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2101-M POND HYDROGEOLOGIC CHARACTERIZATION REPORT

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EXECUTIVE SUMMARY

This report documents information collected by the Pacific Northwest Laboratory[a] at the request of Westinghouse Hanford Company. Presented in this report is the interpretation of the hydrogeologic environment at the 2101-M Pond, located in the 200-East Area of the Hanford Site. This information and its accompanying interpretation were derived from sampling and testing activities associated with the installation of four ground-water monitoring wells, in addition to data gathered from several previously existing wells. The new monitoring wells were installed as part of a ground-water monitoring program initiated in 1988 (Chamness et al. 1989). This ground-water monitoring program is based on requirements for interim-status facilities in compliance with the Resource Conservation and Recovery Act of 1976. Although the 2101-M Pond Site may be regulated under final-status regulations in the future, the ground-water monitoring program and all samples collected through August 1989 were collected following interim-status regulations and are therefore evaluated following the same regulations.

The four new monitoring wells were installed around the 2101-M Pond between May 23 and August 27, 1988. Geologic sampling, aquifer testing, and initial ground-water sampling were performed during the installation of these wells. Laboratory analyses of the sediment samples for particle size, calcium carbonate content, and selected natural and contaminant constituents were performed. A full year of quarterly ground-water sampling and the first statistical analysis of background and downgradient data have also been performed. Interpretations of the available information indicate the following:

1. The ground-water flow direction beneath the 2101-M Pond is difficult to determine in the 200-East Area because of the small hydraulic gradient. There is less than 0.5-ft difference in water-level elevations in wells up to 0.5-mi away from the pond. However, the well southwest of the pond (299-E18-1) has consistently higher water levels and a slightly different chemistry, indicating it is upgradient from and unaffected by the 2101-M Pond.

(a) Pacific Northwest Laboratory is operated by Battelle Memorial Institute for the U.S. Department of Energy under Contract DE-AC06-76RLO 1830.

2. The uppermost portion of the unconfined aquifer is contained within the middle unit of the Ringold Formation. Results of aquifer testing at the wells demonstrated that hydraulic properties within the Ringold Formation at this site are within an order of magnitude and one another. The transmissivity is estimated to be about 1000 ft^2/d, and the hydraulic conductivity is about 200 ft/d.

3. Results for the first year of the quarterly samples and the statistical comparison of the background and downgradient data indicate there is no contamination of the ground water beneath the 2101-M Pond. The sporadically elevated levels of chromium and iron in the four new monitoring wells are believed to be caused by metals introduced into the aquifer during drilling or through the well construction materials and not by the discharge of water to the pond.

4. Quality of the analytical data through August 1989 indicates the results are generally good, with relatively few outliers. A large number of the outliers appear to be the result of 1) matrix spikes being at levels too low for the amount of constituent in the sample and 2) laboratory contamination. Both of these problems were identified through a combination of interlaboratory comparisons, comparison to target recovery ranges, and the Quality Control programs at both the analytical laboratory and Pacific Northwest Laboratory. Consequently, it is felt that any problems with the data were detected and corrected generating quality data.

5. The ground-water monitoring system provides representative samples of ground water both upgradient and downgradient of the 2101-M Pond. The downgradient wells are located close enough to the pond to detect any contamination entering the ground water from the vadose zone.

ACKNOWLEDGMENTS

The authors wish to acknowledge Steve Teel and Shannon Goodwin for their help in providing the well-site geology and Darrell Newcomer for providing assistance during the aquifer tests. Wayne Gorst and Regina Lundgren provided invaluable assistance in generating this report. Kaiser Engineers Hanford Company installed the monitoring wells. Westinghouse Hanford Company assisted in writing a standardized text for the regional geology and hydrology section.

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1.0 INTRODUCTION

This report presents the interpretation of hydrogeologic data collected during the installation and sampling of four ground-water monitoring wells at the 2101-M Pond, as required by the ground-water monitoring program (Chamness et al. 1989). The 2101-M Pond is located in the 200-East Area of the Hanford Site in southcentral Washington State (Figure 1.1). The information presented in this report was collected and interpreted by the Pacific Northwest Laboratory (PNL) for the Basalt Waste Isolation Project (BWIP) at the request of Westinghouse Hanford Company (WHC) and the U.S. Department of Energy (DOE). These activities were conducted under a quality assurance program based on applicable criteria of ANSI/ASME NQA-1 (1986) as reflected in PNL's quality assurance manual (PNL 1989b) and satisfies the U.S. Environmental Protection Agency (EPA) requirements (Stanley and Verner 1983).

Congress terminated BWIP in 1987. Regulations governing projects such as BWIP require the return of all sites used in the project to as near their original condition as possible. Because BWIP discharged waste water to the 2101-M Pond for a short period in the 1980s, a ground-water monitoring project for that site was initiated in 1988 as part of the BWIP restoration and reclamation tasks. The ground-water monitoring project was based on requirements for interim-status facilities (such facilities are authorized to continue interim operations while in the process of obtaining final permits), as defined by the Resource Conservation and Recovery Act (RCRA) of 1976 as amended in 1984. These regulations are promulgated by the EPA in 40 CFR 265 Subpart F and by the State of Washington Department of Ecology (hereafter called Ecology) in Washington Administrative Code (WAC) 173-303-400. Although the site may be managed under final status regulations in the future, work performed through August 1989 has followed interim-status regulations. Therefore, the discussions and evaluations presented in this report conform to interim-status regulations.

The ground-water monitoring program for the 2101-M Pond provides for both background and indicator evaluation (detection level) monitoring, which are required to provide immediate detection of significant amounts of

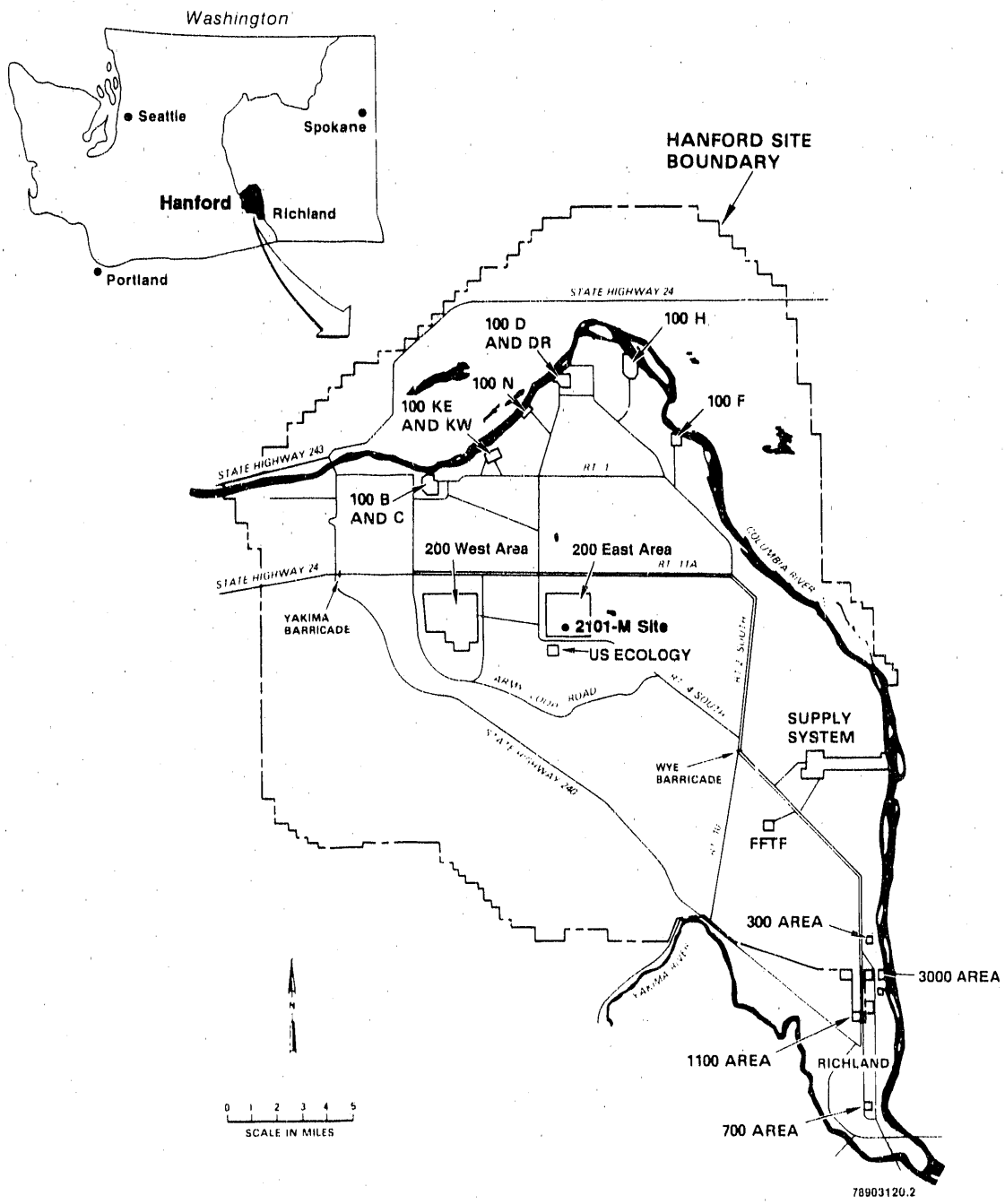

FIGURE 1.1. Hanford Site Location Map

dangerous waste constituents that may migrate from the pond to the uppermost aquifer. The initial plan for this program is provided in Chamness et al. (1989). The specific objectives of the plan include the following:

- characterize the stratigraphy and the lateral ground-water flow pattern and flow rates within the uppermost portion of the unconfined aquifer beneath the pond
- implement a monitoring program to determine if statistically significant concentrations of dangerous waste constituents are detectable in the ground water
- initiate, if necessary, the development of an assessment-level monitoring program to determine the nature and extent of contaminant migration from the pond.

Installation of four ground-water monitoring wells was a necessary element for achieving these objectives. The wells were designed to provide hydrogeologic characterization data as well as long-term ground-water monitoring capabilities. Well construction began on May 23, 1988, with final monitoring well installation completed on August 27, 1988. Geologic sampling, aquifer tests, and predevelopment ground-water sampling were performed during and/or immediately after the installation of the monitoring wells.

The evaluation of the data collected from these wells is the focus of this report. The purposes of this report include the following:

- provide geologic and hydrologic site characterization
- provide the data necessary to develop closure options
- assess the technical adequacy of the ground-water monitoring network
- assess the technical adequacy of the hydrogeologic characterization
- identify any additional activities required to achieve compliance with the applicable regulations.

Chapter 2.0 provides an overview of the pond, including the site location and layout, current and historical disposal practices, and possible types and amounts of wastes discharged to the pond. Chapter 3.0 explores the environmental setting of the region. Chapter 4.0 discusses the hydrogeologic

characterization of the pond. Chapters 5.0 and 6.0 present the geology and hydrology at the pond, respectively. Ground-water quality is addressed in Chapter 7.0. Future ground-water monitoring plans and the conclusions of this report are summarized in Chapter 8.0.

2.0 BACKGROUND INFORMATION

The purpose of this chapter is to provide a summary of the disposal facility and the waste constituents of interest. The preliminary closure plan (DOE 1989) describes in detail the location and physical layout of the 2101-M Pond, the facility operators, the general disposal practices, and the operational history of the pond. Information is based on data available through September 30, 1989.

2.1 SITE LOCATION AND LAYOUT

The 2101-M Pond is located in the 200-East Area (a controlled access area) on the Hanford Site (Figure 2.1). The 200-East Area and nearby 200-West Area (collectively known as the 200 Areas or Separations Areas) contain the nuclear fuels reprocessing and plutonium separations facilities, as well as the majority of radioactive waste storage and disposal facilities on the Hanford Site (see Figure 1.1). There are no operational facilities located in the immediate vicinity of the 2101-M Pond (Figures 2.1 and 2.2).

The 2101-M Pond is located adjacent to the 2101-M Building and was used for the disposal of waste water, including laboratory wastes, from that building (Figure 2.3). The pond is an artificial, earthen, unlined, uncovered, U-shaped surface impoundment with earthen berms on its north and south sides (Figure 2.4). The total area covered by the pond is less than 1 acre. The north and south arms of the pond are 205 and 210 ft in length, respectively, and the connecting east arm is approximately 70 ft long. The pond bottom varies from approximately 10 ft wide and 5 ft below grade in the south arm to approximately 3 ft wide and 9 ft below grade in the north arm. Discharge from the 2101-M Building enters near the pond's southeast corner through a 4-in. drain pipe. A rainwater run-off ditch is located near the southeast corner of the pond (Figure 2.4).

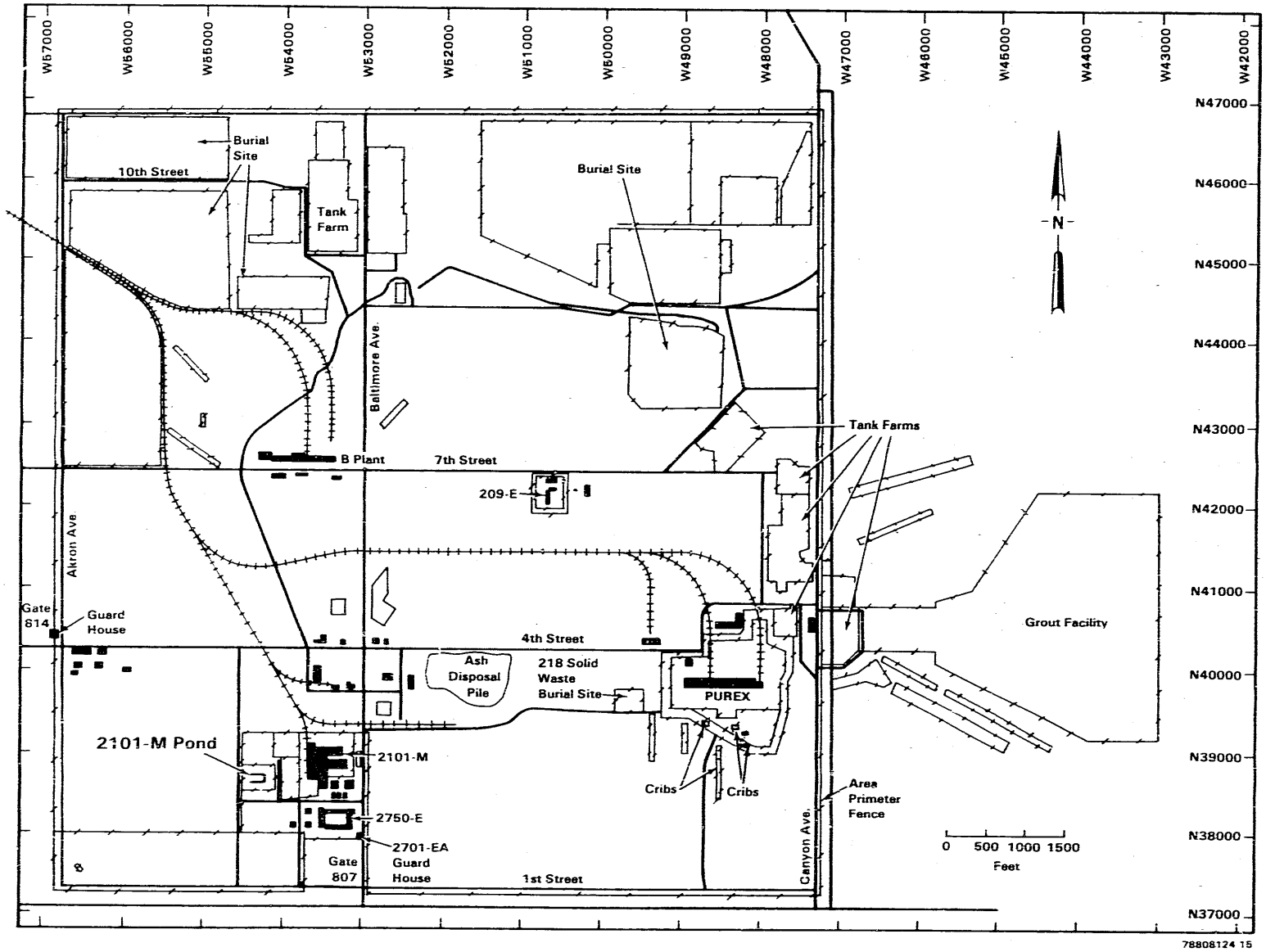

FIGURE 2.1. 200-East Area Site Plan

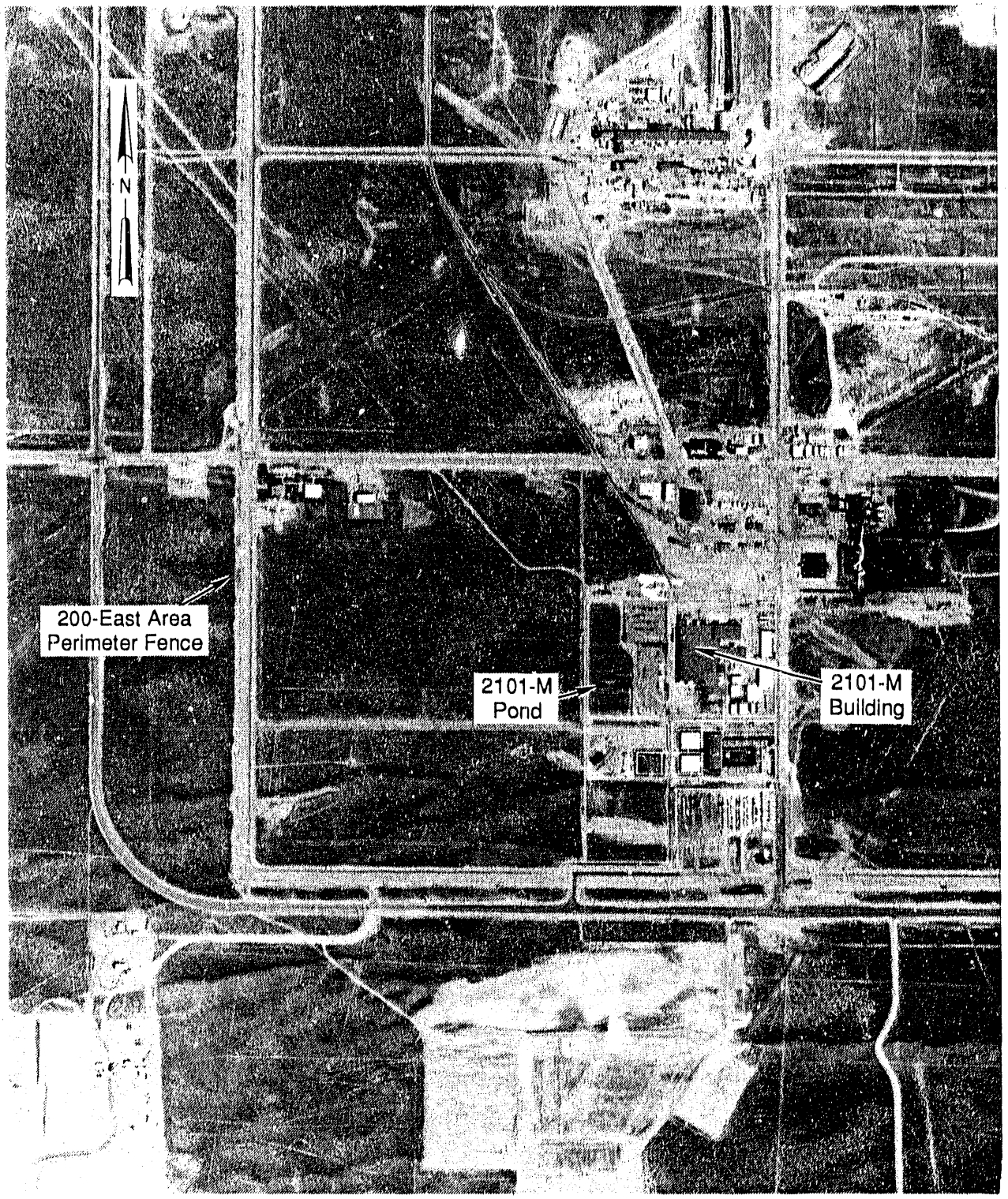

FIGURE 2.2. Aerial Photograph of the 2101-M Pond and Vicinity

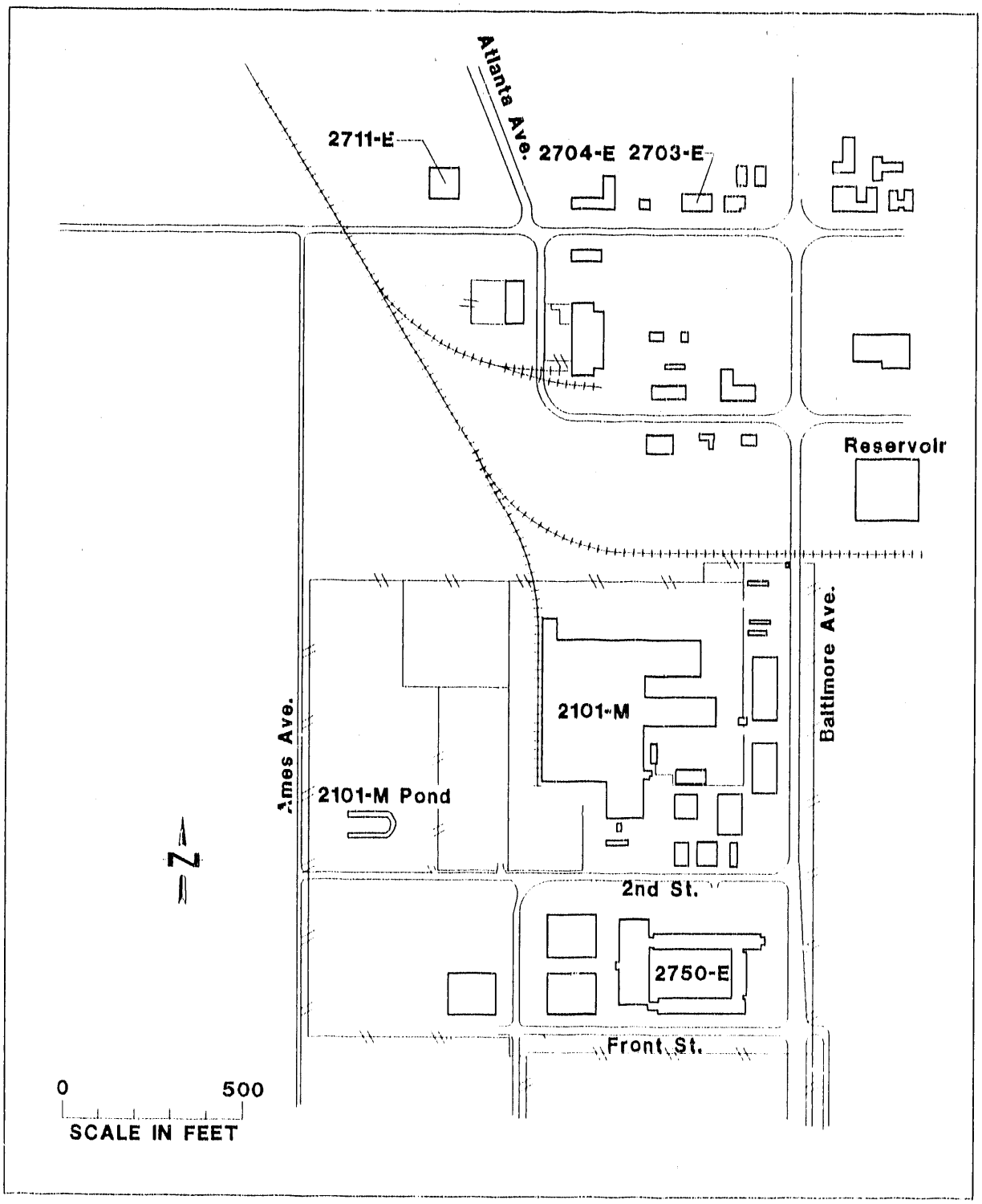

FIGURE 2.3. Location of the 2101-M Pond and Nearby Facilities

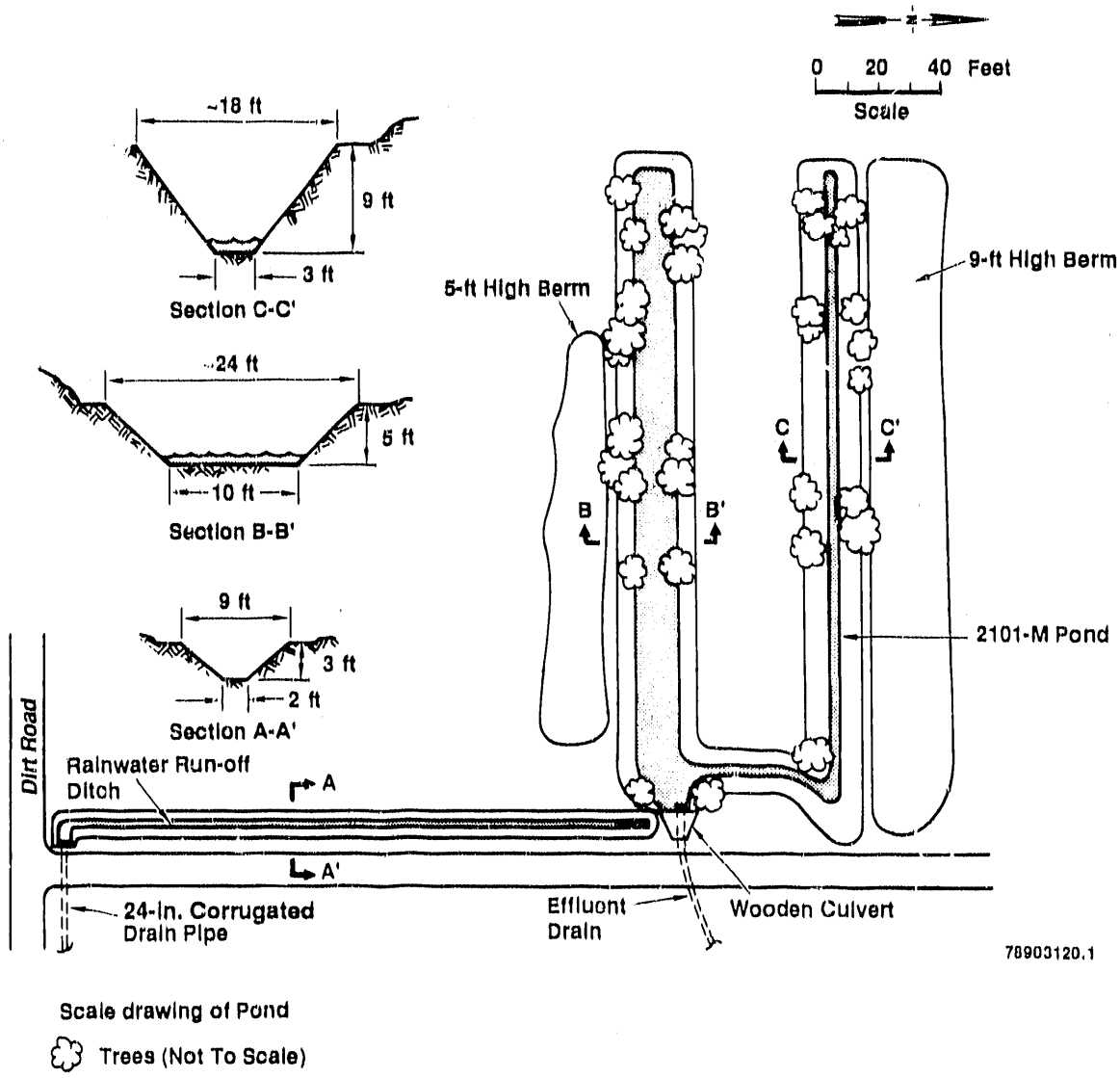

FIGURE 2.4. Generalized Map of the 2101-M Pond

2.2 FACILITY OPERATORS

The 2101-M Pond has been operated by several companies under contract to DOE or DOE's predecessors since its construction in 1953. The owners, operating contractors, and their respective periods of operation are listed in Table 2.1.

