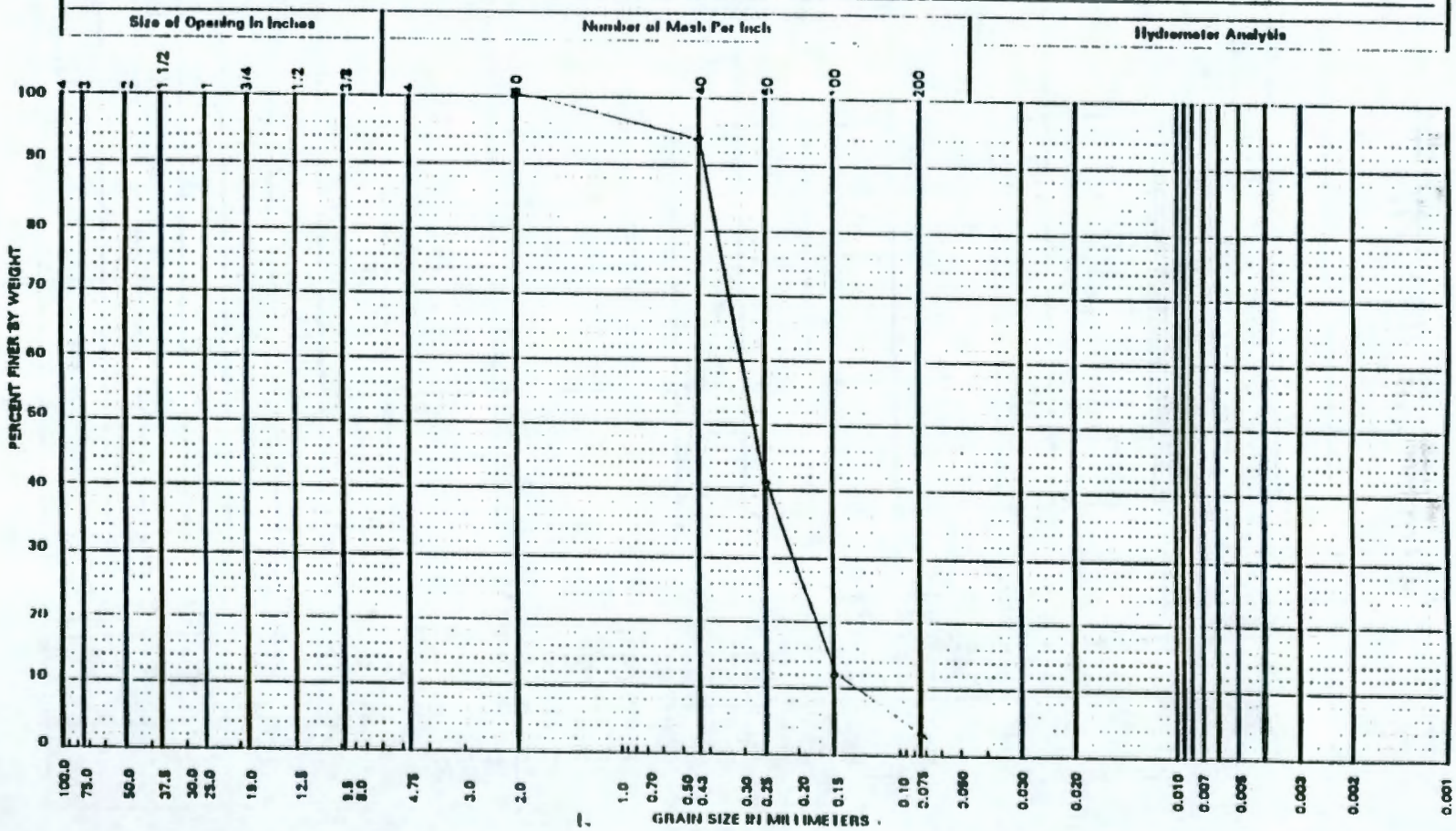


GEL-07 GRAIN SIZE ANALYSIS PLOT

Sample No. 3 0270

Page ___ of ___

Remarks B07W13 EE1

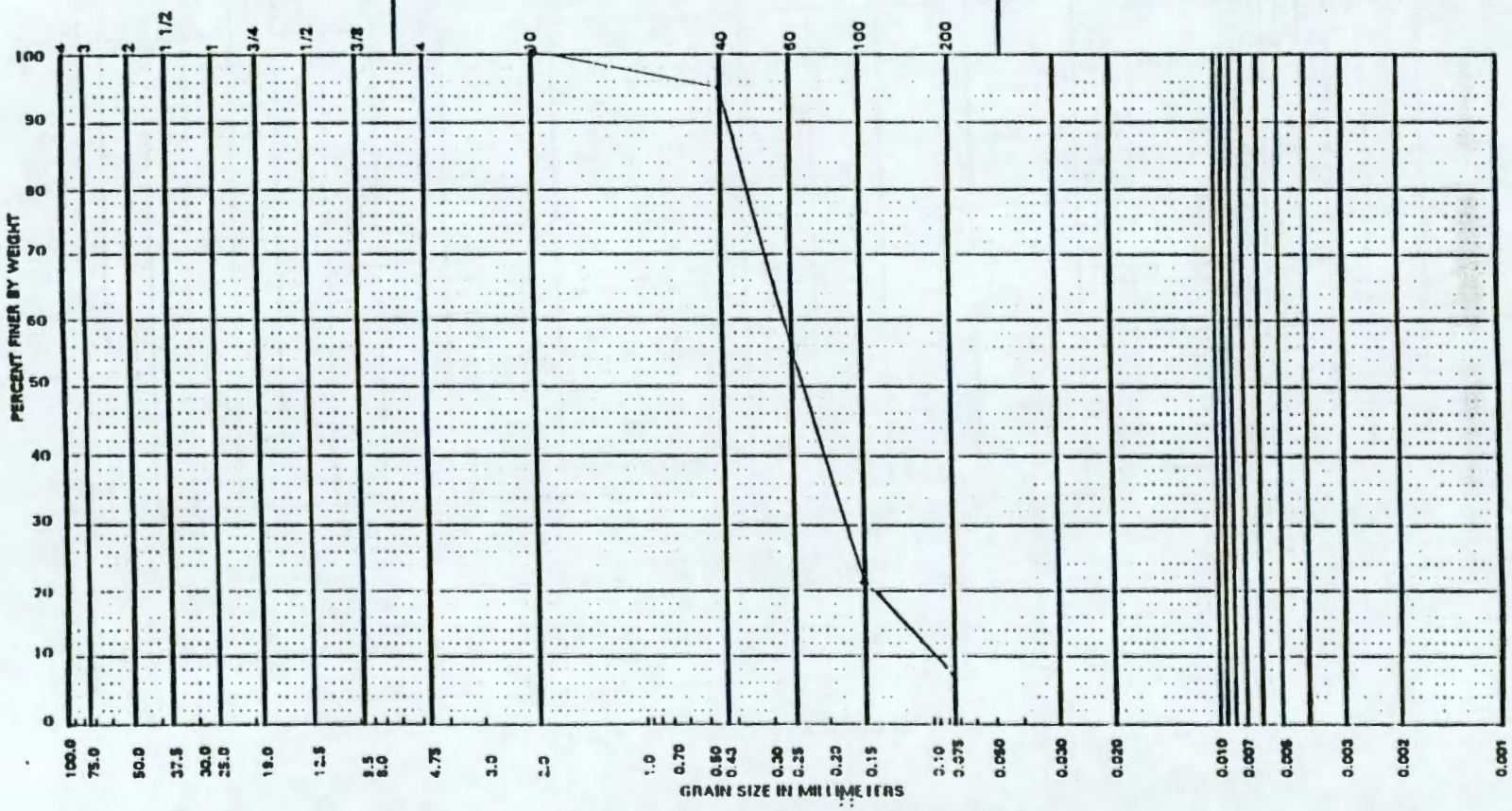


GEL-07 GRAIN SIZE ANALYSIS PLOT

Sample No. 3 0271

Page ___ of ___

Remarks B07HH4 FF1

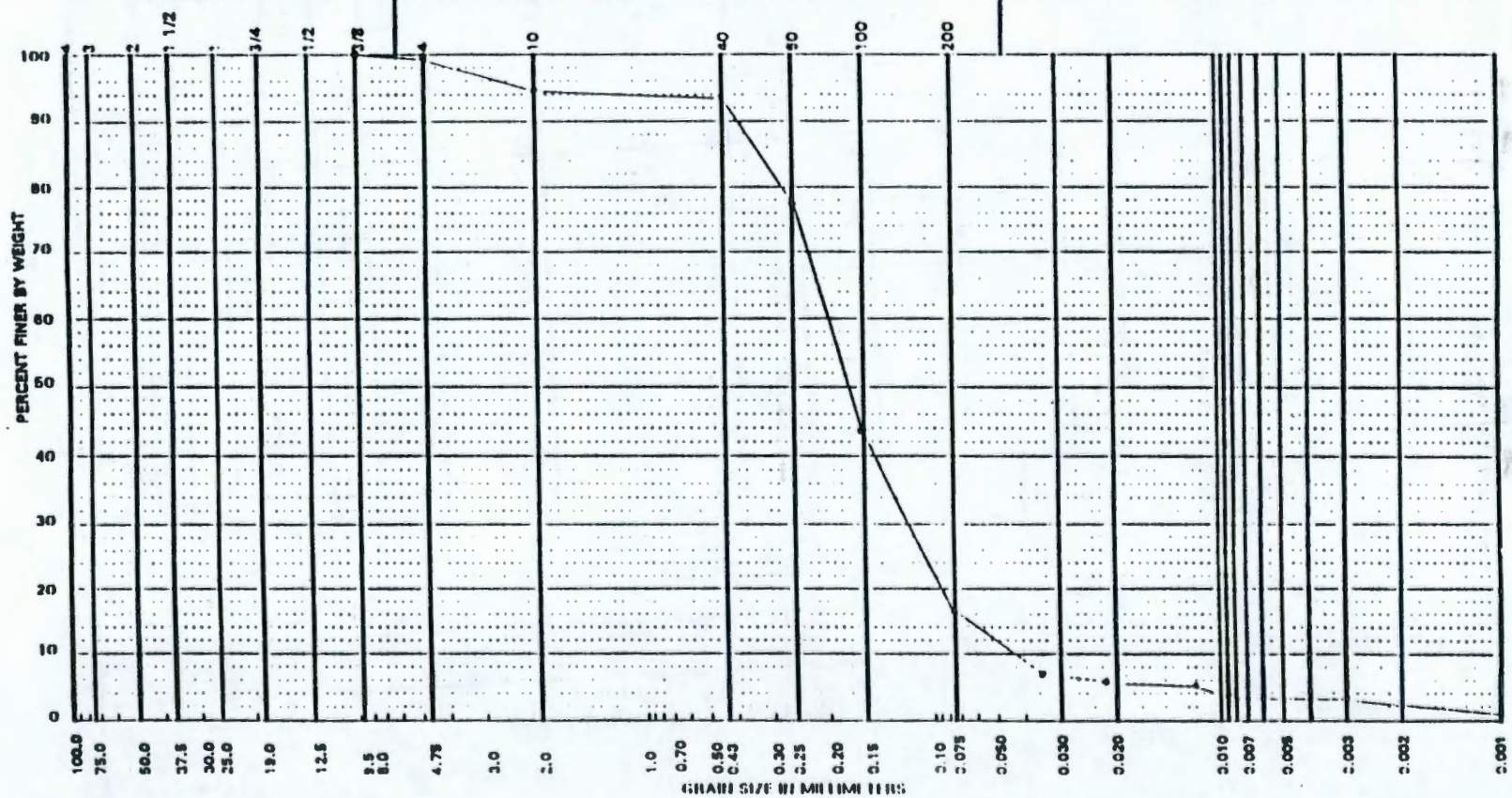


GEL-07 GRAIN SIZE ANALYSIS PLOT

Sample No. 3-0232

Page ____ of ____

Remarks HAN 2 BOZHD2 HAN 2