TABLE 2.1. Owners and Operators of the 2101-M Pond

Owners	Operators
1953	
U.S. Atomic Energy Commission	General Electric Company
	January 1, 1966
	Isochem
	September 1, 1967
1974	
U.S. Energy Research and Development Administration	Atlantic Richfield Hanford Company
1977	
	July 1, 1977
U.S. Department of Energy	Rockwell Hanford Operations
	June 29, 1987
	Westinghouse Hanford Company

2.3 PAST DISPOSAL PRACTICES

The 2101-M Building was constructed in 1953. From 1953 to 1981, the only water discharged from the building to the pond came from the building's heating, ventilation, and air conditioning (HVAC) system. Discharges to the pond from the HVAC system were as high as 5,029,944 gal of water per year until 1981, when the HVAC system was upgraded. The amount of discharge from the other components of the HVAC system are not metered. In 1979, BWIP began installation of a variety of laboratories in the 2101-M Building, which were plumbed into the drain pipe leading to the 2101-M Pond. From 1981, when the laboratories were completed, until July 1985, the BWIP laboratories in the 2101-M Building sporadically generated dangerous wastes, which may have been discharged to the 2101-M Pond. Official documentation of waste types generated and waste disposal methods were not kept until July 1985 when administrative procedures were set in place to prohibit the disposal of dangerous waste into the drains discharging to the pond (DOE 1989). Known discharges of chemical wastes to the 2101-M Pond include barium and waste acids, primarily hydrochloric and nitric acids. Table 2.2 provides the estimated quantities of barium and acids discharged. The preliminary closure plan (DOE 1989) contains detailed information on the assumptions made and how these

TABLE 2.2. Estimated Types and Quantities of Wastes Discharged

Waste Type	Estimated Quantity
Barium	26.9 lb of barium ions from 1982 to 1984, creating up to 10,250 lb of dangerous waste water
Acids	2.2 to 22 lb/yr of principally hydrochloric and nitric acids for 4 to 5 years

quantities were calculated and identifies other chemical wastes from the laboratory that may have been discharged to the 2101-M Pond.

2.4 PRESENT DISPOSAL PRACTICES

Currently, the 2101-M Building contains a spare parts storage area, a geologic sample storage area, an insulator shop, a high-efficiency particulate air (HEPA) filter test shop, a substation maintenance shop, an instrument maintenance shop, the Vent and Balance Group (responsible for maintaining the HVAC system), and offices. The administrative procedures set in effect in 1985 have controlled the disposal of dangerous chemicals in the 2101-M Building through the closure of BWIP to the present. Consequently, no dangerous constituents are being discharged to the pond. The minimum estimated volume of water discharged in 1988, a fairly typical year, was 1,279,692 gal (DOE 1989). This figure, however, is based only on the amount of steam going into the building and does not include the quantity of water used in the air conditioning system (swamp coolers). The quantity of water discharged by the air conditioners is thought to be less than that from the steam condensate, but no measurements have been made.

3.0 ENVIRONMENTAL SETTING

The 2101-M Pond is located in the central portion of DOE's Hanford Site in southcentral Washington. This chapter provides a brief description of the regional environmental setting of the Hanford Site, including its physiography, climate, geology (stratigraphy, tectonic framework, seismicity), and hydrology. A more detailed discussion of the Hanford Site is given in DOE (1988).

3.1 PHYSIOGRAPHY

The Hanford Site lies within the Columbia Basin subprovince of the Columbia Intermontane Province (Figure 3.1). The Columbia Intermontane Province is the product of Miocene flood basalt volcanism and regional deformation that occurred over the past 16 million years. The Columbia Plateau is that portion of the Columbia Intermontane Province that is underlain by the Columbia River Basalt Group (Thornbury 1965).

The physiography of the Hanford Site is dominated by the low-relief plains of the Central Plains physiographic region and anticlinal ridges of the Yakima Folds physiographic region. The surface topography has been modified within the past several million years by the following geomorphic processes: 1) continued structural deformation, 2) Pleistocene cataclysmic flooding, 3) Holocene eolian activity, and 4) landsliding. Structural deformation of the Yakima Folds was probably contemporaneous with the eruption of the basalts, beginning in the Miocene and possibly continuing to the present (Reidel 1984). Cataclysmic flooding occurred when ice dams in western Montana and northern Idaho were breached, allowing large volumes of water to spill across eastern and central Washington. The last major flood occurred about 13,000 years ago, during the late Pleistocene Epoch. Anastomosing flood channels, giant current ripples, bergmounds, and giant flood bars are among the landforms created by the floods. The 200 Areas waste management facilities are located on one prominent flood feature, the Cold Creek Bar (Figure 3.2) (Bretz et al. 1956).

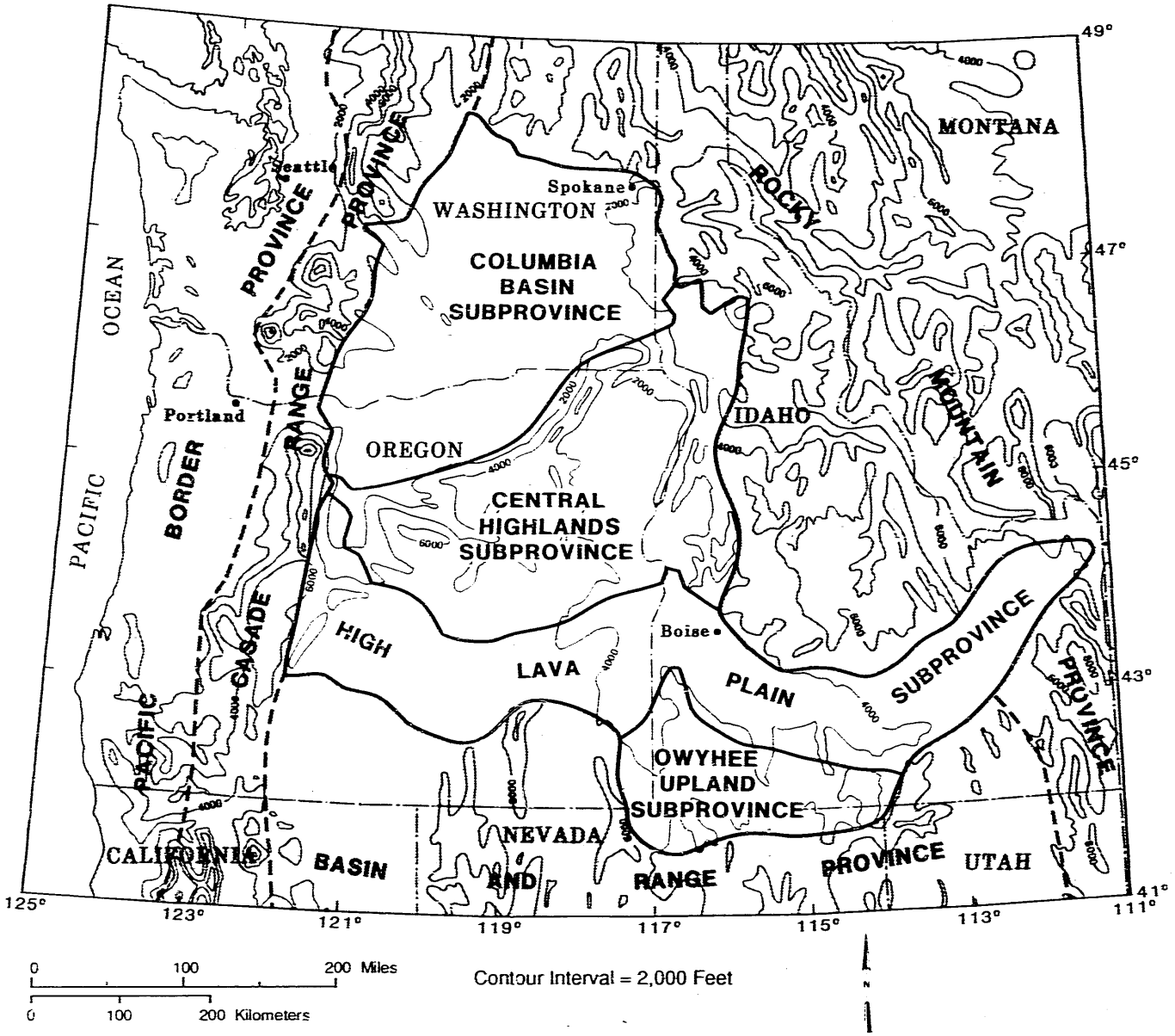

FIGURE 3.1. Physiographic Provinces of the Pacific Northwest (Columbia Intermontane Province is shown in white)

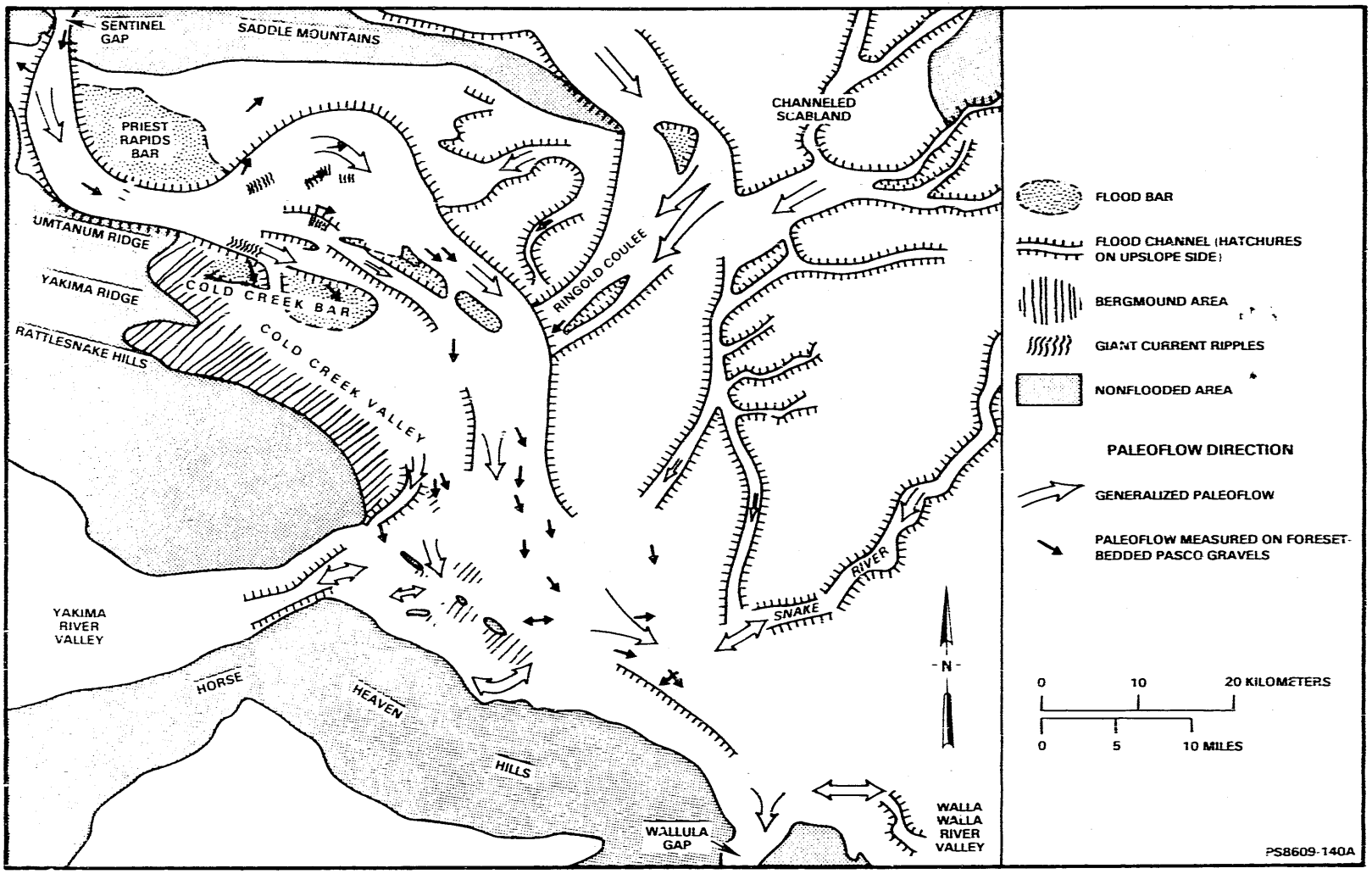

FIGURE 3.2. Paleoflow Directions and Landforms Associated with Cataclysmic Flooding in the Central Columbia Plateau (after 1988)

Since the end of the Pleistocene, winds have locally reworked the flood sediments, depositing dune sands in the lower elevations and loess (windblown silt) around the margins of the Pasco Basin. Many sand dunes are currently stabilized by anchoring vegetation.

Landslides occur along the north limbs of some Yakima Folds and along steep river embankments such as the White Bluffs (Figure 3.3). Landslides on the Yakima Folds generally occur along sedimentary units intercalated with the basalt, whereas landslides at the White Bluffs occur in suprabasalt sediments. The landslides at the White Bluffs are attributed to irrigation activities east of the Columbia River. No landsliding occurs in the 200 Areas.

3.2 CLIMATE AND METEOROLOGY

The climate of the Hanford Site is primarily controlled by the rain-shadow effect of the Cascade Range, located approximately 75 mi to the west. The Cascades also serve as a source of cold air drainage, which affects the wind regime at the Hanford Site.

Climatological data have been collected at the Hanford Meteorological Station (HMS) (located between the 200-East and -West Areas) since 1945 (Cushing 1988). Temperature and precipitation data are also available from nearby locations for the period 1912 to 1943. A summary of these data through 1980 has been published by Stone et al. (1983). Data from the HMS are similar to those associated with the general climatic conditions exhibited in the surrounding region and are representative of the specific climatic conditions at the 200 Area Plateau.

3.2.1 Wind

Prevailing wind directions on the 200 Area Plateau are from the northwest in all months of the year (Figure 3.4). Secondary maxima occur for southwesterly winds.

Monthly average wind speeds are lowest during the winter months, averaging 6 to 7 mph, and highest during the summer, averaging 9 to 10 mph. Wind speeds that are well above average are usually associated with

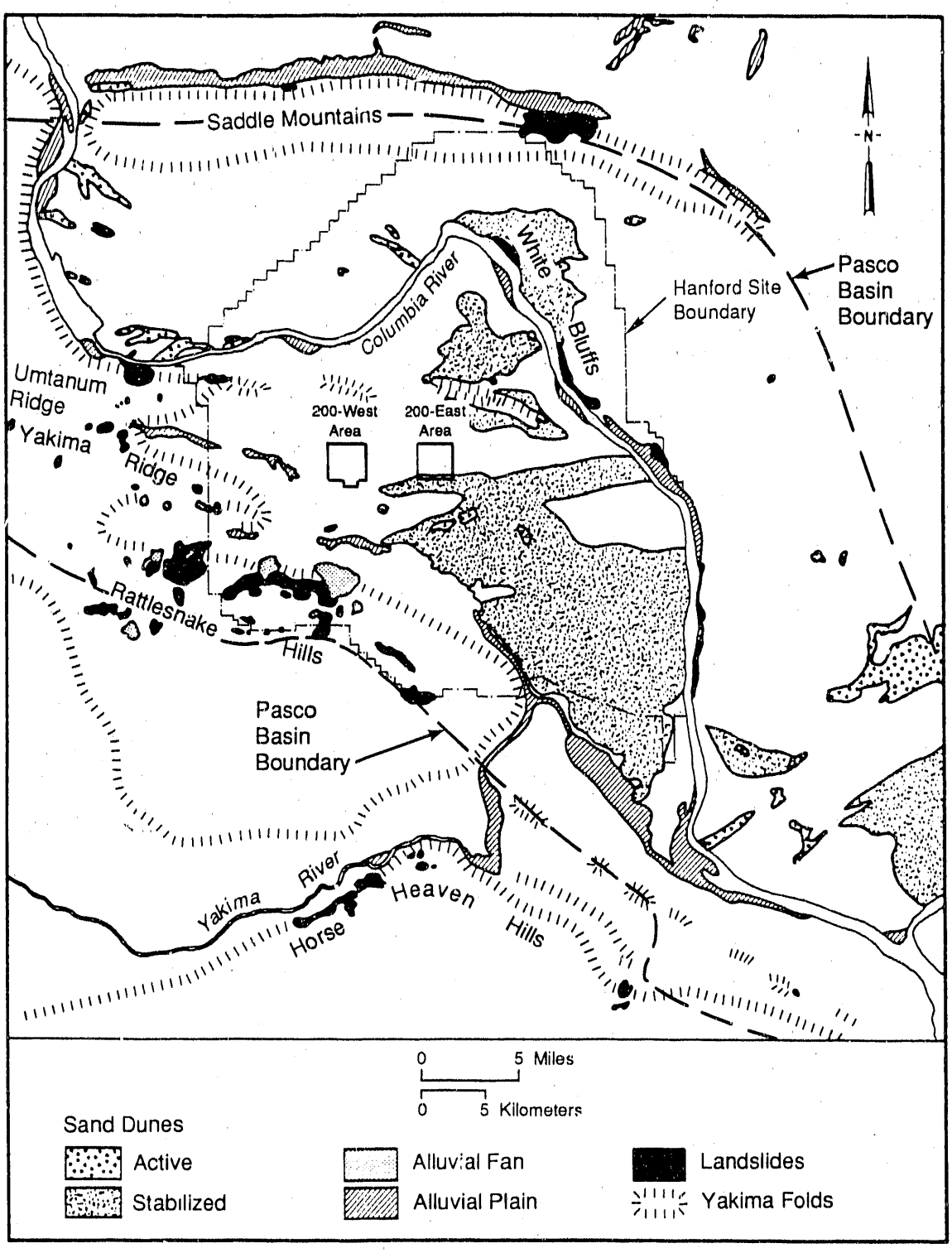

FIGURE 3.3. Geomorphic Features of the Pasco Basin

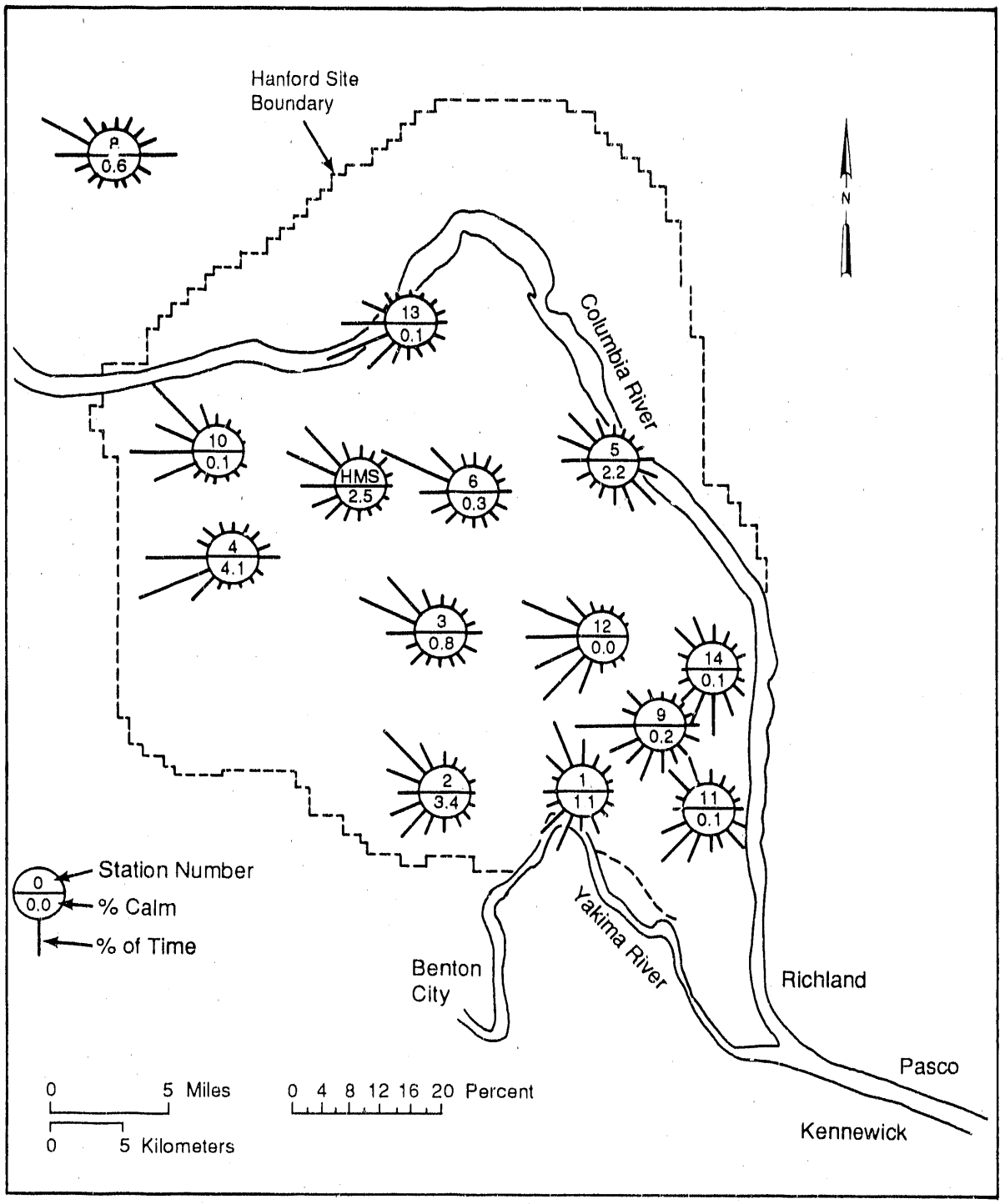

FIGURE 3.4. Wind Rose Diagrams for the Hanford Site (after Stone et al. 1983)

southwesterly winds. However, the summer drainage winds are generally northwesterly and frequently reach 30 mi/h.

Tornadoes are generally small and infrequent in the northwest portion of the United States. No violent tornadoes are listed in DOE (1987) for the region surrounding Hanford. The HMS climatological summary (Stone et al. 1983) and the National Severe Storms Forecast Center data base list 22 separate tornado occurrences within 100 mi of the Hanford Site from 1916 through August 1982. Two additional tornadoes have been reported since August 1982.

3.2.2 Temperature and Humidity

Ranges of daily maximum and minimum temperatures vary from normal maxima of 35.6°F in early January to 95°F in late July. The record maximum temperature is 114.8°F (July 27, 1939), and the record minimum temperature is -27°F (December 19, 1919).

The annual average relative humidity at the HMS is 54%. It is highest during the winter months, averaging about 75%, and lowest during the summer, averaging about 35%.

3.2.3 Precipitation

Precipitation measurements have been made at the HMS since 1945. Average annual precipitation at the HMS is 6.3 in. Most of the precipitation occurs during the winter with nearly half of the annual amount occurring in the months of November through February. Days with >0.5 in. precipitation occur <1% of the year. Rainfall intensities of 0.5 in./h persisting for 1 h are expected once every 10 yr. Rainfall intensities of 1 in./h for 1 h are expected only once every 500 yr. Winter monthly averages range from 0.3 in. in March to 5.3 in. in January. The record snowfall of 24.4 in. occurred in February 1916. Snowfall accounts for about 38% of all precipitation occurring during the months of December through February.

3.3 STRATIGRAPHY

The surficial stratigraphy of the Hanford Site consists of Miocene age and younger rocks. Older Cenozoic sedimentary and volcaniclastic rocks underlie the Miocene and younger rocks but are not exposed at the surface.

The Hanford Site stratigraphy is summarized in Figure 3.5 and described below. A more detailed discussion of the Hanford Site stratigraphy is given in DOE (1988).

3.3.1 Columbia River Basalt Group

The Columbia River Basalt Group (Figure 3.5) comprises an assemblage of tholeiitic, continental flood basalts of Miocene age. These flows cover an area of more than 63,000 mi^2 in Washington, Oregon, and Idaho and have an estimated volume of about 41,600 mi^3 (Tolan et al. 1987). Isotopic age determinations suggest flows of the Columbia River Basalt Group were erupted during a period from approximately 17 to 6 Ma, with more than 98% by volume being erupted in a 2.5 million-year period (17 to 14.5 Ma).

Columbia River basalt flows were erupted from north-northwest-trending fissures or linear vent systems in northcentral and northeastern Oregon, eastern Washington, and western Idaho (Swanson et al. 1979; Waters 1961). The Columbia River Basalt Group is formally divided into five formations, from oldest to youngest: Imnaha Basalt, Picture Gorge Basalt, Grande Ronde Basalt, Wanapum Basalt, and Saddle Mountains Basalt. Of these, only the Grande Ronde, Wanapum, and Saddle Mountains Basalts are known to be present in the Pasco Basin. The Saddle Mountains Basalt forms the uppermost basalt unit in the Pasco Basin except along some of the bounding ridges where Wanapum and Grande Ronde Basalt flows are exposed.

3.3.2 Ellensburg Formation

The Ellensburg Formation (Figure 3.5) includes epiclastic and volcaniclastic sedimentary rocks that are interbedded with the Columbia River Basalt Group in the central and western part of the Columbia Plateau (Schmincke 1964; Swanson et al. 1979). The age of the Ellensburg Formation is principally Miocene, although locally it may be equivalent to early Pliocene. The thickest accumulations of the Ellensburg Formation lie along the western margin of the Columbia Plateau where Cascade Range volcanic and volcaniclastic materials interfinger with the Columbia River Basalt Group. Within the Pasco Basin, individual interbeds have been named (e.g., Rattlesnake Ridge, Cold Creek), and these deposits are found primarily in the Wanapum and

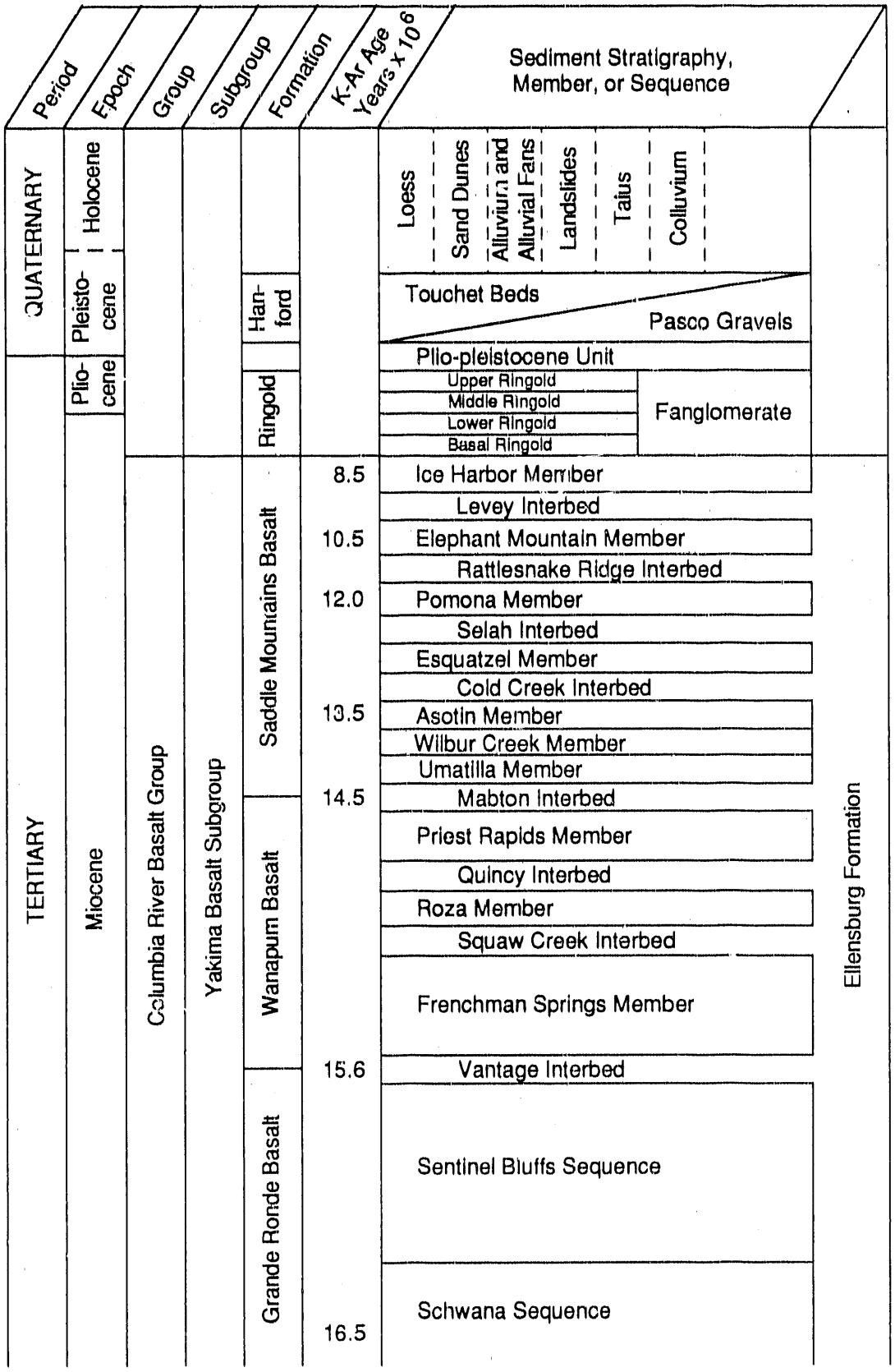

FIGURE 3.5. Stratigraphic Column for the Pasco Basin

Saddle Mountains Basalts. The lateral extent and thickness of interbedded sediments generally increase upward in the section (Reidel and Fecht 1981). Two major facies, volcaniclastic and fluvial, are present either as distinct or mixed deposits.

3.3.3 Suprabasalt Sediments

The suprabasalt sediments within and adjacent to the Hanford Site (Figure 3.5) were derived from a variety of sedimentary environments, although the fluvial-lacustrine Ringold Formation and glaciofluvial Hanford formation dominate the preserved stratigraphic record (Brown 1959; Routson and Fecht 1979; Tallman et al. 1981).

3.3.3.1 Late Neogene Deposits

Late Neogene (i.e., late Miocene to Pliocene) deposits, younger than the Columbia River Basalt Group, are represented by the Ringold Formation within the Pasco and Quincy Basins of the central Columbia Plateau (Grolier and Bingham 1978; Gustafson 1973; Newcomb et al. 1972; Rigby and Othberg 1979). The fluvial-lacustrine Ringold Formation was deposited in generally east-west-trending valleys by the ancestral Columbia River and its tributaries in response to development of the Yakima Folds Belt. Although exposures of the Ringold Formation are limited to the White Bluffs within the central Pasco Basin and to Smyrna and Taunton benches north of the Pasco Basin, extensive subsurface data on the Ringold Formation are available from boreholes.

The Ringold Formation is classified into three facies associations referred to as stratigraphic section types that represent variations in the paleogeography during Ringold time (Figure 3.6). Section Type I, comprising gravel and associated sand and silt, represents a migrating channel deposit of the major, thoroughgoing, ancestral Columbia and/or Snake river systems, which were confined to the central portion of the Pasco Basin. Section Type II comprises mainly overbank sand, silt, and clay deposited along the margins of the basin, beyond the influence of the main ancestral channel. Section Type III, a fanglomerate, occurs locally around the extreme margins of the basin and primarily comprises angular basaltic debris, derived from side-stream alluvium shed off bedrock ridges.

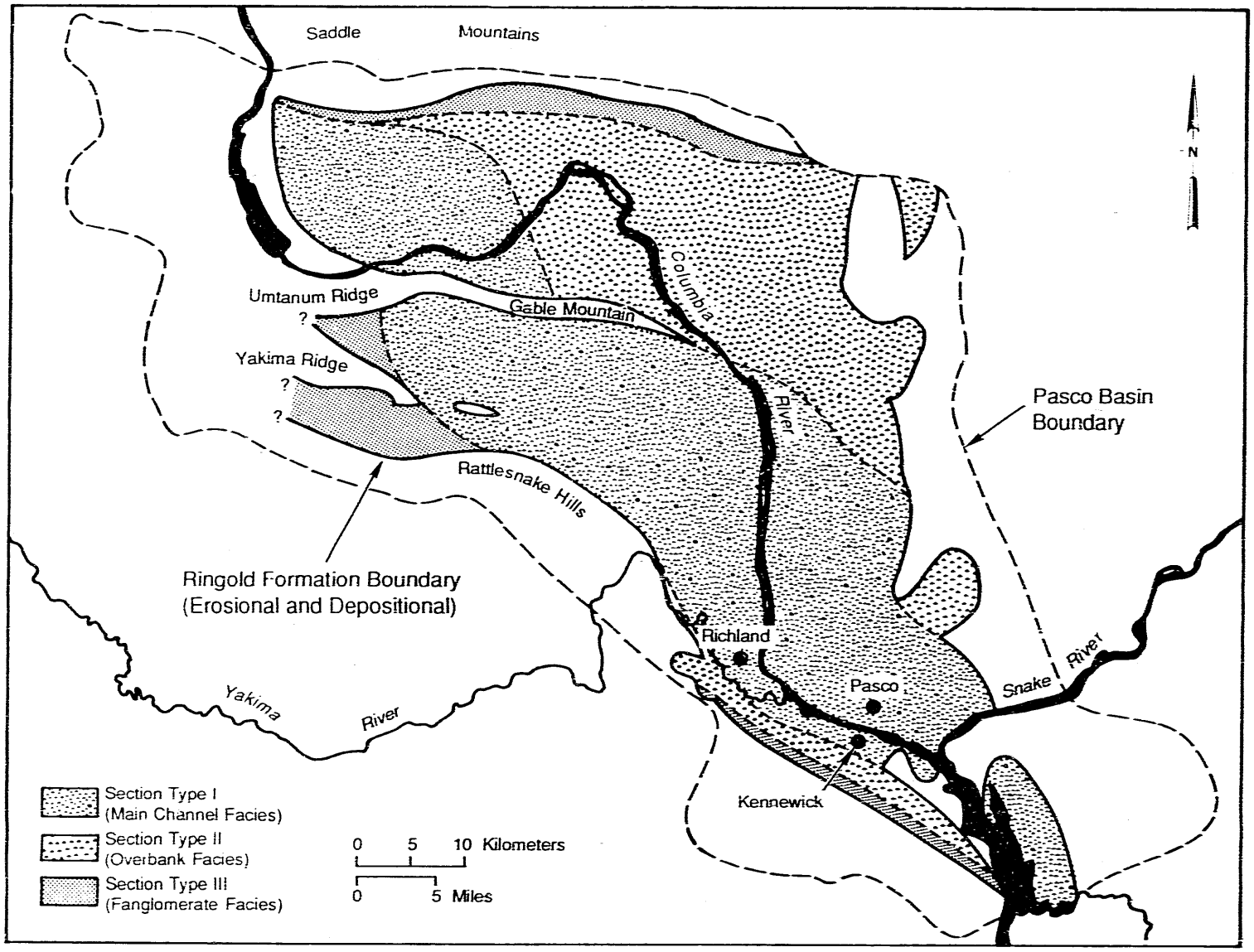

FIGURE 3.6. Distribution of Ringold Formation Section Types

Two methods have been used to subdivide Section Type I Ringold Formation deposits in the central Pasco Basin. One is based on lithofacies distinctions and the other on upward-fining cycles. Newcomb (1958) divided the Ringold into three lithofacies: a coarse-grained middle unit bounded above and below by fine-grained units. Tallman et al. (1979) described a fourth lithofacies unit, the coarse-grained basal Ringold unit, which underlies the fine-grained lower Ringold unit in the west-central Pasco Basin. The nomenclature for the basal Ringold unit was further subdivided into a coarse- and fine-grained subunit within the central Cold Creek syncline by Bjornstad (1984). A second method was used by Puget Sound Power and Light Company (PSPL 1981) in the area south and east of Gable Mountain, where the subsurface Ringold Formation was divided into four fluvial cycles (Units I through IV). Figure 3.7 provides a comparison of these changing interpretations of the Ringold sediments. The stratigraphic sequence defined by Bjornstad (1984) is used in this report.

Plio-Pleistocene Hiatus. The late Pliocene to early Pleistocene is generally characterized as a period of regional incision on the Columbia Plateau. Within the Pasco Basin this is reflected by the abrupt termination and eroded nature of the top of the Ringold Formation (Brown 1960a; Bjornstad 1985; Newcomb et al. 1972). Following incision, a well-developed soil formed on the eroded surface.

The exact timing and duration of incision is unknown; however, it probably occurred during the interval between 0.9 Ma (the age of the basalt from Haystack Butte) and 3.4 Ma (the youngest age reported from the Ringold Formation). Haystack Butte is located in the Columbia River Gorge, approximately 90 mi southwest of the Pasco Basin. Lava from Haystack Butte flowed into the old river channel, which was at the same elevation as the present river channel. The fact that the old and present river channels were at similar elevations indicates that incision (as much as 492 ft in the Pasco Basin) had ceased by 0.9 Ma.

Plio-Pleistocene Unit. A locally derived unit consisting of a side-stream alluvium and/or pedogenic calcrete occurs at the unconformity between the Ringold Formation and the Hanford formation. The side-stream alluvial

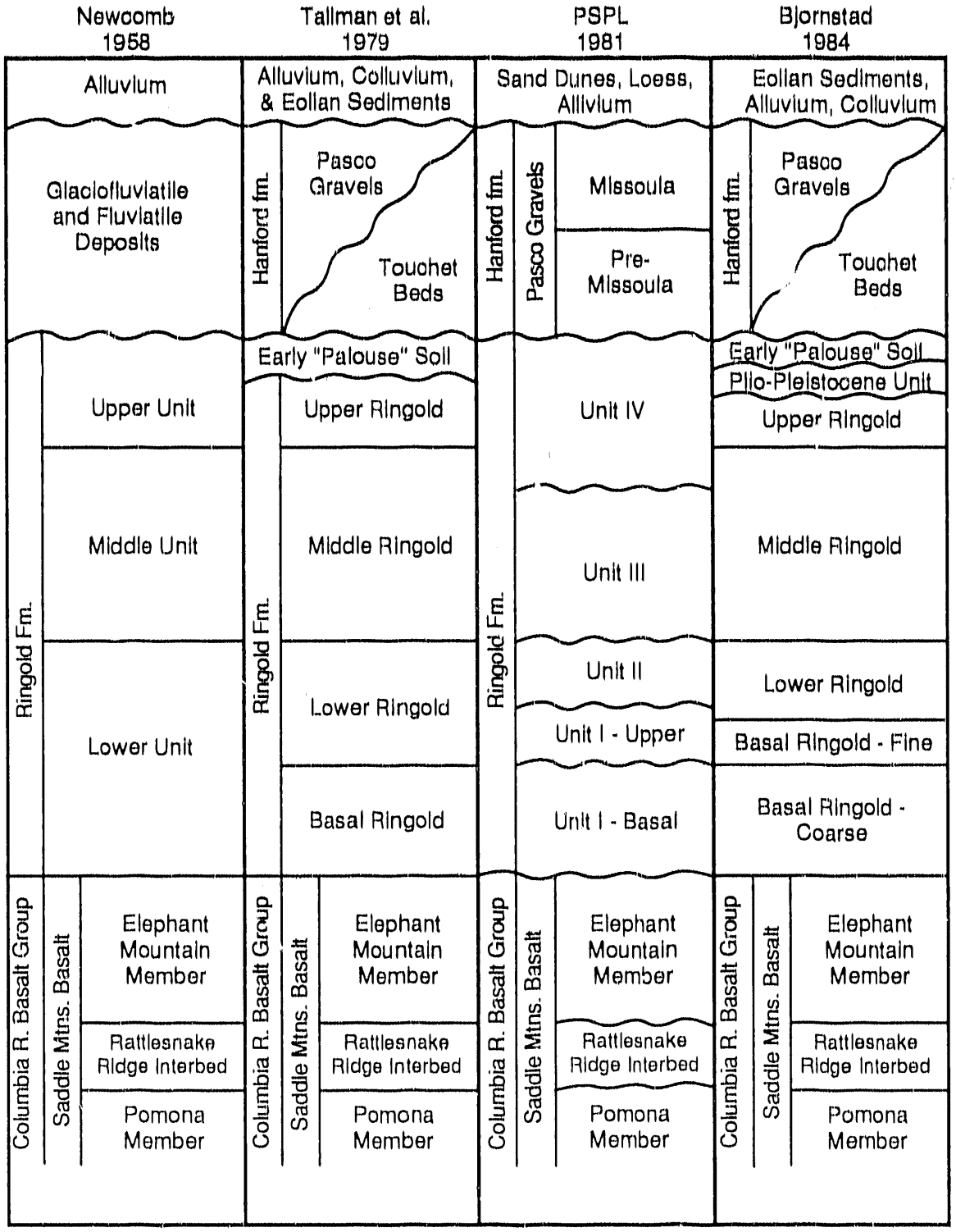

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FIGURE 3.7. Various Authors' Stratigraphic Nomenclature

facies is derived from Cold Creek and its tributaries and is characterized by relatively thick zones of unweathered basalt clasts along with pedogenically altered loess or colluvium.

Early "Palouse" Soil. Overlying the Plio-Pleistocene unit in the Cold Creek syncline area is a fine-grained sand to silt. It is believed to be mainly of eolian origin, derived from either the reworked Plio-Pleistocene unit or upper Ringold Formation. This early "Palouse" soil can be distinguished from overlying slackwater flood deposits by a greater calcium-carbonate content, massive structure in core samples, and a high natural gamma response in geophysical logs (Bjornstad 1984).

3.3.3.2 Quaternary Deposits

Aggradation of sediments resumed during the Quaternary following the period of late Pliocene to early Pleistocene incision. Quaternary deposits are associated with a variety of depositional processes, including those associated with volcanism, glaciation, lakes, rivers, wind, and mass wasting. In the central Columbia Plateau, the Quaternary record is dominated by proglacial cataclysmic flood deposits with lesser amounts of fluvial and eolian deposits, which lie below, between, and above flood deposits. Nonflooded areas on the Columbia Plateau are often mantled by alluvium, colluvium, or loess.

Cataclysmic Flood Deposits. Proglacial flood deposits blanket low-lying areas over most of the central Columbia Plateau. Most cataclysmic flood deposits that are preserved are late Pleistocene; the last major flood sequence is dated at about 13,000 yr ago by the presence of Mount St. Helens "S" tephra (Mullineaux et al. 1978) interbedded with these sediments. Cataclysmic floods inundated the Pasco Basin a number of times during the Pleistocene, beginning as early as 1 Ma (Bjornstad and Fecht 1989). The largest and most frequent floods came from glacial Lake Missoula in northwestern Montana; however, smaller floods may have escaped downvalley from glacial Lakes Clark and Columbia along the northern margin of the Columbia Plateau (Waitt 1980). Another source of Pleistocene floodwaters came down the Snake River from glacial Lake Bonneville in Utah (Malde 1968). Lake Bonneville flood deposits, however, have not been positively identified

within the Pasco Basin. This may be because of erosion and/or burial by younger flood deposits from Lake Missoula. The last Lake Bonneville flood occurred about 14,000 to 15,000 yr ago (Scott et al. 1982).

Cataclysmic floodwaters entering the Pasco Basin quickly became impounded behind Wallula Gap, which was too restrictive for the volume of water. Floodwaters ponded up to an elevation of 1150 ft, forming a lake up to 430 ft deep in the vicinity of the 2101-M Pond. A proposed model for each proglacial flood cycle in the Pasco Basin consists of three phases that include the following: 1) large-scale erosion, followed by 2) deposition associated with lake filling behind a hydraulic dam at Wallula Gap, and finally 3) deposition and erosion associated with lake retreat (Bjornstad et al. 1987). It is estimated that each flood cycle lasted only a few weeks or less (Baker 1978). As the lake drained for the last time, floodwaters became channelized as current energy along the bed increased, forming the present network of anastomosing channels within the central Pasco Basin. Two end-member types of flood deposits are normally observed: a coarse-grained, main-channel facies and a finer-grained, slackwater facies. Within the Pasco Basin, these are referred to as the Pasco Gravels and Touchet Beds of the Hanford formation, respectively (Myers et al. 1979). Sediments with intermediate grain sizes, indicative of intermediate current strength, are also present in areas throughout the Pasco Basin, particularly on the south, relatively protected side of the Cold Creek Bar.

Deciphering the history of cataclysmic flooding in the Pasco Basin is complicated not only by floods from multiple sources, but also because paths of Lake Missoula floodwaters migrated and changed course with the advance and retreat of the Cordilleran ice sheet (Baker and Bunker 1985). Cataclysmic floods inundated the central Columbia Plateau several times during the Pleistocene. At least three major flooding episodes (early, middle, and late Pleistocene) are recognized in the Pasco Basin, although many more minor flood events probably occurred during each of these major episodes. The evidence for the different ages of flooding include changes in magnetic polarity, truncated clastic dikes, and soil development on flood sequences (Bjornstad et al. 1987; Bjornstad and Fecht 1989).

Clastic dikes are commonly associated with, but not restricted to, cataclysmic flood deposits on the Columbia Plateau. Although there is general agreement that clastic dikes formed during cataclysmic flooding, a primary mechanism to satisfactorily explain the formation of all dikes has not been identified (WPPSS 1981). Among the more probable explanations are injection initiated by hydrostatic loading and dewatering associated with receding floodwaters.

Other Quaternary Deposits. Alluvium is present not only as a surficial deposit along major river and stream courses (see Figure 3.3), but also in the subsurface, where it is found underlying, and interbedded with, proglacial flood deposits. Two types of alluvium are recognized in the Pasco Basin: quartzitic mainstream and basalt-rich side-stream alluvium. Colluvium (talus and slopewash) is also a common Holocene deposit in moderate-to-high relief areas and, like the dune sand found locally in the semiarid central plateau, is not commonly preserved in the stratigraphic record.

Varying thicknesses of loess or sand mantle much of the Columbia Plateau. Active and stabilized sand dunes are widespread over the Pasco Basin (see Figure 3.3).

Landslide deposits in the Pasco Basin are of variable age and genesis. Most are associated with the north limbs of Yakima Folds, such as the north side of Rattlesnake Mountain, or along steep river embankments, such as the White Bluffs in the Pasco Basin (see Figure 3.3).

3.4 TECTONIC FRAMEWORK

The Columbia Plateau lies east of the Cascade Range and is a part of the North American continental plate. It is bounded on the north by the Okanogan Highlands, on the east by the Northern Rocky Mountains and Idaho Batholith, and on the south by the High Lava Plains and Snake River Plain. This section describes the tectonic setting of the Hanford Site, which lies within the Columbia Plateau. A more detailed discussion is presented in DOE (1988).

3.4.1 Structural Geology of the Region

The Columbia Plateau can be divided into three informal structural subprovinces: Blue Mountains, Palouse, and Yakima Fold Belt (Figure 3.8). These subprovinces are defined on the basis of their structural fabric, unlike the physiographic provinces that are defined on the basis of

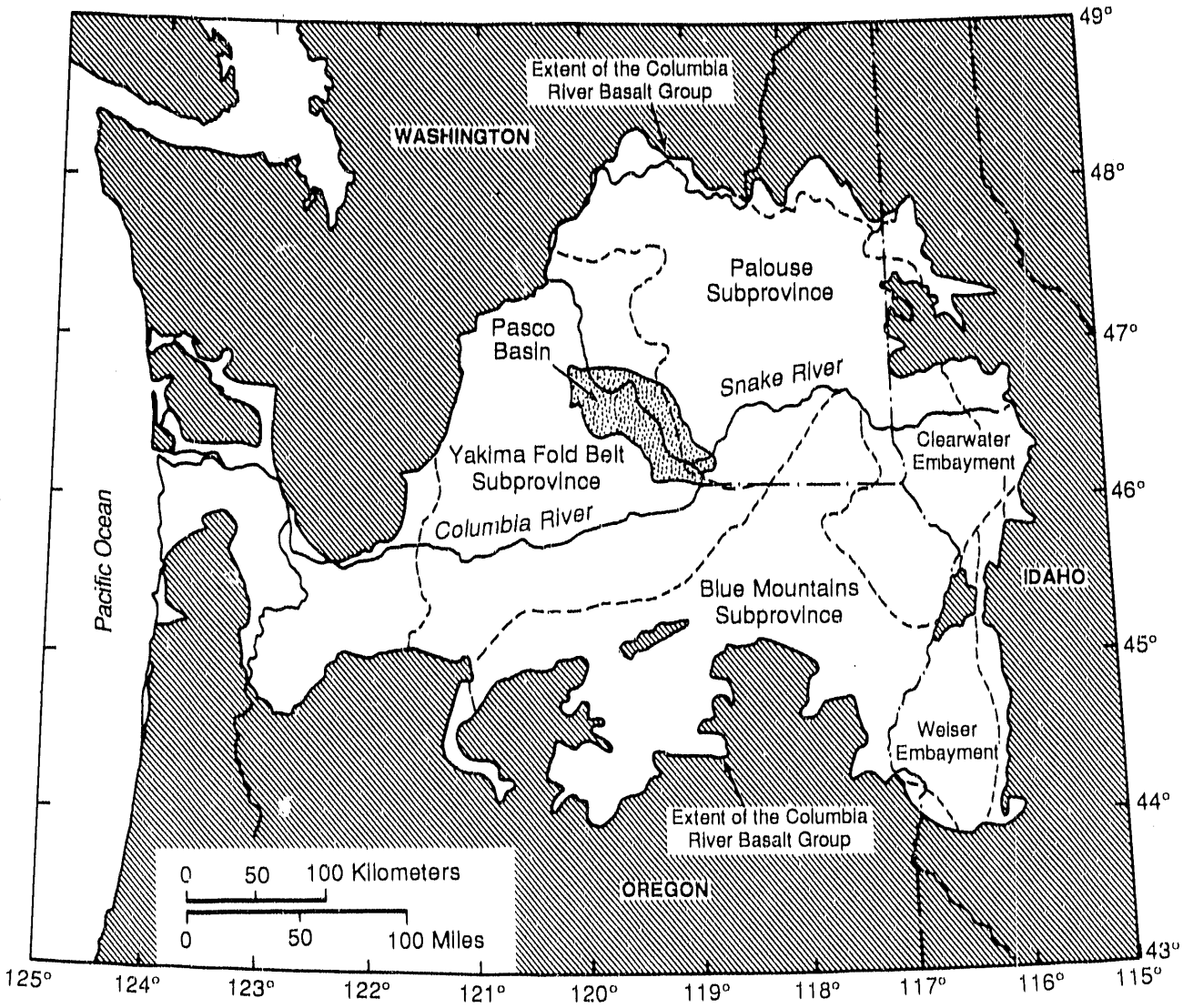

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FIGURE 3.8. Structural Subprovinces of the Columbia Plateau (modified from DOE 1988)

landforms. The Hanford Site is located near the junction of the Yakima Fold Belt and the Palouse subprovinces, and north of the Blue Mountains subprovince.