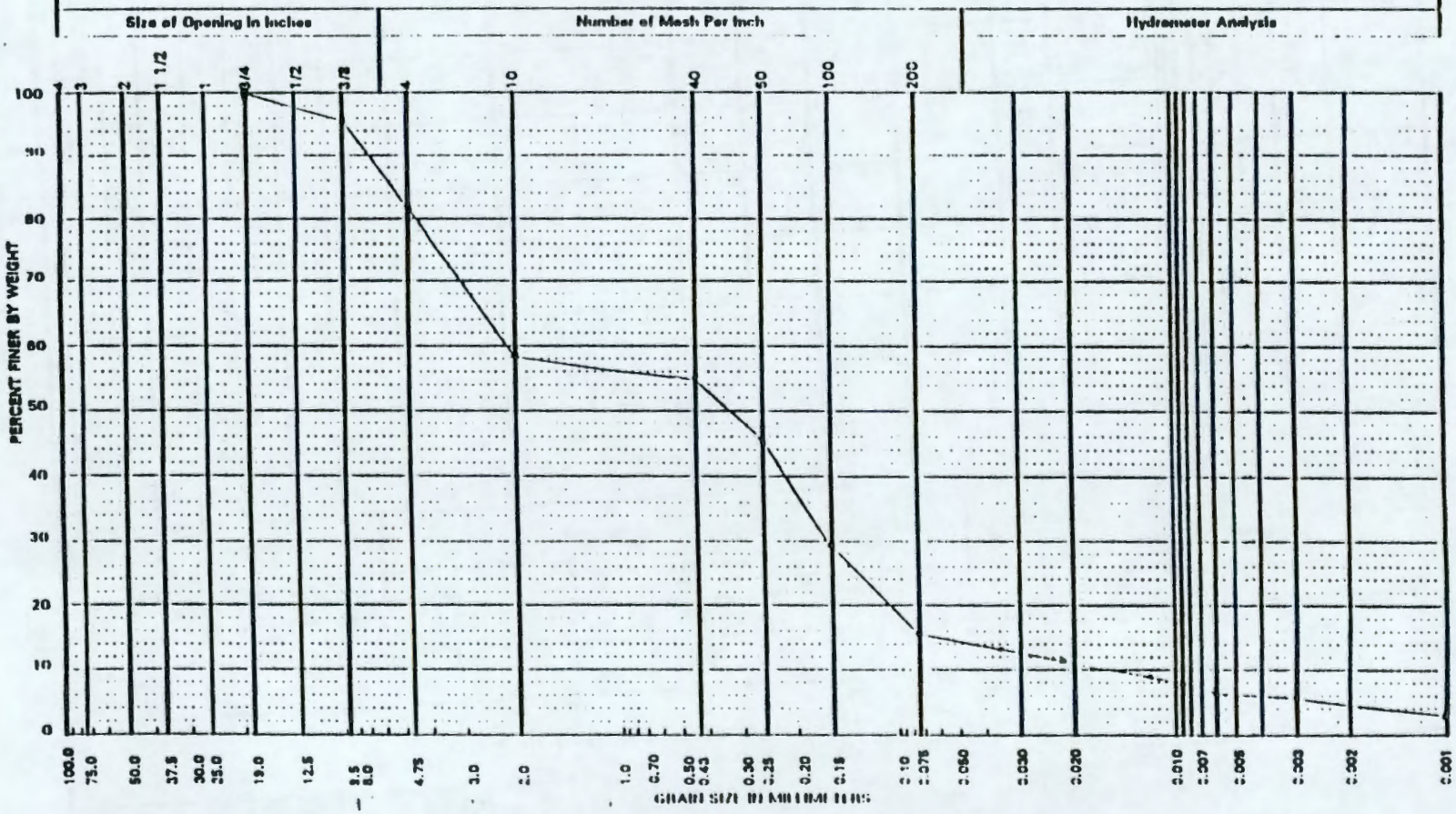


GEL-07 GRAIN SIZE ANALYSIS PLOT

Sample No. 3-0233

Page ____ of ____

Remarks Hanford 12-18" B07W03 HAN 2

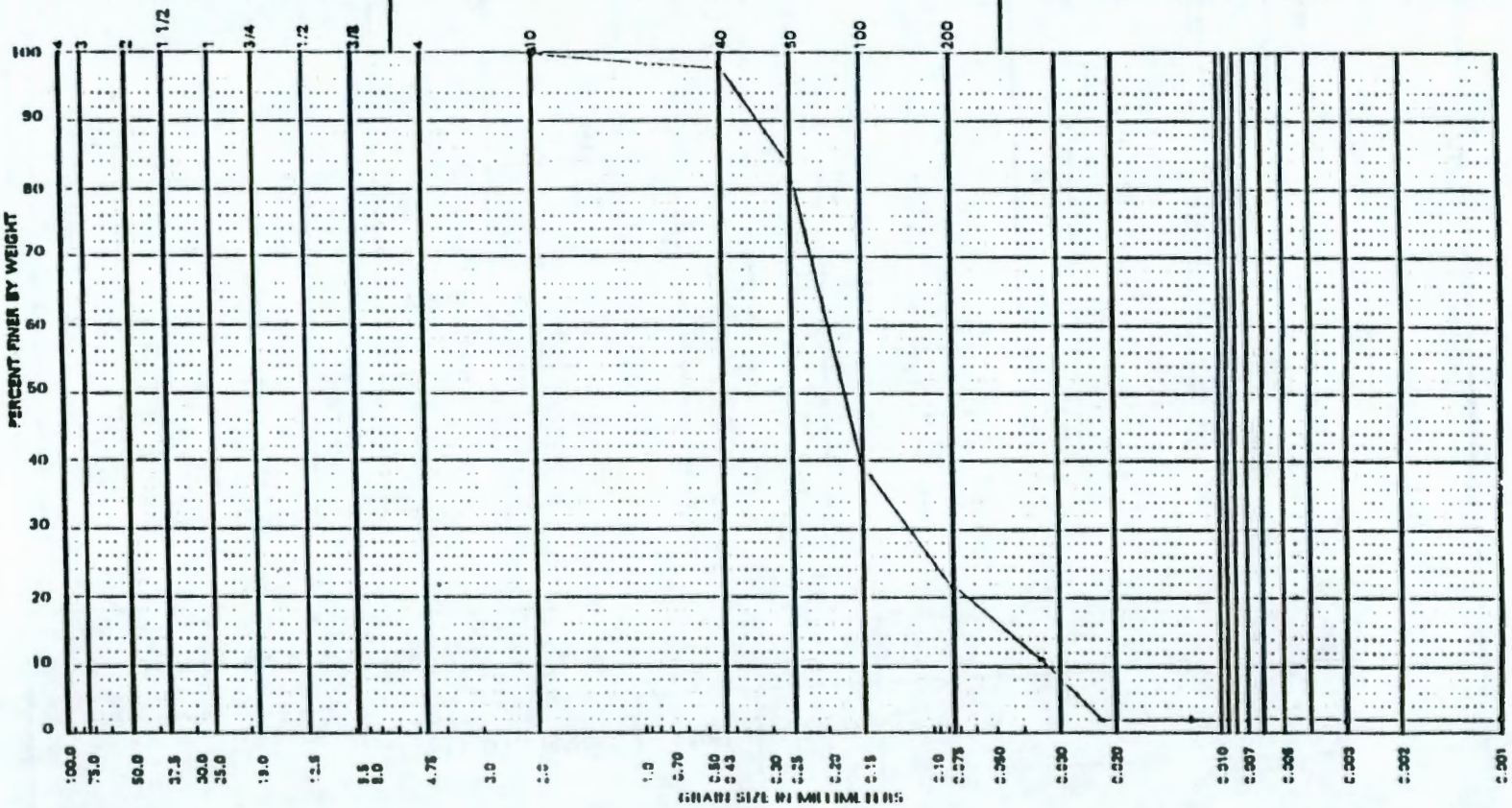


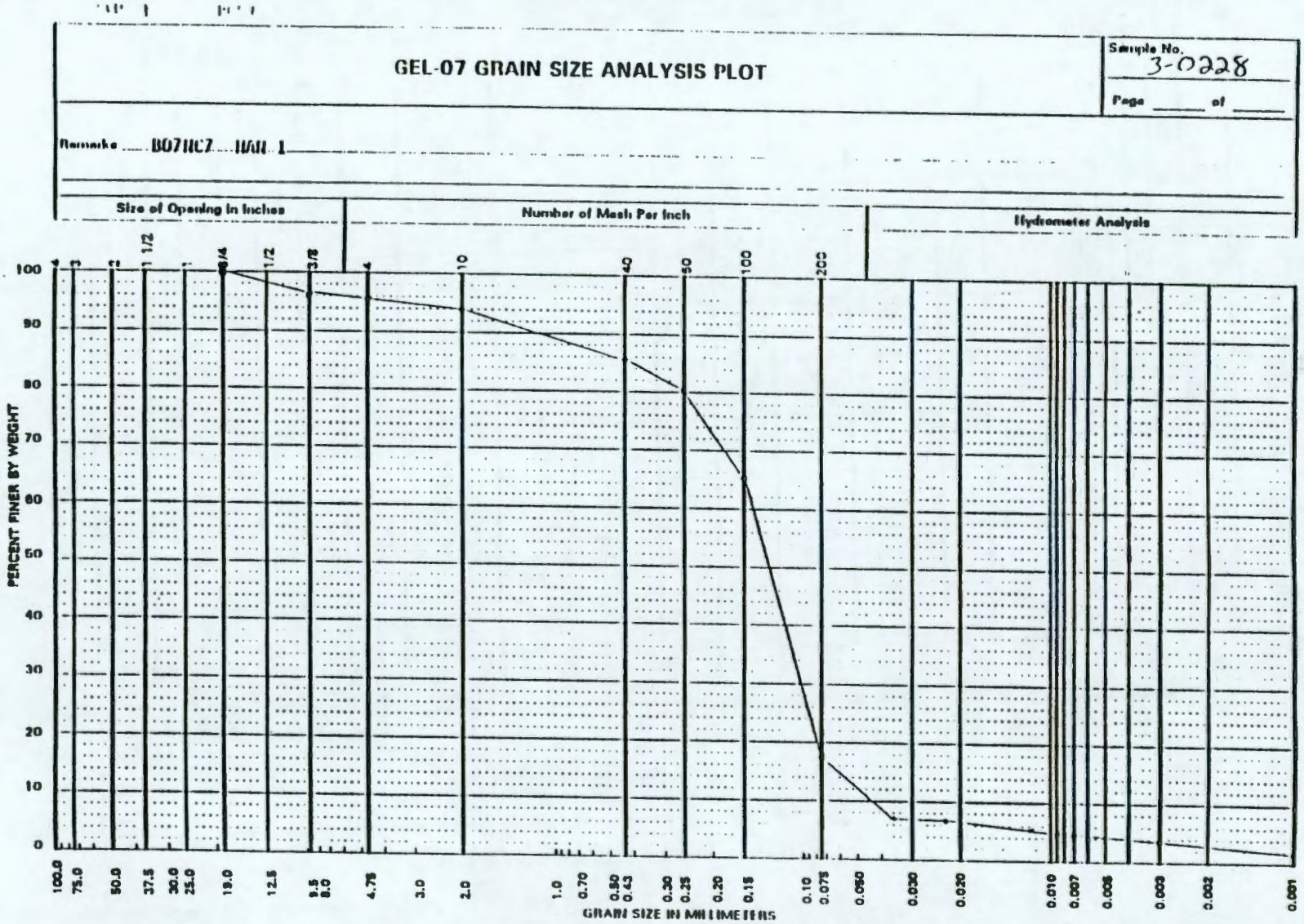
GEL-07 GRAIN SIZE ANALYSIS PLOT

Sample No. 3-0227

Page ____ of ____

Remarks Hanford Pewee 0-6" B07HC6 HAR 1




GEL-07 GRAIN SIZE ANALYSIS PLOT
Sample No. 3-0228
Page ____ of ____