3.4.1.1 Blue Mountains Subprovince

The Blue Mountains subprovince is a structurally diverse region dominated by the complexly faulted Blue Mountains anticlinorium in its northern portion and a series of structural basins in its central and southern portions. The structural basins are generally of two types: 1) fault-bounded basins (e.g., the La Grande, Baker, and Unity Basins) and 2) fold-bounded basins (e.g., the John Day Basin). In the northern and central portions of the Blue Mountains proper, two important fault systems have been recognized: the Hite Fault System and the La Grande Fault System.

3.4.1.2 Palouse Subprovince

The Palouse subprovince is primarily a regional paleoslope that dips gently toward the central Columbia Plateau and exhibits only relatively mild structural deformation. The Palouse Slope is underlain by a wedge of Columbia River basalt that thins gradually toward the east and north and laps onto the adjacent highlands.

3.4.1.3 Yakima Fold Belt Subprovince

The principal characteristic of the Yakima Fold Belt is a series of segmented, narrow, asymmetric anticlines that have wavelengths between 3 and 19 mi and amplitudes commonly <0.6 mi. These anticlinal ridges are separated by broad synclines or basins that, in many cases, contain thick accumulations of Neogene- to Quaternary-age sediments.

Thrust or high-angle reverse faults with fault planes that strike parallel or subparallel to the axial trends are principally found along the limbs of the anticlines (Bentley et al. 1980; Hagood 1985; Reidel 1984; Swanson et al. 1979, 1981). The amount of vertical stratigraphic offset associated with these faults varies but commonly exceeds hundreds of feet.

The deformation of the Yakima Folds occurred under north-south compression and was probably contemporaneous with the eruption of the basalt flows (Reidel 1984). The fold belt was growing during the eruption of the Columbia

River Basalt Group and continued to grow through the Pliocene, into the Pleistocene and perhaps to the present.

Cold Creek Syncline. The Cold Creek syncline (Figures 3.9 and 3.10) lies between the Umtanum Ridge-Gable Mountain uplift and the Yakima Ridge uplift and is the principal structural unit that contains the 200 Areas. The Cold Creek syncline is an asymmetric and relatively flat-bottomed structure. Its amplitude is higher, and wavelength shorter, west of the Hanford Site.

The Yakima Barricade geophysical anomaly (Figure 3.10) occurs on the west end of the Cold Creek syncline and coincides with a west-to-east change in hydraulic gradient within the confined aquifer system. It does not affect the unconfined aquifer system. The data suggest that this feature is either a steeply dipping fold or a high-angle fault that formed during the late Miocene to early Pliocene; movement is believed to have ended by late Pliocene (DOE 1988).

Umtanum Ridge-Gable Mountain Structural Trend. The Umtanum Ridge-Gable Mountain structural trend is a segmented anticlinal ridge extending for a length of 85 mi in an east-west direction and passing north of the 200 Areas (Figures 3.9 and 3.10). This structure consists of five segments. From the west, Umtanum Ridge plunges toward the basin and joins the Gable Mountain-Gable Butte segment near the western boundary of the Hanford Site. The easternmost segment, the Southeast anticline, trends southeast off the eastern boundary of the Gable Mountain-Gable Butte segment.

Umtanum Ridge is an asymmetrical, primarily north-vergent to locally overturned anticline with a major-thrust to high-angle reverse fault on the north side (Goff 1981; PSPL 1982) that dies out as it plunges eastward toward the Gable Mountain-Gable Butte segment. Gable Mountain and Gable Butte are two topographically isolated, anticlinal ridges that comprise a series of northwest trending, doubly plunging, en echelon anticlines, synclines, and associated faults. Capable faulting has been identified on Gable Mountain (NRC 1982; PSPL 1982).

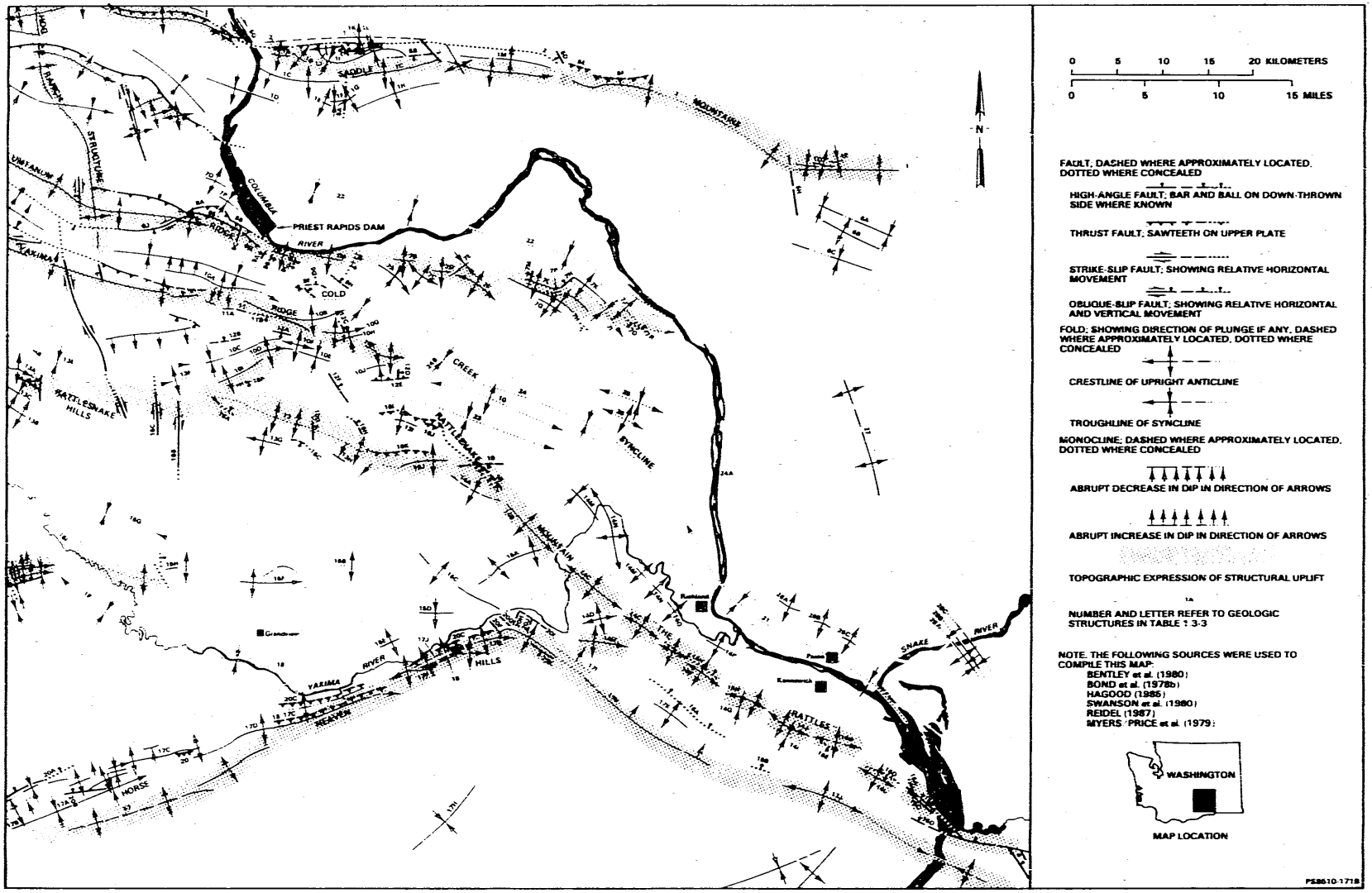

FIGURE 3.9. Structural Elements of the Yakima Fold Belt Subprovince (after DOE 1988)

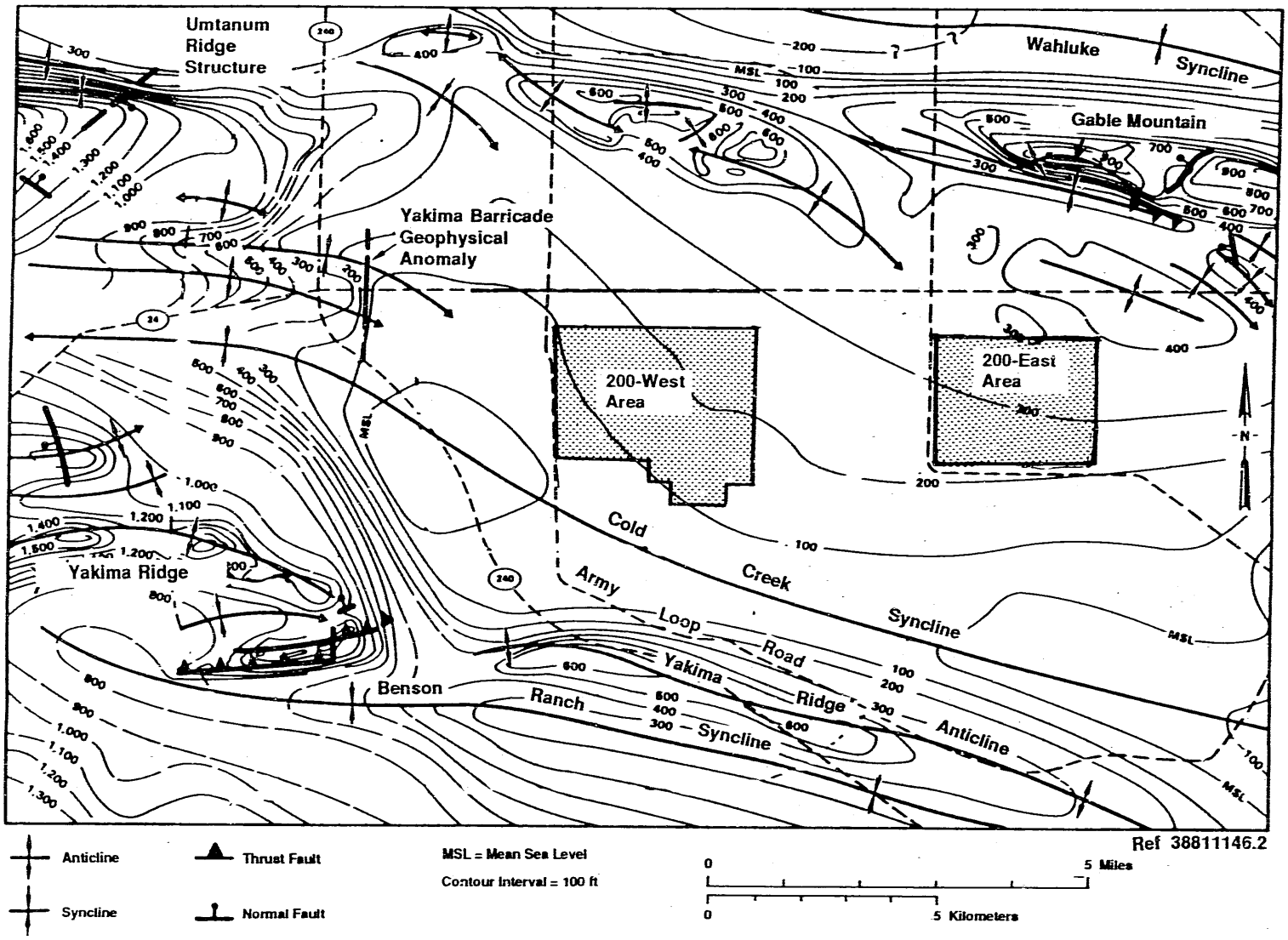

FIGURE 3.10. Top of Basalt Structural Map for the Area Adjacent to the 200 Areas

Yakima Ridge. The Yakima Ridge uplift extends from west of Yakima to the center of the Pasco Basin, where it forms the southern boundary of the Cold Creek syncline (Figures 3.9 and 3.10). The easternmost surface expression of the Yakima Ridge uplift is represented by an anticline that plunges eastward into the Pasco Basin (Myers et al. 1979, Plate III). The eastern extension of Yakima Ridge into the basin is mostly buried beneath sediments, but is assumed to be similar to the exposed parts.

3.5 SEISMICITY

The Pasco Basin and surrounding Columbia Plateau is an area of relatively low seismicity. Earthquake records for the Pacific Northwest extend back to about 1850. Earthquakes occurring before 1969 were documented from reports of tremors that were felt (Coffman and Von Hake 1982; Fifer 1966; NRC 1982; Rasmussen 1967; WCC 1980, 1982; WPPSS 1981), while earthquakes since 1969 have been instrumentally recorded. Depending on the data available, various analytical methods were used to calculate the intensity of past earthquakes. Consequently, different scales are used in the following discussion.

Earthquake activity on the Hanford Site is confined to the crust and is characterized primarily by shallow swarms of microearthquakes that occur predominantly in the basalts. Focal mechanisms for basalt and sub-basalt events indicate north-south compression and reverse faulting along nearly east-west planes.

3.5.1 Regional Earthquakes

Low seismicity characterizes eastern Washington. The historic record of events with epicentral intensities of MM IV or greater and the seismographic record of events of magnitude 3 or greater are remarkably similar, and indicate that the major seismicity of the Columbia Plateau is broadly scattered.

The largest earthquake known to have occurred within the Columbia Plateau was the July 16, 1936, Milton-Freewater, Oregon, earthquake. The maximum epicentral intensity was estimated to be MM VII, and was originally estimated to be surface-wave magnitude 5-3/4 (Gutenberg and Richter 1965). An evaluation of Gutenberg's original seismographic data suggested that the

Richter magnitude could have been as high as 6.1 (WCC 1980). A reevaluation using station corrections (WCC 1982) yielded a surface-wave magnitude of 5.7 to 5.8 (NRC 1982).

Other earthquakes that have historically been considered in seismic evaluations on the Hanford Site are

- the December 4, 1872, earthquake that occurred in the North Cascades tectonic province somewhere in northcentral Washington State (NRC 1982)
- the March 5, 1893, earthquake near Umatilla, Oregon (about 44 mi south of the Hanford Site), that had an estimated MM intensity of VI (WPPSS 1981, Plate 123)
- the November 1, 1918, earthquake in the vicinity of the Saddle Mountains and Frenchman Hills that had an estimated surface-wave magnitude of 4.4 (WPPSS 1981, p. 2.5J-36)
- the December 20, 1973, earthquake that occurred near the same location as the November 1, 1918, event and had a coda-length magnitude 4.4
- the April 8, 1979, coda-length magnitude 4.1 earthquake that occurred near College Place, Washington, which was a shallow event with a focal depth of between 1.9 and 3.7 mi.

A complete listing of known regional earthquakes is given in DOE (1988).

3.5.2 Seismicity of the Central Columbia Plateau and Hanford Site

Most of the currently observed seismicity of the central Columbia Plateau is concentrated between the Saddle Mountains and Frenchman Hills, and between the Saddle Mountains and the Gable Mountain-Gable Butte area.

The densest groups of epicenters in the central Columbia Plateau are caused by earthquake swarms. An earthquake swarm may be defined as a cluster of events within a relatively short period of time that have comparable magnitudes and that first wax and then wane in number with no one outstanding event; the main criterion is that no "outstanding" (large) event occurs. An outstanding event is considered a mainshock, and any earthquakes that precede or follow it are considered foreshock or aftershock activity. However, because of the low seismicity rates and generally small magnitudes of events

that have been observed in the central plateau region (roughly 90% have magnitudes of 2 or less), the distinction between swarm and nonswarm activity is not always clear.

Based on the seismographic record, Columbia Plateau seismicity can be segregated by depth into three zones: 0 to 2.5 mi, 2.5 to 5 mi, and deeper than 5 mi (WPPSS 1981). Nearly 90% of the seismicity occurs at depths less than 5 mi, and most of this shallow seismicity (70% to 80%) occurs in the uppermost 2.5 mi as earthquake swarms (WPPSS 1981; Rasmussen 1987).

Since 1969, when the collection of local Columbia Plateau seismographic data began, most swarm events have been observed to have coda-length magnitudes of about 1.5 or less. The largest swarm event has been the 4.4 coda-length magnitude 1973 Royal Slope shock, which in some ways exhibited main shock characteristics. Only about 10% of the seismicity at depths less than 5 mi exceed (coda-length) magnitude 2.0.

Two areas of shallow swarm activity, the Coyote Rapids and the Cold Creek swarm areas, are located within 6.2 mi of the 200 Areas and a third area, the Wooded Island swarm, occurs 9 mi east to southeast of the 200 Areas (Figure 3.11). The Coyote Rapids swarm area has been the site of several events since 1969, when instrumental monitoring of this area began. A total of 91 events occurred in the Coyote Rapids swarm area between 1969 and 1986, the bulk of which appear to congregate into two 3- to 6-mi, roughly east-west lineations at either end of the west leg of the Columbia River horn.

Most of the Coyote Rapids events (76, or approximately 85%) have magnitudes (coda-length) of 1.5 or less. The two largest events in this area occurred during swarms on October 25, 1971 (3.8 coda-length magnitude), and on October 20, 1983 (3.4 coda-length magnitude).

Activity has been recorded in the Wooded Island swarm area since the installation of the local area net in 1969. Hundreds of events have occurred on Wooded Island as well as the surrounding area both east and west of the Columbia River. The majority of the events are of coda-length magnitude 1.5 or less. The largest event recorded in the Wooded Island swarm was a 2.4 coda-length magnitude. The latest swarm activity in this area was in the fall of 1988 through the early part of 1989.

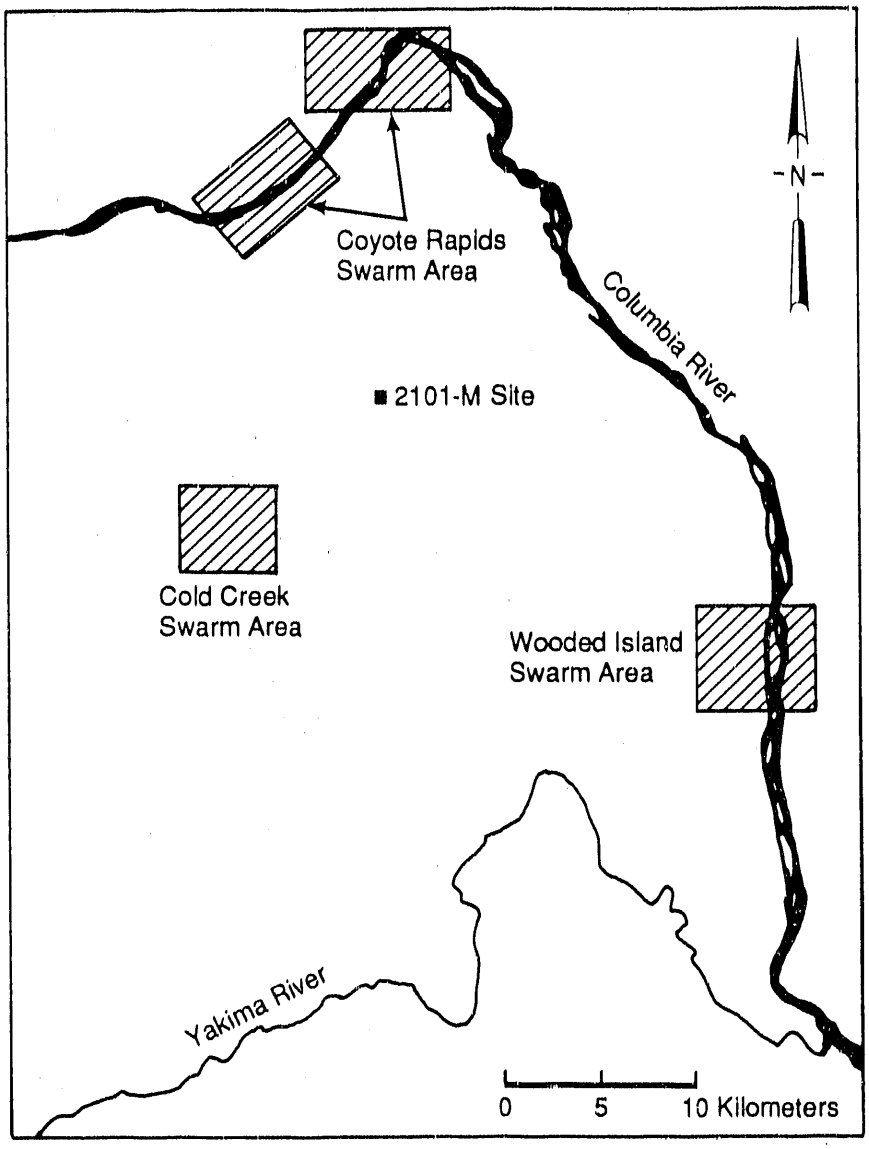

FIGURE 3.11. Location of Earthquake Swarms on the Hanford Site

Other activity has occurred in the Cold Creek swarm area, located 3 to 5 mi south of the 200-West Area. Three periods of activity have occurred here since 1969: July to November 1979; August 1981; and November 1985 to April 1986. A total of 35 events occurred in this area, all less than 3 mi deep. The largest event had a 2.4 coda-length magnitude.

3.6 REGIONAL HYDROLOGY

The following subsections summarize the surface- and ground-water hydrology of the Hanford Site and immediate vicinity. A more detailed discussion of Hanford Site hydrology is given in DOE (1988).

3.6.1 Surface Water

The primary surface-water feature associated with the Pasco Basin is the Columbia River with its major tributaries the Yakima, Snake, and Walla Walla rivers. With the exception of the Columbia River, there are no perennial streams within the Hanford Site. West Lake, about 10 acres in size and <3 ft deep, is the only natural lake within the Hanford Site (DOE 1988). There are, however, several surface ponds and ditches associated with waste disposal activities (Figure 3.12). A network of dams and multipurpose water resource projects are located along the course of the Columbia River (Figure 3.12). The Columbia River is considered to be free-flowing along approximately two-thirds of the Hanford Site. This area, referred to as the Hanford reach, extends from Priest Rapids Dam to the headwaters of Lake Wallula (the reservoir behind McNary Dam) near the southern part of the Hanford Site. The stream flow has been inventoried and described in detail by the U.S. Army Corps of Engineers (DOE 1986). Stream flow along this reach is controlled by Priest Rapids Dam. Several drains and intakes are also present along this reach, including irrigation outfalls from the Columbia Basin Irrigation Project, the Washington Public Power Supply System (WPPSS) Nuclear Project 2, and Hanford Site intakes for onsite water use.

Cold Creek and its tributary, Dry Creek, are ephemeral streams within the Yakima River drainage system. Western portions of the Hanford Site are drained by both streams as they flow southwest toward the Yakima River. Surface flow, which may occur during spring runoff or after heavier than normal precipitation, infiltrates as direct recharge to the subsurface sediments. Rattlesnake Springs, located on the western part of the Hanford Site, forms a small surface stream that flows for about 1.8 mi before infiltrating into the ground. Approximately one-third of the Hanford Site is drained by the Yakima River system.

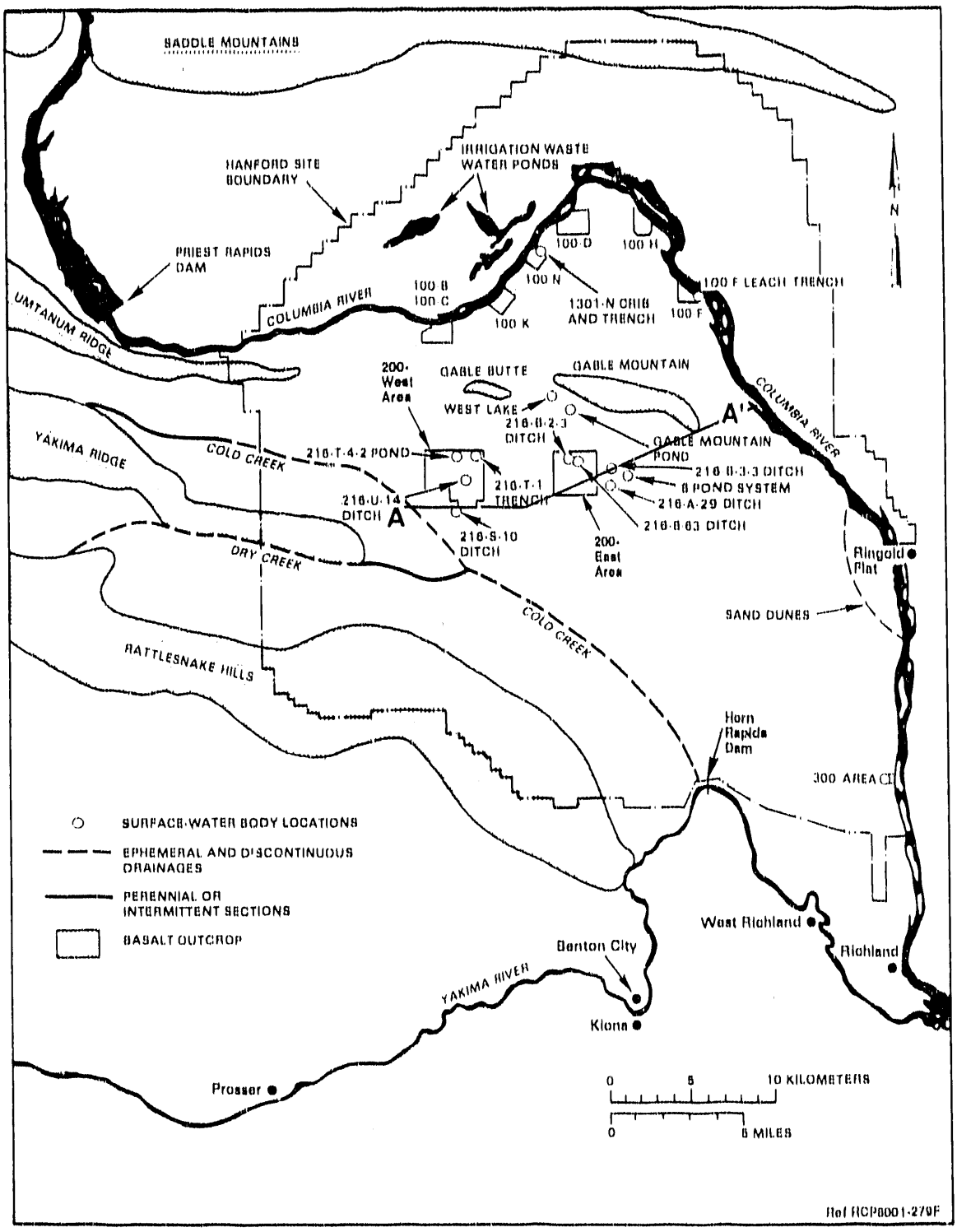

FIGURE 3.12. Surface Water Features of the Hanford Site and Surrounding Area

The Yakima River, bordering the southeastern portion of the Hanford Site, has a low annual flow compared to the Columbia River. For the 57-yr period of record, the average annual stream flow of the Yakima River is about 3.7×10^3 ft^3/s with monthly maximum and minimum flows of 1.7×10^4 ft^3/s and 1.6×10^2 ft^3/s, respectively. Recorded flow rates of the Columbia River have ranged from 1.6×10^5 to 6.4×10^5 ft^3/s during the runoff in spring and early summer, to 3.5×10^4 to 1.6×10^5 ft^3/s during the low flow period of late summer and winter (Jamison 1982). The average annual Columbia River flow in the Hanford reach, based on 65 yr of record, is about 1.2×10^5 ft^3/s (DOE 1987). Normal river elevations within the Hanford Site range from 394 ft above mean sea level where the river enters near Vernita to 341 ft where it leaves the Hanford Site near the 300 Area.

Large Columbia River floods have occurred in the past (DOE 1987), but the likelihood of recurrence of large-scale flooding has been reduced by the construction of several dams upstream. Historical and hypothetical floods have been investigated for the Columbia River, Yakima River, and Cold Creek at the Hanford Site (DOE 1988). No 100-yr flood plain maps have been made for the Hanford reach of the Columbia River, but the 200 Areas are above the flood level of an even larger projected flood, a hypothetical 50% breach of Grand Coulee Dam (DOE 1987).

Routine water-quality monitoring of the Columbia River is conducted by DOE for both radiological and nonradiological parameters. Reports on monitoring results have been published annually by PNL since 1973 (e.g., Jaquish and Mitchell 1988). Ecology has issued a Class A (excellent) quality designation for Columbia River water along the reach from Grand Coulee Dam, through the Pasco Basin, to McNary Dam. This designation requires that all industrial uses of this water be compatible with other uses, including drinking, wildlife habitat, and recreation. In general, the Columbia River water can be characterized by a very low suspended load, a low nutrient content, and an absence of microbial contaminants (DOE 1988).

Radionuclides in the Columbia River below the Hanford Site have decreased significantly since single-pass plutonium production reactors were shut down in 1971 and improved effluent control systems were installed at the

N Reactor. Low levels of radionuclides, however, continue to be measured downstream of the Hanford Site and have been since 1985. Fluctuations in the concentrations of some of these radionuclides are attributed, in part, to the discharge of contaminated ground water from the Hanford Site to the Columbia River (DOE 1988).

3.6.2 Ground Water

Ground water occurs both within a suprabasalt aquifer system consisting of fluvial and lacustrine sediments, and within a system of deeper, confined to semiconfined aquifers in the basalt flow tops, flow bottom zones, and sedimentary interbeds (DOE 1988). These deeper aquifers are intercalated with confining layers consisting of basalt flow interiors. Vertical flow and leakage across the confining layers are inferred from water-level or potentiometric surface data, but the flow and leakage are not quantified, and direct measurements are not available (DOE 1988). The multiaquifer system within the Pasco Basin has been conceptualized as consisting of four primary geohydrologic units: 1) suprabasalt Hanford and Ringold Formation sediments; 2) Saddle Mountain Basalt; 3) Wanapum Basalt; and 4) Grande Ronde Basalt.

3.6.2.1 Suprabasalt Aquifer System

The suprabasalt aquifer is the uppermost regionally extensive aquifer beneath the Hanford Site. The water table ranges in depth from 0 ft below land surface (bls) at West Lake and the Columbia and Yakima rivers, to >350 ft bls near the center of the Hanford Site. Ground water within the suprabasalt aquifer system is contained within the glaciofluvial sands and gravels of the Hanford formation and/or the fluvial/lacustrine sediments of the Ringold Formation. The position of the water table beneath the western portion of the Hanford Site is generally within the middle Ringold unit. In the northern and eastern portions, however, the water table is generally within the Hanford formation.

The suprabasalt aquifer system is approximately 500 ft thick near the center of the Pasco Basin. Laterally, the aquifer system is bounded by anticlinal basalt ridges, which extend above the water table. A generalized east-west geologic cross section showing the position of the water table and

major stratigraphic units beneath the Hanford Site is presented in Figure 3.13. The location of this cross section is shown in Figure 3.12.

The base of the suprabasalt aquifer system is conceptualized as the basalt surface. On a local scale, the silts and clays of the lower and fine-grained basal members of the Ringold Formation form a confining layer within the suprabasalt system.

Sources of natural recharge to the suprabasalt aquifer are rainfall and runoff from the higher bordering elevations, water infiltrating from small ephemeral streams, and river water along influent reaches of the Yakima and Columbia rivers. Total estimated precipitation over the Hanford Site is about 3×10^{10} ft^3 annually, averaging <6.2 in./yr. Mean annual runoff from the basin is estimated to be $<2.5 \times 10^4$ acre-ft/yr, or approximately 3% of the total precipitation. The remaining precipitation is assumed to be lost through evapotranspiration with a small component (perhaps <1%) recharging the ground-water system (DOE 1988). Ground water also enters the suprabasalt aquifer system from underlying confined aquifers in areas of upward hydraulic gradient.

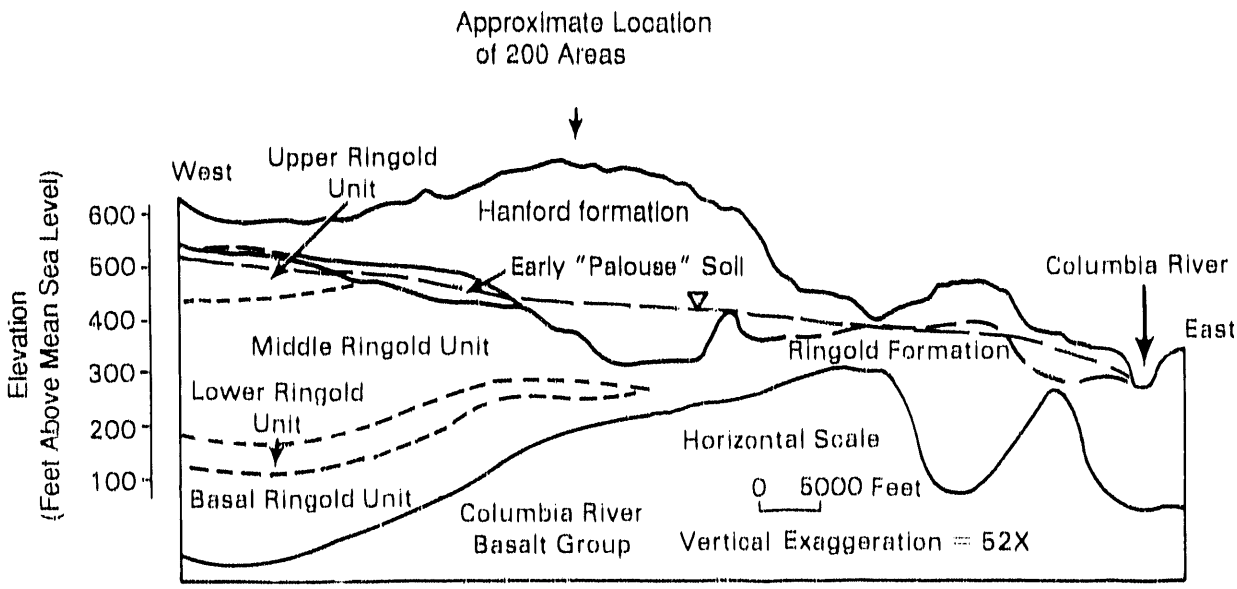

FIGURE 3.13. Generalized East-West Cross Section Through the Hanford Site

The movement of precipitation through the unsaturated (vadose) zone has been studied at several locations on the Hanford Site to define the movement of water in the vadose zone. Conclusions from these studies vary, depending on the location studied. Some investigators conclude that no downward percolation of precipitation occurs on the 200 Area Plateau where the sediments are layered and vary in texture with depth, and vegetation removes moisture penetrating the soil through evapotranspiration (Routson et al. 1989). Others have suggested downward water movement below the root zone from tests conducted near the 300 Area, where soils are coarse-textured, precipitation was above normal during the test interval, and there was little vegetation to promote evapotranspiration (DOE 1987; Gee 1987).

Water levels in the suprabasalt aquifer system have risen because of artificial recharge mechanisms such as excessive application of imported irrigation water or impoundment of streams. Waste water ponds on the Hanford Site have artificially recharged the suprabasalt aquifer(s) in and near the 200-East and 200-West Areas. Recharge from the 200 Areas waste water disposal facilities is estimated to be approximately 10 times the natural recharge on the Hanford Site (Graham et al. 1981a). This artificial recharge has caused the water table to rise. The increase in water-table elevations was most rapid from 1950 to 1960 and apparently had nearly equilibrated between 1970 and 1980, when only small increases in water-table elevations occurred. Waste water discharges from the 200-West Area were significantly reduced in 1984 when U Pond was decommissioned (Serkowski et al. 1988), and the water levels there are now slowly declining.

Ground water flows east from the natural recharge areas west of the Hanford Site to discharge areas, primarily along the Columbia River. This general west-to-east flow pattern is interrupted locally by the artificially induced ground-water mounds in the 200 Areas. From the 200 Areas, there is also a component of ground-water flow to the north, between Gable Mountain and Gable Butte. Figure 3.14 illustrates the water-table conditions beneath the Hanford Site in June 1987.

Hydraulic conductivities for the Hanford formation (2000 to 10,000 ft/d) are much greater than those of the middle member of the Ringold

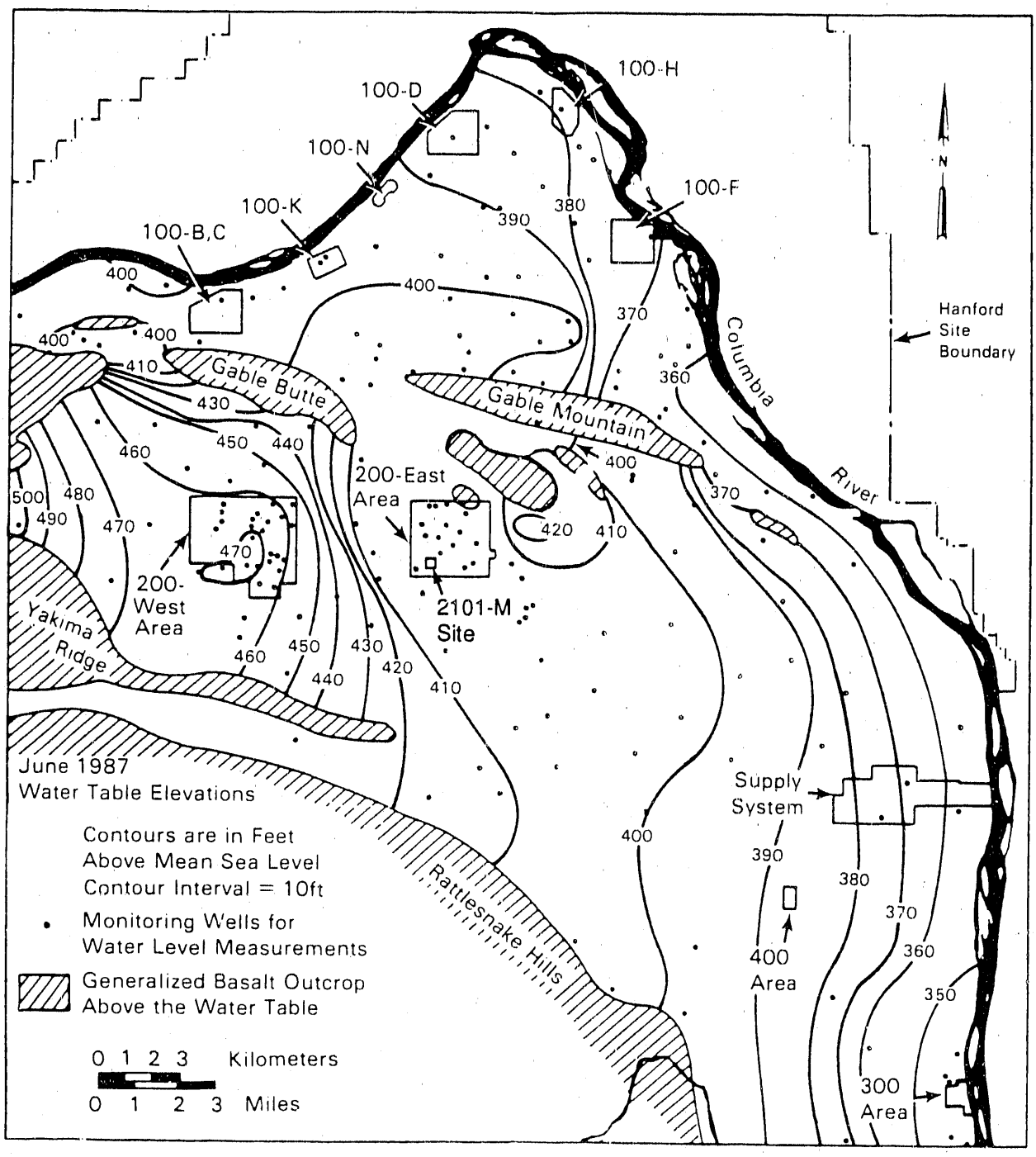

FIGURE 3.14. Water-Table Elevations, June 1987

Formation (610 to 3050 ft/d) (Law et al. 1987). The main body of this aquifer occurs within the middle member of the Ringold Formation.

Waste water discharged on the Hanford Site has affected ground-water quality in the suprabasalt aquifer. The primary constituents that have reached the aquifer are tritium, iodine-129, ruthenium-106, technetium-99, uranium, nitrate, and chromium (DOE 1987). The ground water is routinely and extensively monitored to trace the movement of contaminants and to determine any impact from the Hanford Site to the public. Ground-water monitoring reports are produced annually (e.g., Jaquish and Mitchell 1988; Serkowski et al. 1988).

3.6.2.2 Basalt Confined Aquifer System

Confined aquifers are present in the sedimentary interbeds and/or interflow zones that occur between dense basalt flows of the Saddle Mountains, Wanapum, and Grande Ronde Basalts. The main water-bearing portions of the interflow zones are networks of interconnecting vesicles and fractures of the flow tops and flow bottoms.

Recharge to the Saddle Mountains Basalt apparently occurs along the southwestern and western boundaries of the Pasco Basin. Some recharge may also occur on the eastern Saddle Mountains anticline along the northern boundary of the Pasco Basin (DOE 1988). Ground water also flows from the suprabasalt aquifer into the Rattlesnake Ridge interbed in the western half of the Hanford Site (DOE 1988).

The potentiometric surface and ground-water cation concentration ratios for the Saddle Mountains Basalt imply that ground water within the Saddle Mountains Basalt discharges into the Columbia River. This discharge occurs between the Columbia River's confluence with the Yakima and Snake rivers and the eastern portion of the Hanford Site. Ground water from the Saddle Mountains Basalt may also discharge into the lower Snake and Walla Walla rivers in the Pasco Basin. In the eastern half of the Hanford Site, the Rattlesnake Ridge aquifer has a higher potential than the suprabasalt sediments (DOE 1988), and ground water may flow upward through the confining units into the Ringold Formation.

Ground-water flow in the Wanapum Basalt in the Pasco Basin is inferred to be toward the Columbia River from the north, west, and east. Ground-water movement in the Grand Ronde Basalt in the Pasco Basin is believed to be to the south and west from the east side of the Columbia River, and to the east from the west side of the river (DOE 1988).

Erosional "windows" through the dense basalt flow interiors provide the potential for direct interconnections between the suprabasalt and uppermost confined aquifer (Rattlesnake Ridge) in the basalt system. Strait and Moore (1982) and Graham et al. (1984) indicated that some contamination was present in the uppermost confined aquifer (Rattlesnake Ridge) south and east of Gable Mountain Pond. Graham et al. (1984) evaluated the hydrologic relationships between the Rattlesnake Ridge aquifer and the suprabasalt aquifer in this area and delineated a potential area of intercommunication beneath the northeast portion of the 200-East Area.

4.0 HYDROGEOLOGIC CHARACTERIZATION

The three objectives of the 2101-M Pond ground-water monitoring plan (Chamness et al. 1989) are as follows:

1. Characterize the stratigraphy and the horizontal ground-water flow directions and rates of the uppermost portion of the unconfined aquifer beneath the pond.

2. Implement a monitoring program to determine if statistically significant amounts of dangerous waste constituents are detectable in the ground water.

3. Initiate, if necessary, the development of an assessment-level monitoring program to determine the nature and extent of contaminant migration from the pond.

To fulfill these objectives, a program was initiated for the collection of site-specific hydrogeologic data. This chapter discusses the investigative approach, available data base, and investigative methods used to achieve these objectives.

4.1 INVESTIGATIVE APPROACH

Before this investigation, little information existed on the hydrology or geology in the immediate vicinity of the 2101-M Pond. The only hydrogeologic information available near the pond comes from wells 299-E23-2 and 299-E19-1, located approximately 2100 and 1600 ft to the northeast and southwest, respectively, and from semiannual water-table maps. Consequently, more site-specific information was required to characterize the site. The hydrogeologic characterization effort was conducted in concert with the installation of a ground-water monitoring network consisting of four new wells. These wells were also used to obtain hydrogeologic information on the vadose zone and the upper part of the uppermost aquifer at the site. As shown in Figure 3.14, the 2101-M Pond is located in an area of converging and diverging ground-water flow that has created an area of "ponding," characterized by very small gradients. The lack of a significant hydraulic gradient in the area makes the identification of flow directions difficult. Based on the information available on flow directions in this portion of the Hanford

Site, wells were located with one upgradient [southwest of the pond (299-E18-1)] and three downgradient (east and north) of the 2101-M Pond (299-E18-2, 299-E18-3, and 299-E18-4) (Figure 4.1).

The locations of the four new wells were chosen to comply with the requirements for ground-water monitoring systems (40 CFR 265; WAC 173-303). No wells were planned to be drilled to the bottom of the aquifer because 1) the recently installed monitoring wells' locations already enable detection of ground-water contamination, and 2) contamination had likely not reached the water table. If contamination is detected in any of the downgradient wells, a ground-water quality assessment program will be initiated. At that time, more monitoring wells will be installed at different depths in the aquifer, if necessary.

4.2 AVAILABLE DATA

Numerous regional geologic and hydrologic studies are available for the Columbia Plateau, Pasco Basin, and Hanford Site. Many of these studies were discussed in Chapter 3.0. The focus of this section is to describe those published studies and the available data bases that pertain to the hydrogeologic environment of the 200 Areas, particularly the southwest corner of the 200-East Area.

4.2.1 Previous Studies

Hydrogeologic, geochemical, vadose zone, and ground-water hydrology studies of the 200 Areas have been performed over the last 40 yr. Data from these studies are used in this report wherever appropriate; however, the only reports dealing specifically with the 2101-M Pond are the preliminary closure/post closure plan (DOE 1989) and the ground-water monitoring plan (Chamness et al. 1989). The geology discussion in the ground-water monitoring plan for the pond was developed based on the Separations Areas geology described in Tallman et al. (1979), while the hydrology and ground-water flow direction were interpreted from Site-wide water-level measurements (e.g., Schatz and Ammerman 1988), contaminant plumes (e.g., Law et al. 1987), and water-table maps of the nearby U.S. Ecology Site.

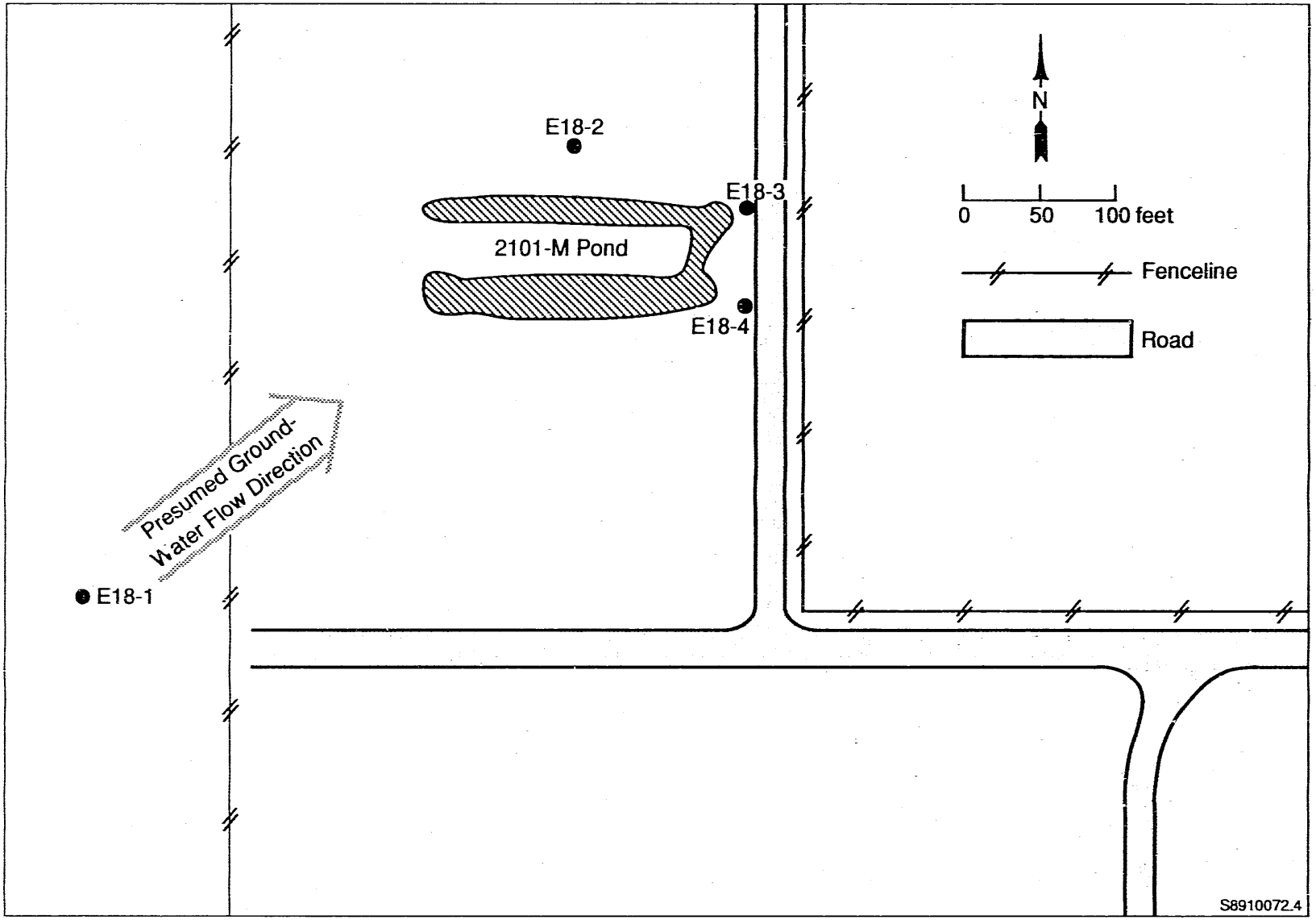

FIGURE 4.1. Locations of the Four New Ground-Water Monitoring Wells Near the 2101-M Pond

4.2.2 Data Bases

Over 1400 wells have been drilled in and near the Separations Areas. Information for wells installed throughout the Hanford Site has been documented by McGhan (1989). Borehole logs (drillers' and/or geologists') of these wells are compiled in three replicate hard copy files (one maintained by PNL and two maintained by WHC). Fecht and Lillie (1982) summarized the borehole logs from the 600 Area (surrounding the Separations Areas). In addition, numerous borehole logs have been summarized and entered into the computerized Hanford Ground-Water Data Base (HGWDB). Borehole sediment samples have routinely been collected from each borehole at 5-ft increments since 1960 and more sporadically before that time (Brown 1960b). These samples are archived in the Hanford Geotechnical Sample Library maintained by WHC. Thousands of the samples have been tested for particle-size distribution and calcium carbonate content. Raw data from these analyses have been entered into the computerized ROCSAN Data Base System maintained by Boeing Computer Services Richland. ROCSAN software calculates weight percentages of the measured size classes and classifies the sediment into one of 19 sediment classes. Geophysical probes have been run in a large percentage of the boreholes on the Hanford Site. The subsequent logs are compiled in hard-copy files maintained by PNL and/or available from published reports (e.g., Jackson et al. 1976; Summers et al. 1975).

Water-level data and ground-water chemistry data from wells throughout the Hanford Site have been entered into the HGWDB. Water-level data have also been documented in previous reports and in semiannual water-table maps (e.g., Schatz and Ammerman 1988). Ground-water chemistry data have been published in annual environmental reports (e.g., Jaquish and Mitchell 1988; Serkowski et al. 1988).

4.3 INVESTIGATIVE METHODS

Data used in the hydrogeologic characterization of the 2101-M Pond site were collected during and after installation of the four ground-water monitoring wells. The data collected can be grouped into the following categories: monitoring well design and installation, geologic sampling,

geophysical logging, well development, aquifer testing, surveying, water-level measurements, sediment sample characteristics, mineralogy and geochemical testing, sediment chemical analysis, and ground-water analyses. This section discusses in detail the methods used to collect and/or generate these data.

4.3.1 Well Installation Program

As discussed earlier, this ground-water monitoring system was designed to meet the requirements of 40 CFR 265 Subpart F and WAC 173-303. The rationale used to design this system, as well as the methods used for its installation, are discussed below.

4.3.1.1 Monitoring System Design

The functional design criteria and requirements for the ground-water monitoring system are described in Chamness et al. (1989). The monitoring wells were constructed according to WHC specifications. The requirements were established to meet the applicable criteria identified in 40 CFR 265 Subpart F and WAC 173-303, as defined below.