Remarks B07HC7 HAR 1
Size of Opening in Inches
Number of Mesh Per Inch
Hydrometer Analysis
PERCENT FINER BY WEIGHT
GRAIN SIZE IN MILLIMETERS

ATTACHMENT 1

METRIC CONVERSION CHART

The following conversion chart is provided to the reader as a tool to aid in conversion.

Into Metric Units

If You Know	*Multiply By*	*To Get*
Length		
inches	25.4	millimeters
inches	2.54	centimeters
feet	0.305	meters
yards	0.914	meters
miles	1.609	kilometers
Area		
sq. inches	6.452	sq. centimeters
sq. feet	0.093	sq. meters
sq. yards	0.836	sq. meters
sq. miles	2.6	sq. kilometers
acres	0.405	hectares
Mass (weight)		
ounces	28.35	grams
pounds	0.454	kilograms
short ton	0.907	metric ton
Volume		
teaspoons	5	milliliters
tablespoons	15	milliliters
fluid ounces	30	milliliters
cups	0.24	liters
pints	0.47	liters
quarts	0.95	liters
gallons	3.8	liters
cubic feet	0.028	cubic meters
cubic yards	0.765	cubic meters
Temperature		
Fahrenheit	subtract 32 then multiply by 5/9ths	Celsius

Out of Metric Units

If You Know	*Multiply By*	*To Get*
Length		
millimeters	0.039	inches
centimeters	0.394	inches
meters	3.281	feet
meters	1.094	yards
kilometers	0.621	miles
Area		
sq. centimeters	0.155	sq. inches
sq. meters	10.76	sq. feet
sq. meters	1.196	sq. yards
sq. kilometers	0.4	sq. miles
hectares	2.47	acres
Mass (weight)		
grams	0.035	ounces
kilograms	2.205	pounds
metric ton	1.102	short ton
Volume		
milliliters	0.033	fluid ounces
liters	2.1	pints
liters	1.057	quarts
liters	0.264	gallons
cubic meters	35.315	cubic feet
cubic meters	1.308	cubic yards
Temperature		
Celsius	multiply by 9/5ths, then add 32	Fahrenheit

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