The ground-water monitoring system must be capable of yielding representative ground-water samples for analysis and must consist of the following:

- The number, location, and depths of monitoring wells installed hydraulically upgradient of the pond must be sufficient to yield ground-water samples that are 1) representative of background ground-water quality in the uppermost aquifer near the pond, and 2) not affected by the pond.

- The number, location, and depth of monitoring wells installed hydraulically downgradient of the pond must ensure that any statistically significant amounts of dangerous waste or dangerous waste constituents that migrate from the pond to the uppermost aquifer can be immediately detected.

- All monitoring wells must be cased in a manner that maintains the integrity of the monitoring well borehole. This casing must be screened and packed with gravel or sand, where necessary, to enable sample collection at depths where appropriate aquifer flow zones

exist. The annular space above the sampling depth must be sealed with suitable material to prevent contamination of samples and the ground water.

Additionally, it was required that the location and construction details for these monitoring wells should support a plausible compliance monitoring system, and that the design life of the wells should include the active life of the pond plus the 30-yr postclosure period, if necessary. The downgradient wells are located around the perimeter of the 2101-M Pond at distances ranging from 20 to 40 ft from the edge. This distance locates the wells close enough to the pond to "immediately detect" any contaminants in the ground water originating from the pond. The upgradient well (299-E18-1) is located approximately 300 ft from the pond, a sufficient distance to be unaffected by discharges to the pond. The justification of the well locations is discussed in greater detail in Chamness et al. (1989) and is further supported in Chapters 5.0, 6.0, and 7.0.

Based on an engineering study by Kasper and Myers (1987), the preferred final casing and screen material for RCRA wells on the Hanford Site is type 304 stainless steel. The chemical stability and structural strength of this material were deemed adequate to provide service for the design life. The preferred casing and screen size was 4-in. inside diameter (ID). The preferred well construction method was to use cable-tool drilling equipment to drill an oversized borehole temporarily supported by at least 8-in.-ID casing. The actual monitoring well was then constructed inside the borehole. The annular space was sealed using RCRA-acceptable (EPA 1986a) well seal material as the temporary casing was removed. Specifications for well installation at the 2101-M Pond were developed based on the above requirements, preferred design, and construction methods and materials.

4.3.1.2 Monitoring Well Installation

Four wells were installed around the 2101-M Pond to a depth of approximately 330 ft, or 20 ft into the uppermost aquifer. Boreholes were drilled with cable-tool drill rigs using drive-barrel (when drilling conditions permitted) or hard-tool methods. When using the drive-barrel method, a drive barrel (a short length of heavy-walled pipe) is driven into the sediments and withdrawn, and the sediment is removed from the drive barrel. This drilling

method yields samples of geologic materials that are representative of the actual moisture content and grain-size distribution. However, this method is difficult to use when gravels are very large or when sediments are saturated, at which time hard-tool drilling is used. Hard-tool drilling consists of driving a solid metal bit into the sediments, breaking them up, and mixing them with added water to form a slurry, which is then bailed out of the borehole. The bailed slurry provides samples for geologic characterization.

Boreholes were drilled to depth using successively smaller sizes of temporary carbon steel casing to support the walls of the borehole. The casings were telescoped one inside the other, so that each size of casing was in contact with 140 to 165 ft of sediments. The exception to this was well 299-E18-3, which used only 20 ft of larger diameter casing. Telescoping the casing facilitated its extraction once the final stainless steel casing was in place. The beginning casing was 10 in. in diameter, telescoping down to the 8-in.-dia casing that was used to drill to the final depth. A straightness test was then performed by running 20 ft of 6-in. or 7-in. stainless steel casing or 8-in. telescoping screen down the borehole. If it passed smoothly, the well was deemed acceptable. A 20-ft-long, 10-slot, 8-in., telescoping stainless steel screen was then installed for use in aquifer testing and/or as an additional sediment filter for the final well screen. The temporary screen was left in the borehole as an additional sediment filter. The wells were completed with 20 ft of 4-in., 20-slot, stainless steel screen extending 16 to 18.6 ft into the unconfined aquifer. This depth will allow ground-water sampling if water levels should rise 2 to 4 ft or decline as much as 10 ft.

Silica sand was used to backfill the hole to the depth desired for setting the 4-in. stainless steel screen and casing. Once the stainless steel permanent casing and screen were set in the hole, silica sand was used to fill the annulus between the 8-in. and 4-in. casing to approximately 5 ft above the top of the stainless steel screen. The temporary casing was extracted as the sand pack and bentonite seals were installed. Approximately 5 ft of bentonite pellets were then placed on top of the sand pack. Bentonite granules or crumbles were used to fill the annulus to within 18 to 22 ft

below ground surface. Cement grout was placed on top of the bentonite crumbles to within 3 ft of the surface, and the remainder of the seal and the pad were filled with concrete.

Because the hydraulic gradient is so small in this area, special care must be taken when measuring water levels. To minimize potential sources of measurement error an A-1 Sure Shot™[a] Deviation Recording Instrument was run down each completed well several times. This tool provided a record of the degrees of borehole deviation from vertical at any given point. The data are considered semi-quantitative because deviation was only measured once every 50 ft, and the direction of deviation could not be measured. The total deviation for each borehole and correction factors for depth measurements were then approximated. The correction factors needed for more accurate water-level measurements are discussed in Chapter 6.0.

The well construction was documented on 1) geologists' drill logs, 2) as-built diagrams, 3) Well Completion Report/Title III Inspection Lists, and 4) geophysical logs, all of which are provided in Fruland et al. (1989a). Simplified as-built diagrams of the completed wells and the geophysical logs are presented in Appendix A of this report.

4.3.2 Geologic Sampling

Two 1-pint sediment samples were collected every 5 ft and/or at changes in lithology. Where possible, the sampled materials were recovered from the borehole using a drive barrel. A sample was also collected for moisture content analysis from each sampled interval above the water table that was retrieved by a drive barrel. Where hard-tool drilling was necessary, the sampled materials were recovered with a bailer. Each sample was described by the well-site geologist and recorded on the geologists' log. These descriptions included a textural name, estimated particle-size distribution, sorting, gross mineralogy, clast roundness, color, reaction to hydrochloric acid, consolidation, changes from previous sample, and any unusual findings. The collection and documentation of these samples were performed in accordance

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(a) A-1 Sure Shot is a tradename of the A-1 Bit and Tool Company, Oklahoma City, Oklahoma.

with the procedures given in Last and Liikala (1987). A summary of the geologic materials penetrated by each borehole is recorded on the as-built diagrams presented in Appendix A.

Additional samples were taken at unusually moist zones for moisture content, particle size, and calcium carbonate content. A total of seven sediment samples were also collected from two of the wells for chemical and x-ray fluorescence analysis. Additional samples were tested for saturated hydraulic conductivity and water retention. All of these are discussed in detail below.

4.3.3 Borehole Geophysical Logging

Borehole geophysical logging was done following PNL procedures in place in 1988, which provided logs suitable for the qualitative interpretations desired. Calibration of the probes at that time was performed by running them down a specific borehole quarterly and comparing the response to responses in the past and adjusting the probe until the two were similar. At the time of the logging, the boreholes were cased with both 8- and 10-in. carbon steel casing, one telescoped inside the other. The presence of multiple casing attenuates the responses, but the logs, particularly the natural gamma logs, can still provide useful information such as indicated below.

Each borehole was geophysically logged when it reached its maximum depth before well completion. Three different geophysical tools were used to log the borehole: natural gamma, neutron-epithermal-neutron, and gamma-gamma. These logs are intended only to provide qualitative hydrogeological information. The natural gamma probe assists in identification and correlation of hydrogeologic units between boreholes and vertical changes within a borehole. Natural gamma logs are particularly useful in distinguishing fine-grained sedimentary units on the Hanford Site (DOE 1988) because generally these units naturally emit more gamma radiation than do coarse-grained sediments. The natural gamma logs are provided along with the as-built diagrams in Appendix A. The neutron and gamma-gamma logs were taken as a record of conditions before well completion and were not used for correlation purposes in this report.

4.3.4 Well Development

Well development removes drilling fluids from the well and fine-grained materials from around the well screens, enabling the wells to provide representative samples of ground water. Well development was generally conducted at one or both of the following times: initial development (when the well is pumped after installing a telescoping screen but before installing final well materials) and final well development (after the final well materials are installed). Predevelopment bailing and sampling were also conducted at every borehole.

Initial development was conducted only in borehole 299-E18-3. Final well development was conducted at each well after completion. The following subsections discuss the methods used in each stage of well development.

4.3.4.1 Predevelopment Sampling

Ground-water samples were collected from each borehole before the initial well development to determine if chemical constituents in the ground water were within acceptable limits for discharging purged waters to the ground. These predevelopment sampling data were not intended for determining the level of contamination in the ground water. These samples were collected using a Teflon®[a] bailer and were then analyzed by the United States Testing Company, Incorporated (UST), Richland, Washington. The chemical constituents analyzed for included volatile organic constituents, gross alpha, gross beta, gamma scan, and metals. Results of these analyses (given in Appendix B) indicated that the levels of these constituents were within WHC's guidelines; therefore, the water quality was acceptable for discharging purged water to the ground.

4.3.4.2 Initial Well Development

Most wells were initially developed by bailing until borehole fluids were cleared of most suspended sediment, as determined by the well-site geologist. A submersible pump was installed in well 299-E18-3 for initial development and to conduct an aquifer test. During initial development of

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(a) Teflon is a registered trademark of E. I. du Pont de Nemours and Company, Wilmington, Delaware.

this well, it was discovered that the sediments had a much lower permeability than first anticipated; therefore, it was decided to conduct aquifer tests in this and other wells after installation of the final well materials. Initial well development with a submersible pump was not conducted in any other well.

4.3.4.3 Final Well Development

Final development was conducted primarily by pumping, increasing the flow rate in steps, and using a pumping and surging technique. Each well was developed until the water was virtually free of suspended sediment (<5 nephelometric turbidity units), as measured in the field. The wells were pumped with a 1.5-hp submersible pump at a discharge rate ranging from 1 to 9 gallons per minute. A HydroStar™[a] sampling pump was installed in each well following development.

Specific information concerning development of each well is documented in drill logs included in Fruland et al. (1989a) or on the aquifer test data sheets (Appendix C).

4.3.5 Aquifer Testing

The purpose of hydrologic testing was to collect information on the transmissivity, hydraulic conductivity, and, if possible, storativity of the uppermost aquifer beneath the 2101-M Pond. The ground-water monitoring plan called for constant discharge and recovery tests in two of the four wells (299-E18-1 and 299-E18-3) to estimate these three aquifer parameters. The quality of all the test results are limited because the wells were designed specifically for ground-water monitoring and not for aquifer testing. In addition, none of the wells fully penetrated the aquifer, and tests could not be performed over long periods.

Aquifer pumping tests were conducted in wells 299-E18-1 and 299-E18-3. The test at well 299-E18-1 was a single-well test, and the test at well 299-E18-3 was a multiple-well test, using wells 299-E18-2 and 299-E18-4 as observation wells. Water-level data were collected at wells 299-E18-2 and

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(a) HydroStar is a tradename of Instrumentation Northwest, Inc., Redmond, Washington.

299-E18-4 during their redevelopment. The length of the tests was limited by the schedule for installing sampling pumps and initiating sampling.

An initial aquifer test conducted within the telescoping screen in well 299-E18-3 was unsuccessful because the permeability of the aquifer materials was much lower than expected. To minimize scheduling delays, the test was conducted after the well was completed. Tests in all of the wells were consequently conducted within the completed 4-in.-dia monitoring wells.

Water-level responses were measured during both the drawdown period and during the recovery period (after pumping had been terminated). These measurements were made using an electric water-level indicator (E-tape) and/or a data logger and pressure transducer system. E-tape measurements are believed to have an absolute accuracy of ±0.5 ft relative to actual water-level elevations. Precision capabilities with E-tape systems are expected to be within ±0.05 ft relative to water-level changes during aquifer testing.

Pressure transducers were also used to measure the changes in the water level. The transducers used are model number PS-7000, marketed by Instrumentation Northwest, Inc., Redmond, Washington. These are capable of measuring pressure ranges of 0 to 5 and 0 to 10 psi and have a repeatability of no more than ±0.025% of full scale. This translates to ±0.0125 psig (0.029 ft) for a 0 to 5 psig transducer, and ±0.025 psig (0.058 ft) for a 0 to 10 psig transducer. Model TERRA 8®[a] data loggers were used, which are capable of resolving 1 part in 1000 over the full range of the transducer. The calibration (repeatability) of four transducers and two data loggers was tested at WHC's Engineering Development Laboratory in April 1989. These transducers and data loggers did not necessarily include those used for the 2101-M Pond aquifer tests. The results of the calibration tests indicated three transducers had a repeatability of 6% to 8%, and the fourth transducer had a repeatability of approximately 3%. The implication of these results to data collected during the 2101-M aquifer tests is unknown. Pressure data collected with the transducer systems during the 2101-M tests did not exhibit the extreme variability or noise that was indicated by the calibration tests.

(a) TERRA 8 is a trademark of Terrascience Systems Ltd., Vancouver, B.C., Canada.

Therefore, it is concluded that the transducer systems used during the 2101-M tests provided pressure data capable of estimating aquifer properties; however, the uncertainty of the pressure data cannot be quantified.

The solutions used to analyze the data include the Cooper-Jacob (Cooper and Jacob 1946) straight-line method (where $u \leq 0.01$) and the Theis (1935) type-curve fitting method, described by Wenzel (1942). These methods are discussed in Lohman (1972). Assumptions inherent in these solutions include the following:

- The aquifer is confined, homogeneous, and isotropic.
- The aquifer is of infinite areal extent.
- The well penetrates the entire thickness of the aquifer.
- The pumped well has an infinitesimal diameter and is 100% efficient.
- Water is instantaneously released from storage.

It is recognized that these assumptions were not all rigorously met for aquifer testing at the 2101-M Pond; however, this does not severely limit use of the analytical solutions for hydraulic property determinations (Driscoll 1986).

Constraints imposed by the well designs (i.e., partially penetrating the aquifer thickness) result in violation of the assumption that the wells fully penetrate the aquifer. Vertical movement can be induced in the vicinity of partially penetrating wells, affecting ideal drawdown responses.

A correction factor derived by Jacob (1963) should be applied to drawdown data from unconfined aquifers when the drawdown exceeds 10% of the aquifer thickness (USDI 1985). The maximum drawdown measured during the 2101-M tests was about 6%, based on a presumed thickness of 50 ft; therefore, no corrections were warranted. Specific analyses for unconfined aquifers (e.g., Boulton 1963) where delayed yield and/or vertical flow components exist were considered; however, the data are not sufficient to utilize these methods.

Insufficient stress was imposed, so very little drawdown (a few hundredths of a foot) or even no measurable drawdown resulted in some cases. Some of the water-level measurement data have limitations, as discussed later. Aquifer heterogeneity or other factors also appeared to affect some of the data. For these reasons, the resulting values are considered to be qualitative, indicating the range of transmissivity values beneath the 2101-M Pond.

Baseline water-level data were obtained for well 299-E18 3 between July 15 and 20, 1989. A daily, cyclic fluctuation of up to 0.10 ft was observed, with the lowest water levels in the daily cycles occurring between approximately 6:00 and 9:00 a.m., and the highest water levels occurring between approximately 4:00 and 7:00 p.m. These fluctuations correspond to daily atmospheric pressure fluctuations and indicate some degree of barometric efficiency in the well; however, the barometric data and water-level data could not be adequately correlated over short periods. Therefore, no attempt was made to correct water-level data collected during aquifer tests with barometric data.

The pumping well drawdown data were evaluated to determine when well casing storage effects were no longer a factor, after an equation by Ramey et al. (1973).

$$t_c = \frac{0.6\,(d_c^{\,2} - d_p^{\,2})}{Q/s}$$

where t_c = the time when casing storage effect becomes negligible, in minutes

d_c = inside diameter of well casing, in inches

d_p = outside diameter of pump column pipe, in inches

Q/s = specific capacity of the well in gallons per minute per foot of drawdown at time t_c.

In cases where log-log plots of drawdown versus time were made, an evaluation of borehole storage effects was conducted using the method discussed by

Earlougher (1977). Wellbore storage is no longer important, and semilog data analysis techniques apply about one cycle in time after the log-log data plot starts deviating significantly from the unit-slope straight line. When applicable, this method is preferred over that presented by Ramey et al. (1973) because it indicates exhibited behavior within the well.

The wells used for each test, discharge rates and durations, water-level data collected (drawdown and/or recovery), and water-level measurement methods are discussed below in the subsections describing individual aquifer tests. The analyses for each test are also discussed below. The data collected for the tests, the figures showing the plotted data, and the solutions are given in Subsection 6.3.3.

4.3.6 Surveying

Each well was surveyed by Kaiser Engineers Hanford following the completion of all the wells. The center of the well casing was surveyed for its horizontal position relative to the Hanford Plant Coordinate System. The accuracy of these measurements is estimated to be ±0.5 ft. A point, marked with an "X," at the top edge of the casing (usually the north side of the casing) and the brass survey marker in the well pad were also surveyed for their vertical elevation relative to the 200-East datum. The accuracy of these measurements is estimated to be ±0.02 ft. The coordinates and elevation are provided on the appropriate as-built diagrams (Appendix A).

4.3.7 Water-Level Measurements

In addition to collecting the water-level measurements required immediately before sampling, water-level measurements have been collected periodically from each new well at the pond and several nearby wells since October 1988. Water-level measurements are repeated for each well until two measurements are within ±0.02 ft, following PNL procedure WL-1 in PNL-MA-567 (PNL 1989a) or its predecessor. Each of the steel tapes used for water-level measurements is calibrated against a standardized steel tape to ±0.10 ft. All water-level measurements have been corrected as accurately as possible for the known vertical deviation of the well. The total possible error on the water-level measurements is approximately ±0.15 ft. These data have been

reported in the quarterly reports on RCRA projects at the Hanford Site (e.g, Fruland et al. 1989b). Hydrographs are presented in Subsection 6.3.2.

4.3.8 Physical Testing of Sediment Samples

Sediment samples were analyzed for their hydrogeologic characteristics in PNL's soil laboratory. Nearly all drive-barrel samples were analyzed for field moisture content, while selected drive-barrel samples were tested for saturated hydraulic conductivity and water retention. Both drive-barrel and hard-tool samples were analyzed for particle-size distribution and calcium carbonate content. Many samples were also tested in the field for sediment pH.

4.3.8.1 Water Content (Field Moisture)

Samples collected for moisture analyses were placed in airtight containers, sealed with tape, and enclosed in plastic bags to prevent moisture loss. At the end of each day, the samples were placed in a refrigerator, where they remained until the analysis was run, usually the next working day. After the plastic bag was removed, the entire sample was weighed, oven-dried at 105°C for 24 h, and reweighed in accordance with American Society for Testing and Materials (ASTM) procedure D 2216 (ASTM 1986). These data are presented in the borehole correlation charts in Appendix D.

4.3.8.2 Particle-Size Analysis

Particle-size analysis was done using the sieving procedure outlined in Uebelacker (1980). Sieve analysis was done on either the moisture samples (after their moisture content had been measured) or on one of the two pint-jar samples collected during drilling at each sample interval. Sieve sizes consisted of those with 4.00-, 2.00-, 1.00-, 0.50-, 0.25-, 0.125-, 0.063-, and 0.043-mm sieve openings. The weight of sediment retained by each sieve was then determined. The procedure was modified in that instead of splitting each sample down to 150 g, the entire sample from the moisture sample or pint jar was sieved.

The raw data were then entered into the ROCSAN data base system, and the ROCSAN program was run. This calculated the total weight percent and particle-size distribution of the sample, and classified the sample

according to one of the 19 sediment classes described in Figure 4.2. The classification scheme is based on Folk (1968) and Tallman et al. (1979). The ROCSAN output is presented in Appendix D.

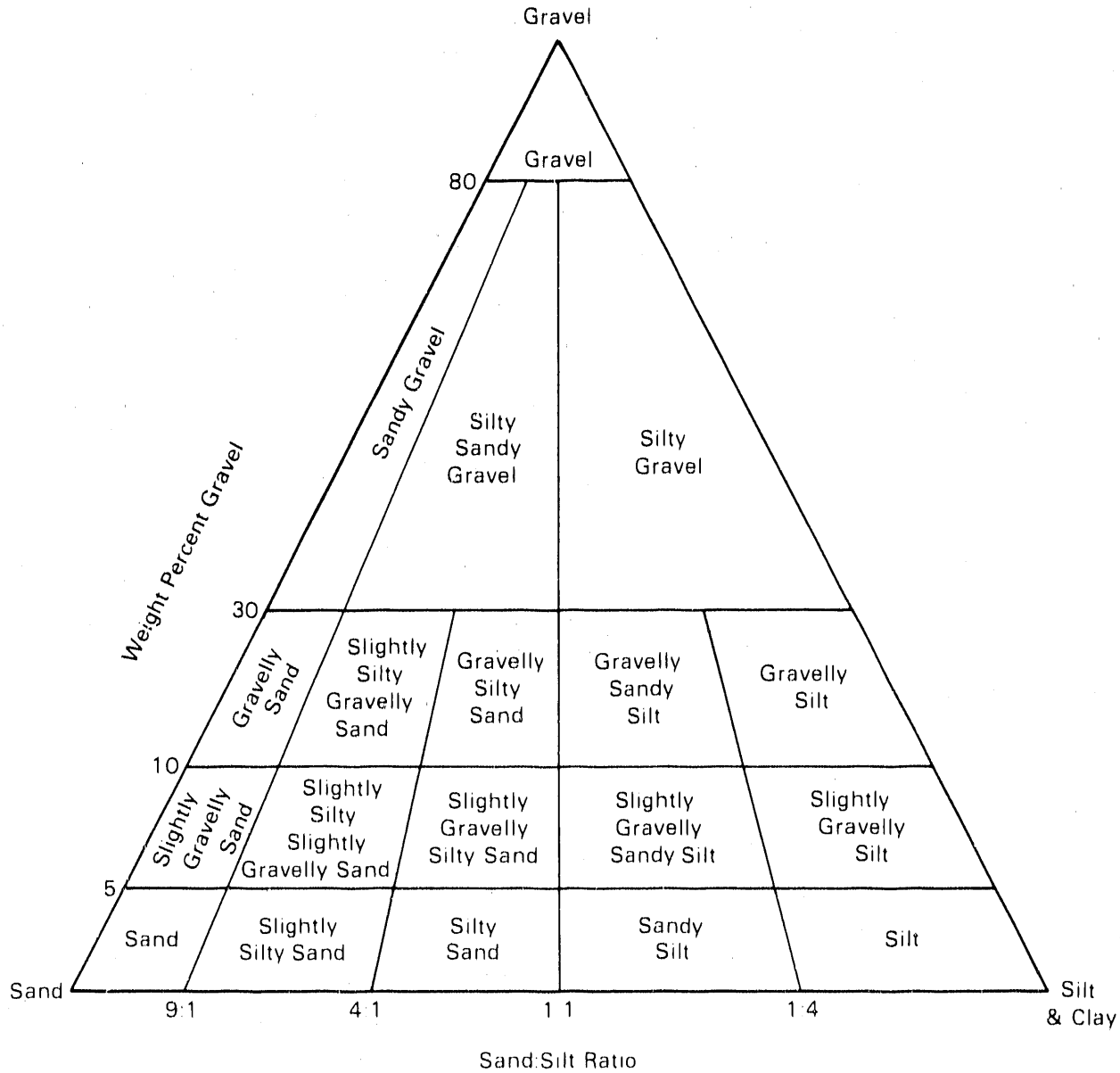


FIGURE 4.2. Sediment Classification Scheme [modified after Tallman et al. (1979)]

4.3.8.3 Calcium Carbonate Analysis

Calcium carbonate content was determined for each of the samples analyzed for particle-size distribution using a volumetric calcimeter method described by Nelson (1982). These data, given as $\%CaCO_3$, were also entered into the ROCSAN data base and are included in the ROCSAN output in Appendix D.

4.3.8.4 Hydraulic Conductivity

Hydraulic conductivity measurements were made on 14 selected drive-barrel samples from the vadose zone. These measurements were made using the constant-head method described by Klute and Dirksen (1986). For this procedure, the loose sediment was packed into a cell 5.36 cm in diameter by 3 cm high, until a bulk density of approximately 1.6 g/cm^3 was reached. The ends of the cell were closed with lids having an inflow valve at one end and an outflow valve at the opposite end. The inflow valve was then connected to the constant-head device, and the outflow valve was connected to a collection vessel. After sample saturation, an initial time was recorded and the water allowed to flow through the sample for a predetermined amount of time. The amount of water discharged from the sample was then recorded, and the hydraulic conductivity calculated. These data are presented and discussed in Section 6.2.

4.3.8.5 Water Retention

Water-retention characteristics were measured on five selected drive barrel samples used in the hydraulic conductivity analyses. Measurements were made at 2.5-, 5-, 10-, 15-, 20-, 25-, 30-, 40-, 50-, 75-, and 100-cm head pressures using hanging water columns. Pressure plate extractors were used for 500-, 1000-, and 3000-cm head pressures. These measurements were made following the procedure given in Klute (1986).

Hanging water-column analyses were performed using the sediments from the same depths and wells as were used in the hydraulic conductivity analyses. The hanging water column is made by creating a continuous column of water from the bottom of the porous plate through a cork in the neck of the funnel and into a narrow tube long enough to allow measurement of the

desired pressure heads. The pressure head is measured from the center of the soil cell, which is in continuous contact with the column of water to the open end of the tubing (i.e., the open water surface). After equilibrium is reached at each head level, the soil cell is weighed, and the weight is recorded. After the final head value equilibrium has been achieved, the sample is oven dried, and the water content at each level is calculated.

For the pressure plate extractor analyses, samples were packed into containing rings on a porous plate and allowed to stand for 24 h. Equilibrium water contents were obtained by pressure-draining the samples in the extractor at the desired test level. At the end of each pressure run, the samples were weighed and oven-dried to determine the moisture content at that pressure. The results of these analyses are discussed in Section 6.2.

4.3.8.6 Field Measurements of Sediment pH

Many of the lithologic samples collected during drilling were tested for their pH using a portable pH meter. This was done to detect noticeable changes in the pH of the sediments from normal or background levels that could indicate the presence of acids originally discharged to the pond. The manufacturer's instructions for use of the instrument were followed by the field geologists in making these measurements. Well 299-E18-4 was the first well drilled, and at that time, pH measurements were taken only when unusual moisture contents were encountered. The availability of only one pH meter also prevented some samples from the other wells from being tested; otherwise, all of the samples collected during drive-barrel drilling were tested. These data are discussed in Subsection 5.3.3 and are provided graphically in the appropriate borehole correlation charts in Appendix D.

4.3.9 Mineralogy and Geochemical Testing

Selected borehole samples were tested for various mineralogical and geochemical characteristics. These tests included modal analysis of the mineralogy and analysis of the whole rock chemistry using x-ray fluorescence (XRF).

4.3.9.1 Mineralogy

Six sediment samples, representative of each of the major textural units beneath the 2101-M Pond, were sieved to remove grains larger than 1.0 mm and smaller than 0.125 mm. The sieved samples were then washed to remove any fine silt or clay clinging to the grain surfaces. A small representative portion of the washed sample was used to prepare a polished grain mount that is analyzed using energy dispersive x-ray analysis (EDX) and the back-scattered electron detector in an electron microprobe. The analyses were conducted according to PNL technical procedures. The EDX analyses were used as a preliminary way to identify the minerals in each grain mount.

Modal analysis of the samples was done using the reflected light illumination on a petrographic microscope. The stage was fitted with an automatic point-counter. A representative sample of the sieved, dried sand was mounted on double-sided tape, which was then mounted on the automatic point-counter. The tape held the particles gently in place, allowing the grains to be moved if necessary. The results of the point counting are provided and discussed in Subsection 5.3.2.

4.3.9.2 X-Ray Fluorescence Analyses

The seven borehole samples analyzed for volatile organic compounds (VOCs) (see Subsection 4.3.10) were also analyzed for metals content using XRF. Pacific Northwest Laboratory performed the analyses using approved procedures (PNL-SP-19, Rev. 0). Because no contamination by metals was found in the vadose zone, these data provide information on the whole rock, major element composition of the sediment samples. These data are provided in Appendix D and are discussed in Subsection 5.3.3 of this report.

4.3.9.3 Inductively Coupled Plasma (ICP) Analyses

Nine sediment samples were analyzed for ICP metals to provide contaminant data for comparison with soil samples taken from the bottom of the pond and to provide information on the wells and depths not sampled for XRF analyses. These samples were collected from the pint-sample jars that are normally used for archive and sieving purposes. These samples had not been collected for analytical purposes using stainless steel sampling equipment,

and had not been kept at 4°C. Therefore, these results are used for comparative and semi-quantitative purposes. The data are discussed in Subsection 5.3.3 and are provided in Appendix D.

4.3.10 Sediment Chemical Analyses

Seven sediment samples were collected during drilling and analyzed for VOCs. Samples were collected by scraping sediments from the center of the drive barrel (i.e., not touching the walls of the drive barrel) into a clean stainless steel bucket. These sediments were then quickly placed in a small vial, leaving as little head space as possible. Samples were kept in a cooler until delivered to UST, generally the same day. As discussed above, XRF and ICP analyses were also run on sediment samples to identify any gross metals contamination.

4.3.11 Ground-Water Chemical Analyses

Water samples were collected and analyzed quarterly from the four wells (299-E18-1, 299-E18-2, 299-E18-3, and 299-E18-4). Quarterly sampling began the third quarter of Calendar Year 1988; the fourth quarterly sample was collected in May 1989. Ground-water samples were analyzed for parameters required by 40 CFR 265.92. In addition, constituents included in the "long list" (40 CFR 264, Appendix XIII, and WAC 173-303-9905) were analyzed from samples collected in November 1988. Results of chemical analyses have been presented in quarterly reports for RCRA projects at Hanford (Fruland et al. 1989a, 1989b; Smith et al. 1989) and are summarized in Appendix B. Appendix B also provides a list of all constituents analyzed from August 1988 through September 1989 and the results for constituents that were detected at least once.

All sampling activities have been performed by PNL personnel. United States Testing Company, Incorporated, conducted sample analyses through August 1989. The water samples have been collected according to PNL procedures (PNL 1989a). Chain-of-custody procedures (PNL 1989a) are followed, providing a history of custody for each sample. Analytical methods used and preservation techniques are given in the ground-water monitoring plan for the 2101-M Pond (Chamness et al. 1989). Quality assurance/quality control for the analyses is discussed in Section 7.3.

5.0 GEOLOGY OF THE 2101-M POND

This chapter provides an interpretation of the geology beneath the 2101-M Pond. This interpretation is based on the field description and laboratory analyses of borehole samples for the four monitoring wells installed in 1988 around the pond. Information available from published reports also aided this interpretation. The term "mud" is used in this report to denote undifferentiated silt and clay. The terms silt and clay are used only when they have been positively identified.

5.1 INTRODUCTION

Samples of the geologic materials encountered in each new borehole were collected at 5-ft intervals and at major lithologic changes. These sediment samples were obtained via one of two cable-tool drilling methods: 1) drive barrel, or 2) hard tool. The drive-barrel method produces representative samples, which, when analyzed for grain size, reflect an accurate measurement of the true grain-size distribution. The hard-tool method, which uses a heavy metal bit to break up the gravels and adds water to form a mud slurry, produces a disturbed sample. These hard-tool samples can produce granulometric results that are skewed more toward the finer-grained fractions than what might have resulted from an undisturbed sample. With either method, however, the variation caused by the drilling and sampling methods is expected to be less than the natural variation in the sediments (Brown 1960b).

Well-site geologists followed the standard procedures and guidance documented by Last and Liikala (1987) for collecting and describing the borehole samples. These sample descriptions systematically included a preliminary textural classification (after Folk 1968 and Tallman et al. 1979) and estimates of particle-size distribution, sorting, gross mineralogy, roundness, color, reaction to hydrochloric acid, and relative consolidation. In addition, each sampled interval was analyzed in the laboratory for its particle-size distribution and calcium carbonate content and, where possible, for moisture content.

The stratigraphic units penetrated by the new monitoring wells were identified from the field descriptions and laboratory results based on the characteristics given in Table 5.1 as originally presented in DOE (1988). Textural units were identified within the stratigraphic units whenever distinct changes were observed between successive depths and between several boreholes. Distinct changes unique to a single borehole were interpreted as a discontinuous lens. Minor changes in individual borehole samples are interpreted to reflect the natural variations, and, to a lesser degree, some sampling variation within a given textural unit.

The following discussions describe the geomorphology and the geology of the area surrounding the 2101-M Pond.

5.2 GEOMORPHOLOGY

The topography of the 200 Areas is the result of two geomorphic processes: 1) Pleistocene cataclysmic flooding, and 2) Holocene eolian activity. Cataclysmic flooding created Cold Creek Bar (Bretz et al. 1956), a prominent flood feature upon which the 200 Areas sit (see Figure 3.3). The last flood(s) covered the 200 Areas with a blanket of coarse-grained deposits, which become finer grained to the south. The northern boundary of the flood bar is defined by an erosional channel running east-southeast before turning south near B Pond. This erosional channel formed during waning stages of flooding as flood waters drained from the basin (Bjornstad et al. 1987). The northern half of the 200-East Area lies within this flood channel (Figure 5.1).

Since the end of the Pleistocene, winds have locally reworked the surface of the glaciofluvial sediments, depositing a veneer of eolian sand in places. Holocene sand dunes are present along the southern portion of the 200-East Area (Figure 5.1) including the vicinity of the 2101-M Pond.

The terrain surrounding the 2101-M Pond dips very gently to the north, with an average slope of approximately 3.8 ft/1000 ft (less than 0.25°) (Figure 5.2). The ground surface elevation ranges from approximately 715 ft near the southwest corner of the site to approximately 720 ft on the berms adjacent to the pond. Most of the area adjacent to the pond has been graded and

TABLE 5.1. Characteristics Used to Distinguish Sedimentary Units (modified from DOE 1988)

Formation	Hanford formation		Plio-Pleistocene unit		Ringold Formation				
Unit / Subunit	Pasco Gravels	Touchet Beds	Fanglomerate Facies	Calcrete Facies	Upper	Middle	Lower	Basal	
								Fine grained	Coarse grained
Thickness, ft	300	210	10	85	0 to 108	180 to 328	0 to 56	0 to 66	20 to 151
Texture	Sandy gravel to gravelly sand	Sand to mud	Muddy sandy gravel	Mud to sand	Sand to mud, occasional gravel	Sandy gravel	Mud	Mud to sand	Gravelly sand to sandy gravel
Sedimentary Structure									
Primary	Large-scale foreset bedding	Graded bedding, planar to ripple lamination	Crude sub-horizontal bedding	Not present	Planar-tabular cross bedding, ripple lamination	Crude sub-horizontal bedding	Moderately to well laminated	Ripple lamination	Planar lamination, crude sub-horizontal bedding
Secondary	Occasional caliche	Load structures, clastic dikes, occasional caliche	Intercalated caliche layers	Pedogenic platy to massive calcrete, bioturbation	Load structures	Not present	Not present	Pedogenic blocky alteration, caliche stringers and nodules, bioturbation	Not present
Roundness of gravel, (mode/range)	Subrounded/ angular to well rounded	Not applicable	Subangular/ angular to subangular	Not applicable	Well rounded/ subrounded to well rounded	Well rounded/ subrounded to well rounded	Not applicable	Not applicable	Well rounded/ subrounded to well rounded
Sorting	Poor	Poor to moderate	Poor	Poor	Moderate to well	Moderate to well	Well	Poor to well	Moderate to well
Natural-gamma activity	Low	Moderate to high	Low	Moderate to high	Moderate to high	Low	High to very high	Low to high	Low to moderate
Basalt content									
Framework (%)	50 to 90	Not applicable	90 to 100	Not applicable	20 to 40	20 to 40	Not applicable	Not applicable	10 to 50
Matrix (%)	10 to 30	10 to 30	75 to 100	0 to 10	5 to 20	5 to 20	Not present	0 to 75	5 to 20
$CaCO_3$ (relative abundance/ occurrence)	Moderate/rinds on gravel, reworked caliche clasts	Moderate/fine grained and disseminated	Low-high, intercalated pedogenic layers	High/advanced pedogenesis, massive to platy	Low/occasional coatings or cement	Low/occasional coatings or cement	Not present	Low to high/ caliche stringers and nodules	Low/occasional coatings or cement
Environment of deposition	Glaciofluvial (high energy)	Glaciofluvial (low energy)	Fluvial/colluvial (side-stream facies)	Subaerial	Fluvial (low energy)	Fluvial (high energy)	Lacustrine and (or) fluvial (low energy)	Fluvial (low energy to subaerial)	Fluvial (high energy)

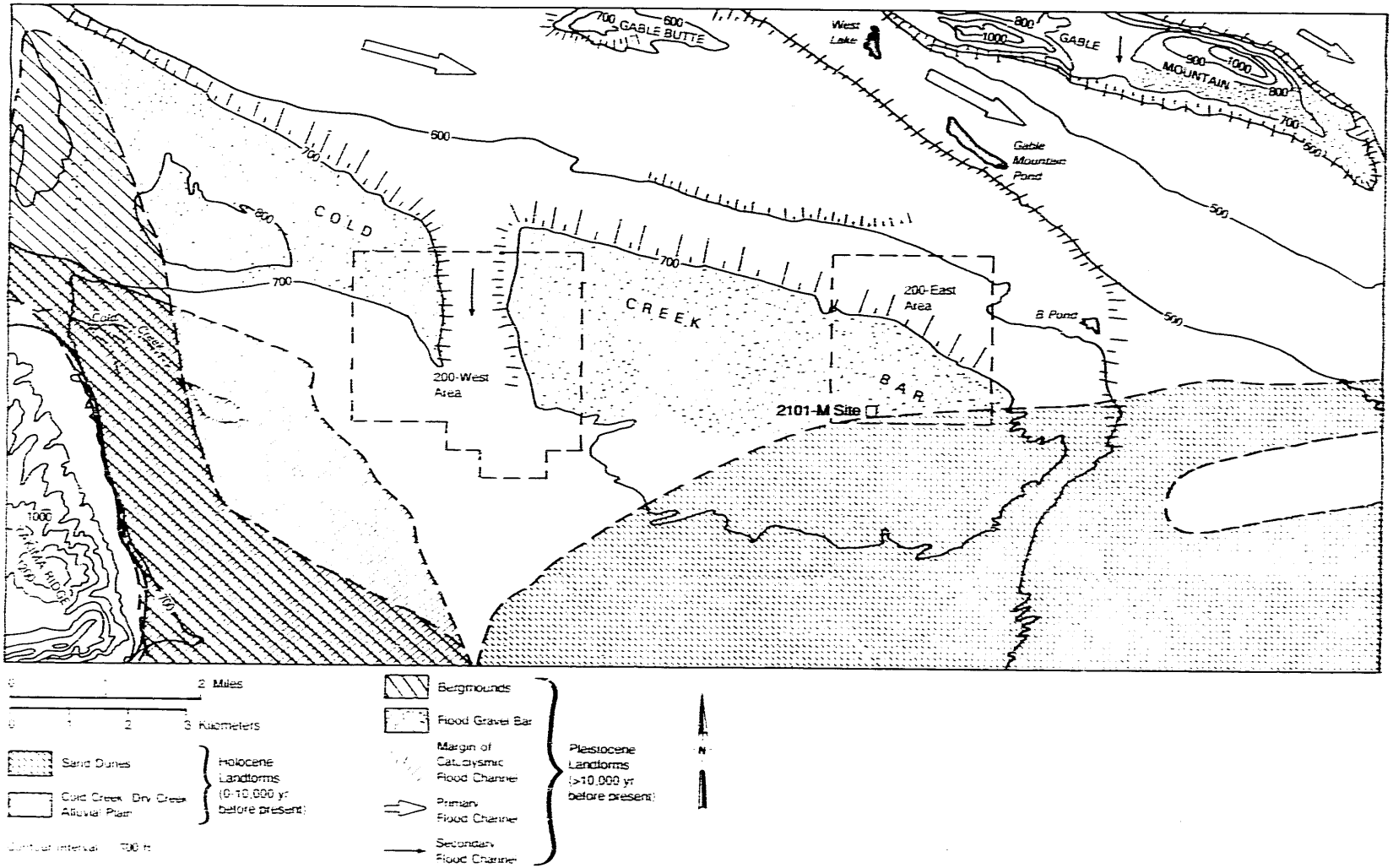


FIGURE 5.1. Geomorphic Features Surrounding the 200 Areas

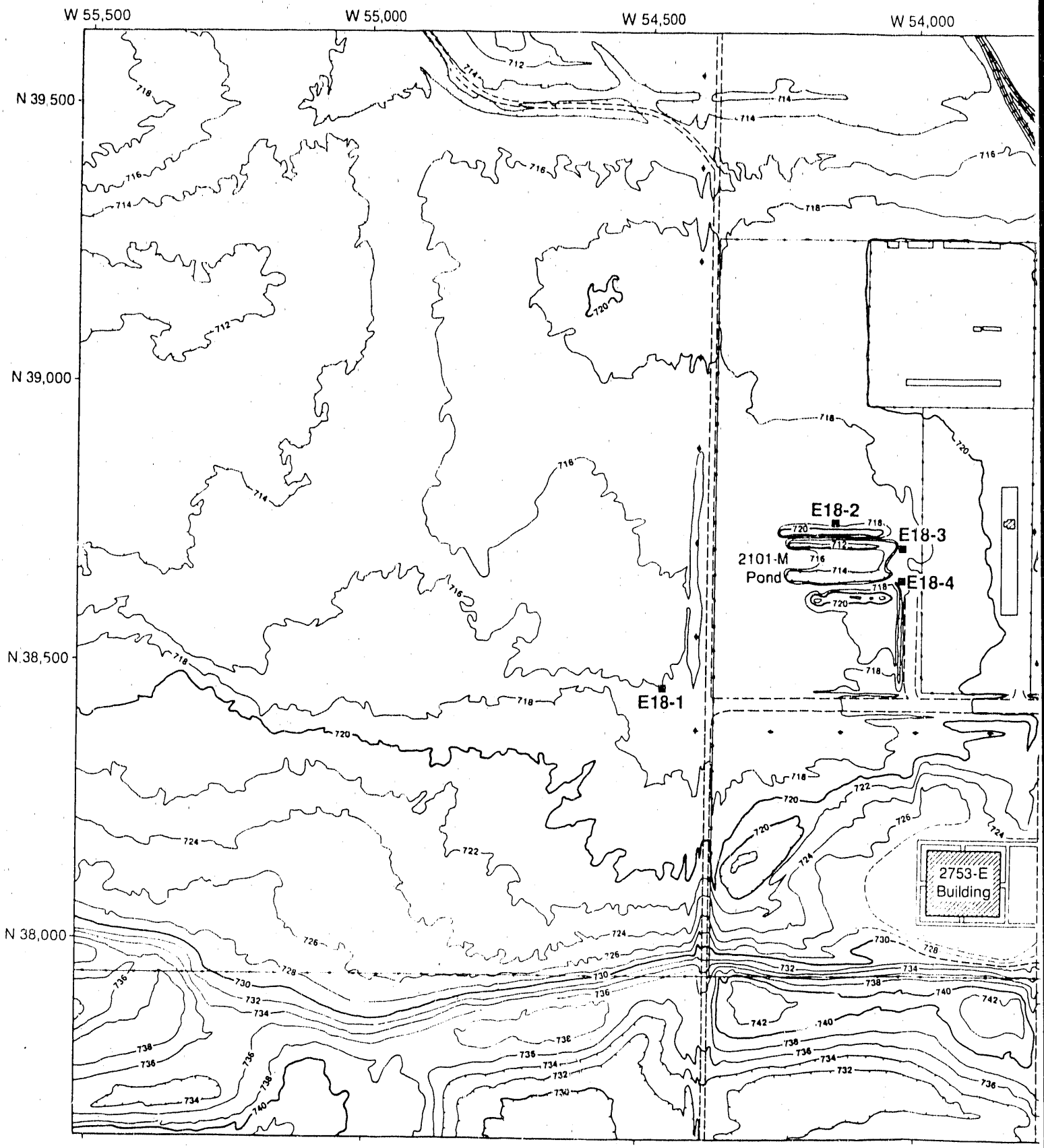
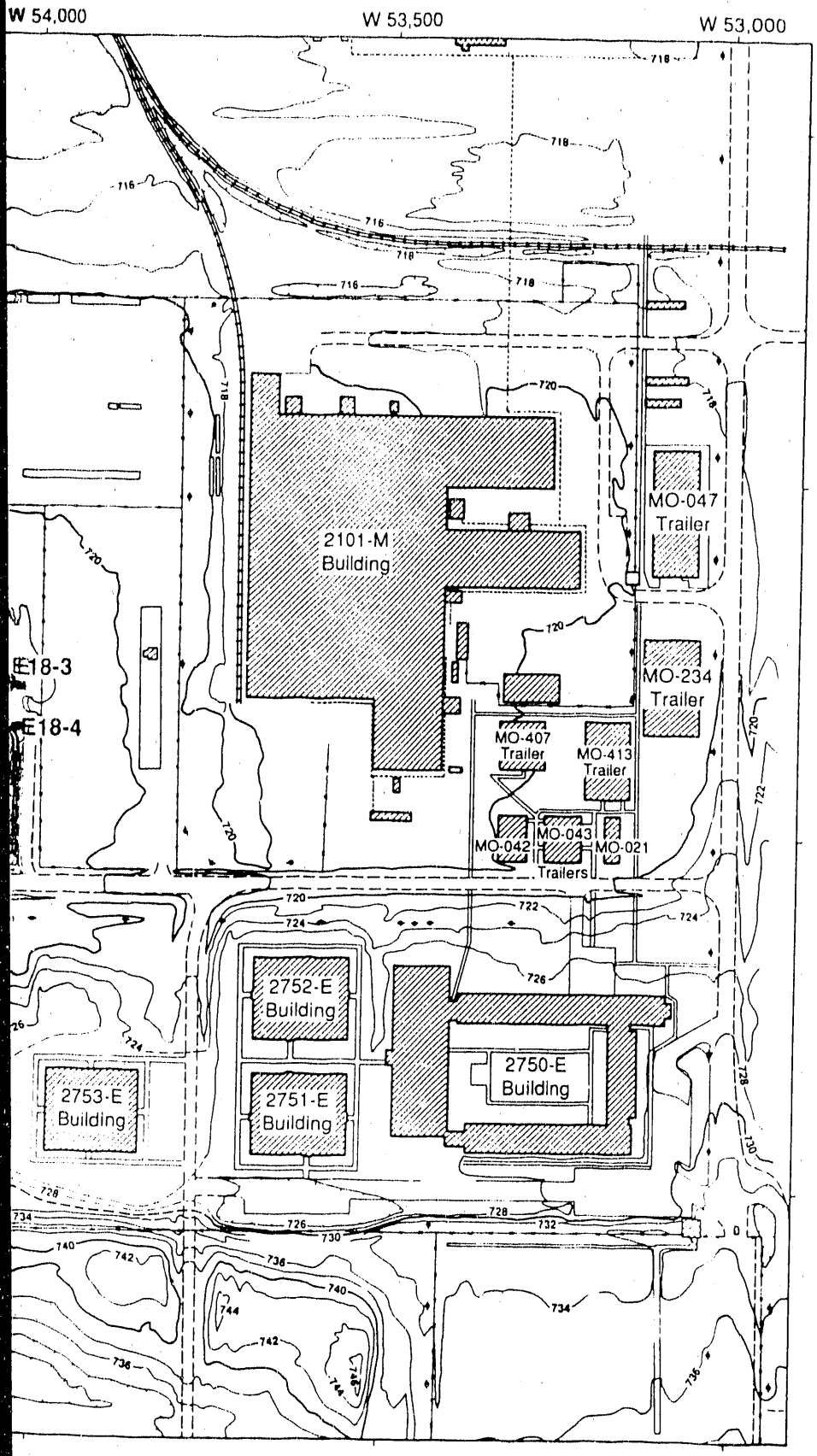


FIGURE 5.2. Topographic Map of the 2101-M Pond (contou



LEGEND

- Well
- Powerpole
- Fence
- Steamline

NOTES:

Hanford Coordinate System Used.
All Wells Prefixed by 299-.

N

0 100 200
Feet

Pond (contour interval is 2 ft)

reworked by humans to form the road and equipment storage area on the east and north sides of the pond, and during excavation of the pond forming the berms on the south and north sides. Only the area near the upgradient well was relatively undisturbed until a pad for the drill rig was cleared off.

5.3 GEOLOGY OF THE 2101-M POND

The stratigraphy beneath the 2101-M Pond has been interpreted from field and laboratory analyses of the cable-tool borehole samples collected during the installation of the four ground-water monitoring wells. Before drilling the boreholes, it was decided that the wells would only penetrate the upper 20 ft or so of the unconfined aquifer. If contamination in these wells is detected or it becomes necessary to identify the bottom of the aquifer, one or more new boreholes may be drilled deeper. This section discusses in detail the units penetrated by the monitoring wells; less-detailed information on units below this depth is based on data from nearby wells.

Two geologic cross sections were constructed through the four wells drilled at the pond. Sieve data (Appendix D) and data from the geologists' logs (Fruland et al. 1989a) were used as the basis for the interpretation. Some of these data are summarized in the borehole correlation charts given in Appendix D for each well. The locations of these cross sections, along with the well locations, are shown in Figure 5.3. The cross sections are shown in Figures 5.4 and 5.5, and a fence diagram is presented in Figure 5.6.

5.3.1 Site Geology

Three geologic formations are present beneath the 200-East Area: 1) the late-Miocene Saddle Mountains Basalt (Elephant Mountain Member), 2) the Miocene/Pliocene Ringold Formation, and 3) the Pleistocene Hanford formation (Tallman et al. 1979). Other units, such as the early "Palouse" soil and the Plio-Pleistocene unit, have not been identified in the 200-East Area. These units may have been present in this area at one time, but were eroded away by the ancestral Columbia River and/or Pleistocene cataclysmic flooding.

Because the new monitoring wells only extend approximately 20 ft into the uppermost aquifer, the only information available on the depth to basalt and the basal and/or lower Ringold units near the pond is from two previously

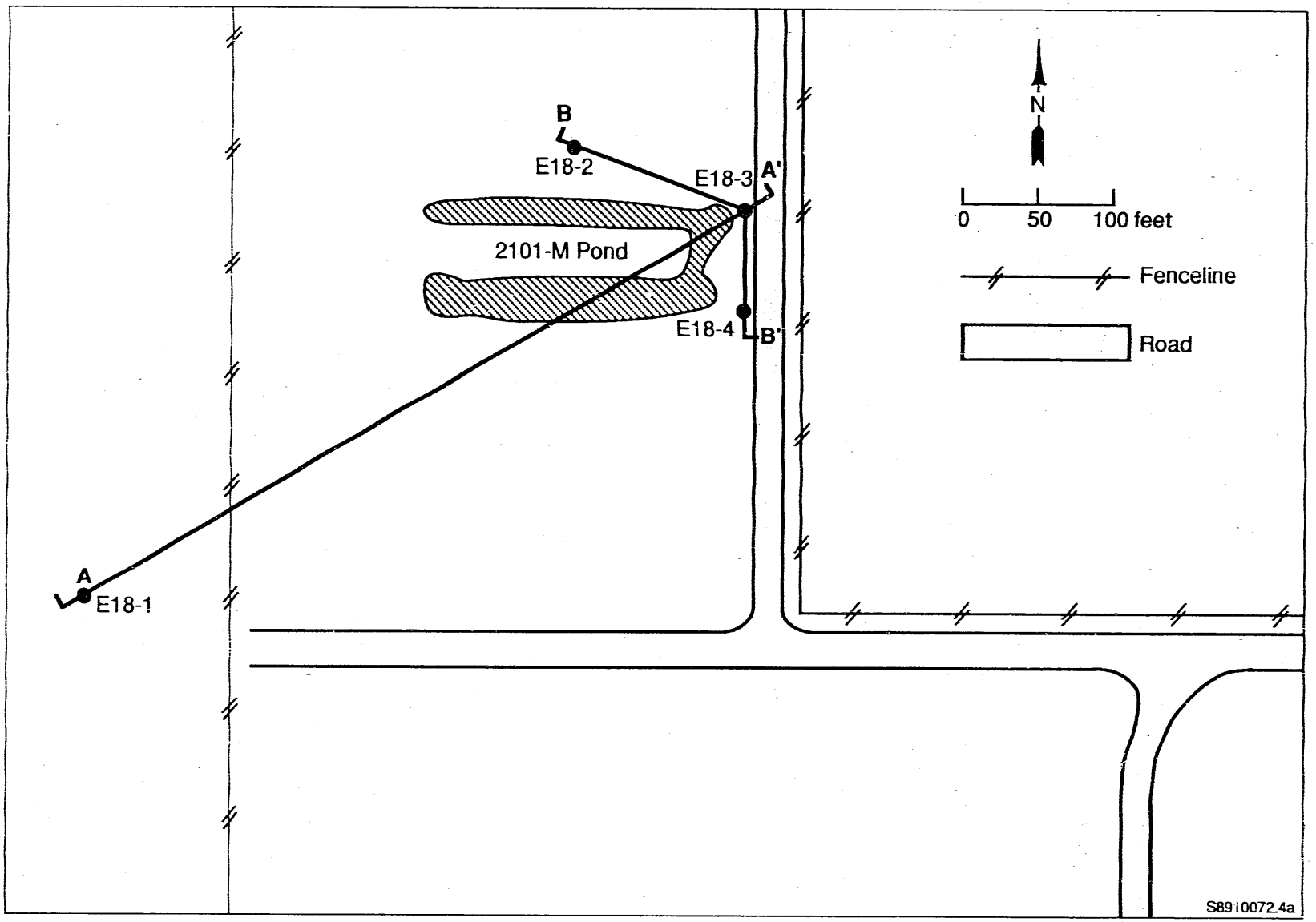


FIGURE 5.3. Cross Section Location Map

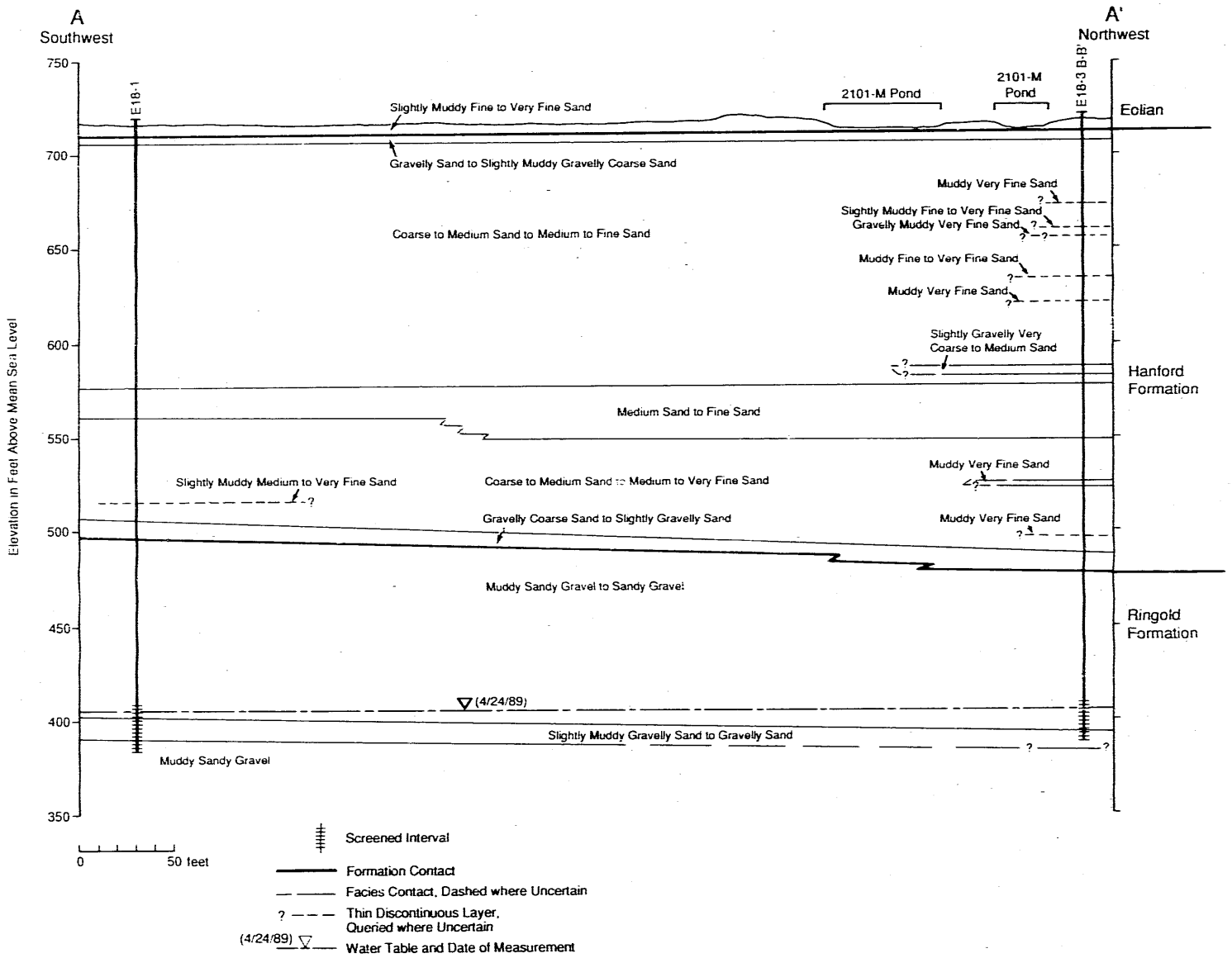


FIGURE 5.4. Cross Section A-A'

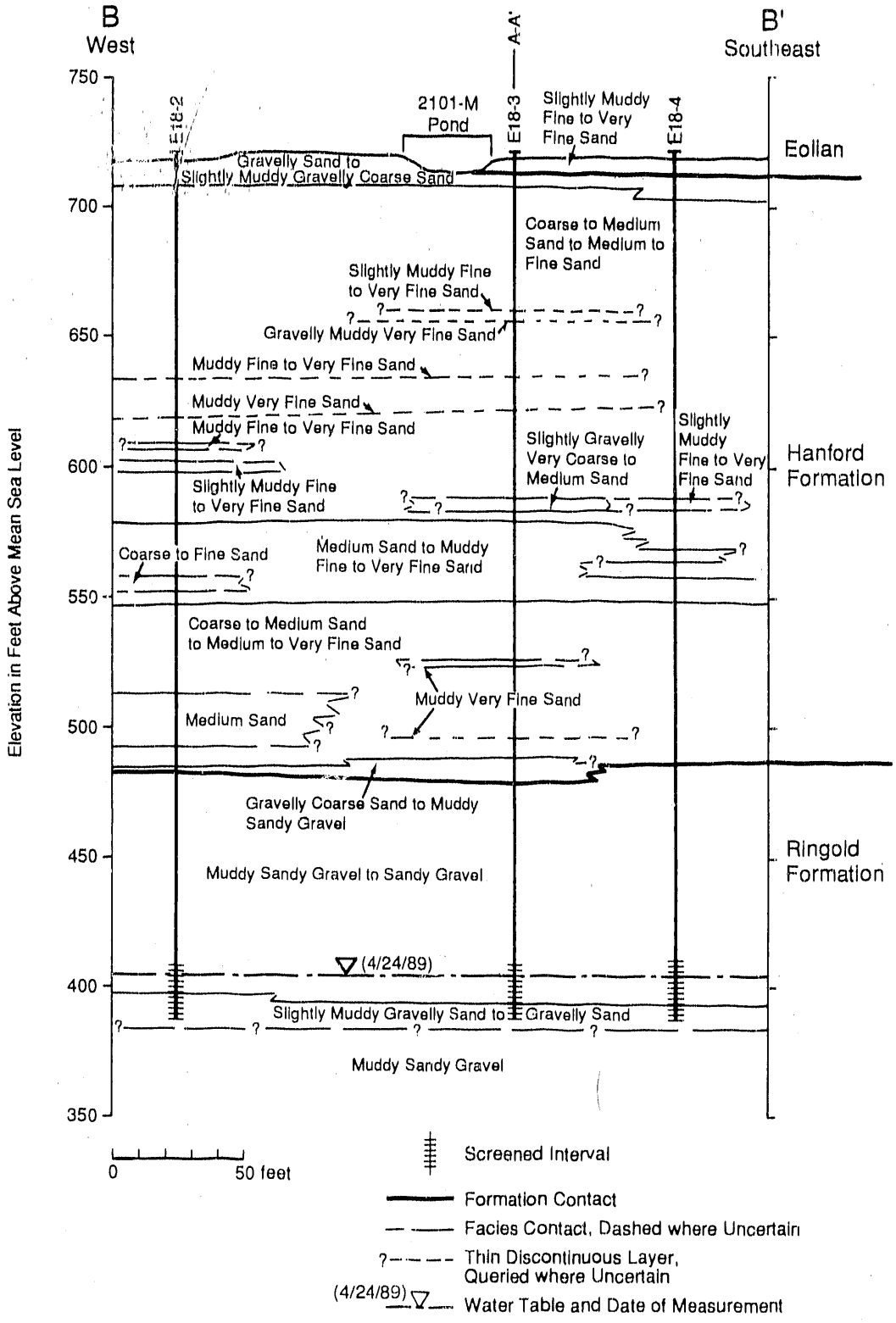


FIGURE 5.5. Cross Section B-B'

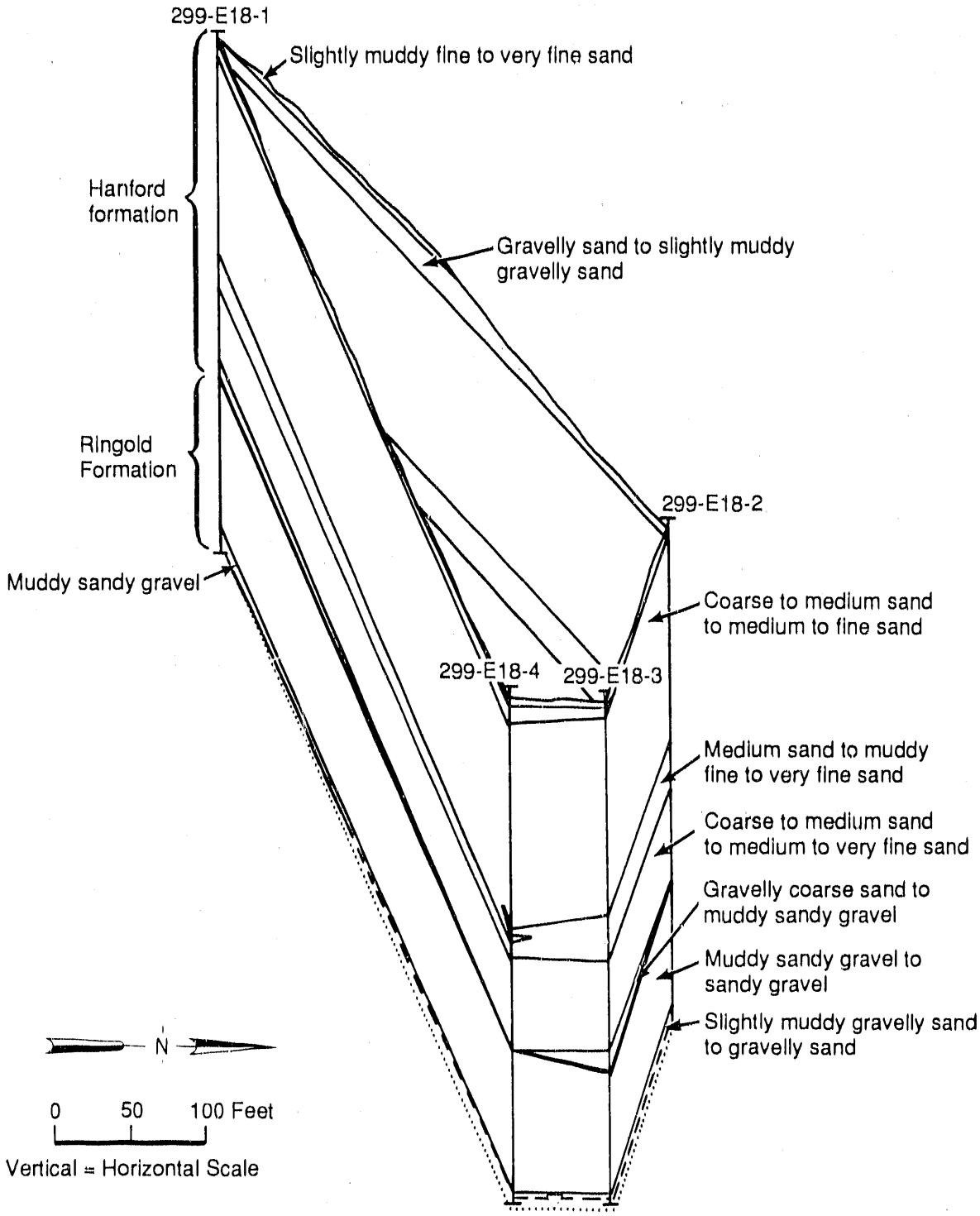


FIGURE 5.6. Fence Diagram

existing wells. These wells are 299-E23-2, approximately 2100 ft to the northeast, and 299-E19-1, approximately 1600 ft to the southwest (Figure 5.7). They will be used to discuss the deeper stratigraphic units, and the new monitoring wells will be used to discuss those units in and above the upper portion of the aquifer.

Well 299-E19-1 intersected basalt at an elevation of approximately 212 ft. The basalt is overlain by 1 ft of coarse-grained basal Ringold sediments consisting of muddy sandy gravel to sandy gravel. Above the gravel is 15 ft of gray clayey sand grading up into a gray clay with plant material that may correlate to the fine-grained basal Ringold. The gray clay is overlain by nearly 40 ft of blue-gray clay, which probably correlates to the lower Ringold unit. The clays are in sharp contact with the overlying muddy sandy gravel to sandy gravel of the middle Ringold, which continues up to an elevation of 480 ft (Webster 1977; Tallman et al. 1979).

In contrast, the deeper stratigraphy of well 299-E23-2 has the top of basalt at an elevation of 281 ft, overlain by 180 ft of muddy sandy gravel to sandy gravel. There is no fine-grained basal/lower Ringold present this far north, leaving the coarse-grained middle Ringold units in contact with the indistinguishable basal Ringold, if present. It is unknown whether the fine-grained sediments, which form a confining layer within the unconfined aquifer, extend beneath the 2101-M Pond. In the vicinity of the pond, the maximum projected elevation of the fine-grained sediment sequence is 365 ft above mean sea level. If the fine-grained sediments do continue beneath the pond, they would be present 40 ft or more below the water table. If the clays do not continue beneath the pond, the base of the aquifer would be the top of basalt, estimated from Figure 5.7 to be at a depth of 480 ft, or 170 ft below the water table.

Based on data from the new wells, the uppermost portion of the unconfined aquifer beneath the pond occurs in the muddy sandy gravel to gravelly sand (see Figures 5.4 and 5.5) of the middle Ringold. Nearly 100 ft of middle Ringold sediments dominated by unconsolidated to slightly consolidated muddy sandy gravel to sandy gravel were penetrated by the four wells. A 5- to 10-ft-thick layer of slightly muddy gravelly sand to gravelly sand was

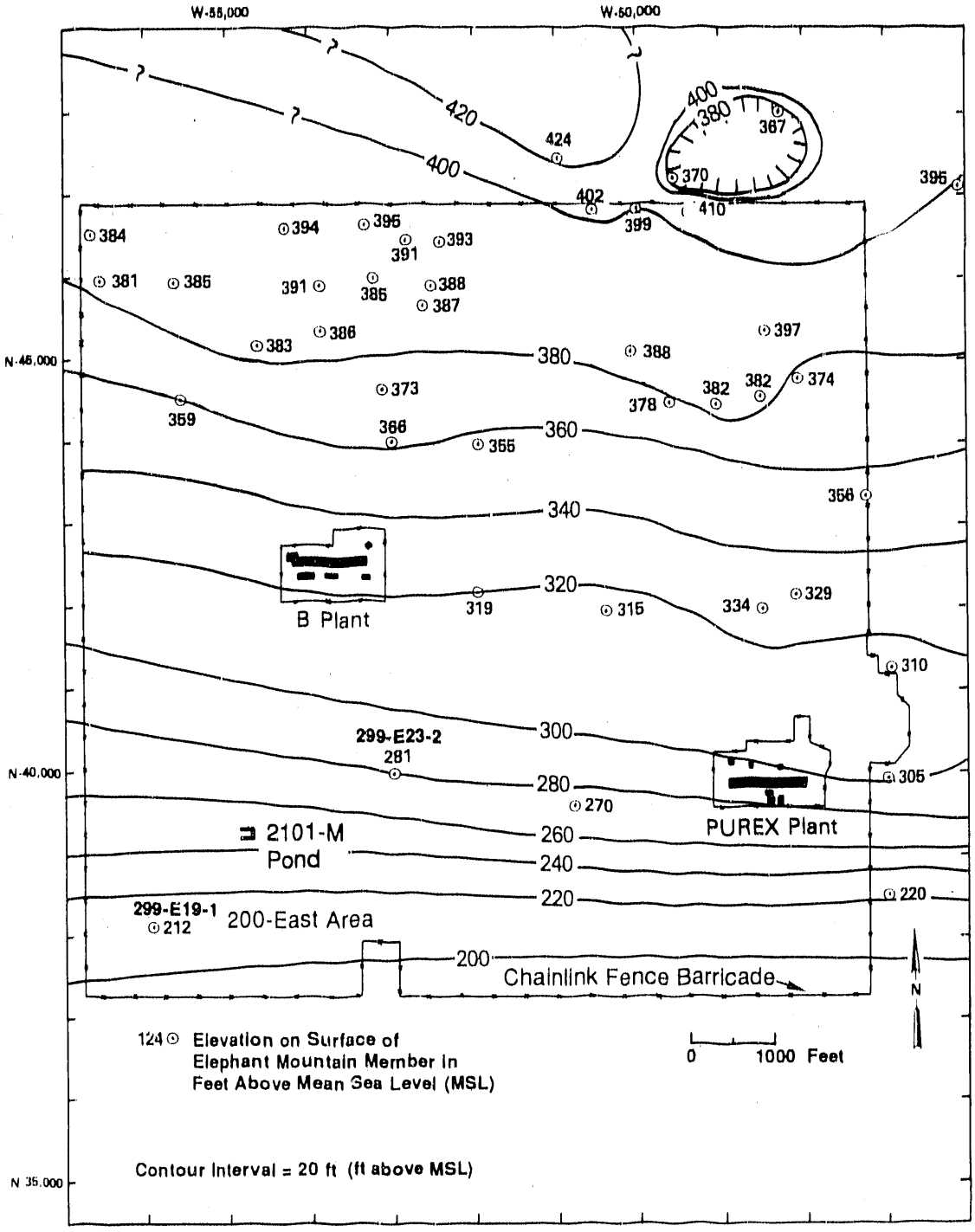


FIGURE 5.7. Top of Basalt Map for the 200-East Area [modified from Last et al. (1989)]

interception of a clastic dike. As discussed in Chapter 3.0, clastic dikes are three-dimensional features associated with the glaciofluvial sediments of the Hanford formation.

5.3.2 Mineralogy

The sand fractions of six sediment samples, one from each major textural unit found beneath the 2101-M Pond, were petrographically inspected for their mineralogical content. Although there were only six samples, these data still provide information on the types of minerals present in the vadose and saturated zones. In this analysis, it was not possible to distinguish between the different types of feldspars or mafic (primarily amphibole and pyroxene) minerals or the different rock types represented by the lithic fragments. The grains were categorized into one of 10 mineral types, as shown in Table 5.2. The data show that quartz is the primary mineral present in the sediments, followed in decreasing order by lithic (rock) fragments of various types, feldspars, biotite, and undifferentiated amphiboles and pyroxenes. There are essentially only traces of zircon, sphene, muscovite, calcite, and apatite present. Four of the samples were collected from

TABLE 5.2. Quantity of Minerals as a Percentage of the Sample

	299-E18-1	299-E18-03				
	265 ft Ringold	45 ft Hanford	90 ft Hanford	150 ft Hanford	205 ft Hanford	330 ft Ringold
Feldspar	8.15	8.48	6.75	8.85	9.60	8.45
Quartz	61.80	66.08	72.52	66.22	66.00	72.37
Lithic fragments	29.18	16.96	14.78	15.01	16.60	11.42
Zircon	--	1.00	0.18	--	--	--
Sphene	--	1.25	0.73	0.27	1.17	0.23
Biotite	0.86	4.99	4.38	4.02	3.75	3.42
Muscovite	--	0.25	0.18	0.80	--	0.91
Pyroxene/Amphibole	--	1.00	1.28	3.75	2.34	2.75
Calcite	--	--	--	0.54	0.47	0.23
Apatite	--	--	0.18	0.54	0.47	0.23

Hanford formation sediments (well 299-E18-3 at 45, 90, 150, and 205 ft) and two from the Ringold Formation (well 299-E18-1 at 265 ft and well 299-E18-3 at 330 ft). Based on a limited number of samples, there appears to be no obvious difference between the two formations as represented by their sand fractions.

5.3.3 Geochemistry

Seven sediment samples, including a duplicate sample, were collected during drilling from wells 299-E18-3 (six samples) and 299-E18-1 (one sample) and analyzed using XRF to determine of potential metals contamination. A laboratory duplicate was also run (see Appendix D). Nine other sediment samples (three samples each from wells 299-E18-1, 299-E18-2, and 299-E18-4) were also analyzed at a later date using ICP analytical methods for metals (Appendix D). The latter samples were analyzed to provide data from the vadose zone for comparison with results from the pond bottom samples (DOE 1989) and to provide data from the two wells not previously sampled. Results using either method provide information on the chemistry of the sediments and an indication of any gross metals contamination beneath the pond. No gross metals contamination of the vadose zone sediments was indicated.

The seven sediment samples collected during drilling were also analyzed for VOCs. Results of these analyses (given in Appendix D) indicate no contamination of those samples by VOCs.

Another indication of the lack of contamination in the vadose zone can be seen by the soil pH measurements (Appendix D, borehole correlation charts) taken in the field immediately after many of the samples were collected. The pH ranged from 7.9 to 9.2 in sediments from the four monitoring wells. Acidic waste waters may have been discharged to the pond, but as can be seen by the relatively high pH values, there has been little or no neutralization by acids of the normally alkaline sediments.

6.0 HYDROLOGY OF THE 2101-M POND

The potential for movement of contaminants originating from wastes discharged to the 2101-M Pond is influenced by the nature of the hydrogeologic framework beneath the pond. An understanding of the hydrogeologic framework is crucial, therefore, in evaluating the potential transport of these contaminants in the subsurface environment. At the 2101-M Pond, this hydrogeologic framework can be broken down into the following three components: 1) natural and artificial recharge, 2) fluid movement in the vadose zone, and 3) ground-water movement in the underlying, unconfined aquifer system (saturated zone). These components at the 2101-M Pond are discussed below.

6.1 RECHARGE

Recharge to the pond and the ground-water system is derived from both natural and artificial sources. Precipitation not removed from the surficial soils by evapotranspiration provides natural recharge as it drains through the vadose zone and into the underlying unconfined aquifer. Artificial recharge is from steam condensate, cooling-water, and other waste water discharges to the 2101-M Pond.

6.1.1 Natural Recharge

Natural recharge from precipitation into and next to the 2101-M Pond is negligible in comparison to the amount of water discharged to the pond. Gee (1987) reviewed available information and concluded that recharge rates at the semiarid Hanford Site vary widely. He concluded that minimum recharge (<0.1 cm/yr) occurs where soils are fine textured and surfaces are vegetated with deep-rooted plants, while maximum recharge (10 cm/yr) occurs where there are coarse soils or gravel, and no vegetation is present at the surface.

Much of the area adjacent to the pond has been cleared of vegetation in the recent past. Some grasses are now growing on the muddy fine sand and gravelly sand found at the surface around the pond, and trees are growing along the edges of the pond. Given the small size of the pond, the amount of vegetation, and the type of surficial sediments present, natural recharge at the pond would be minor compared to the amount of artificial recharge from

the pond. In the vicinity of well 299-E18-1, sediment moisture contents were very low, indicating virtually no natural or artificial recharge, probably because of distance from the pond and the mature, deep-rooted sagebrush and fine-grained sands near the well.

6.1.2 Artificial Recharge

Since 1944, the unconfined aquifer has received a relatively large volume of process cooling water that has been discharged to various ponds by waste management operations at Hanford (Zimmerman et al. 1986). In addition to these discharges, smaller volumes of low- and intermediate-level radioactive liquid wastes have been or are being discharged to several subsurface disposal cribs and ditches. These disposal ponds and subsurface cribs are located in the vicinity of the 200 Areas (see Figure 3.13). Some of these facilities, such as U Pond, no longer receive water and are now inactive. All of these facilities are scheduled to become inactive by 1995.

Collectively, artificial recharge was estimated by Graham et al. (1981) to be approximately 10 times the natural inflow of ground water from areas upgradient of the 200 Areas. The total volume of water discharged from the facilities (see Figure 3.13) from 1943 to 1980 is estimated to be approximately 1.7×10^{11} gal (Zimmerman et al. 1986). This amount of recharge has significantly affected the unconfined aquifer system, creating large ground-water mounds near areas of large-volume discharges and raising the water table at least 15 ft beneath the 200-East Area. The mounds are dominant features in the unconfined aquifer and are most pronounced beneath the former U Pond in the 200-West Area and B Pond near the 200-East Area.

The U Pond facility was decommissioned in 1984. Although the ground-water mound beneath U Pond is slowly declining, ground-water levels are still between 470 and 475 ft above mean sea level, which is approximately 60 ft above pre-Hanford conditions (ERDA 1975). Ground-water levels have reached an elevation between 420 and 425 ft above mean sea level beneath B Pond, which is approximately 35 to 40 ft above pre-Hanford conditions. These two mounds are the primary influences on the ground-water levels beneath the 200 Areas, although other ditches, ponds, and cribs also play an important part.

The water discharged to the 2101-M Pond has always been from the HVAC system, with the addition of the drains from the BWIP laboratories from 1981 to the present. Only the amount of steam going into the building is metered; there are no measurements made of the total amount of water coming out of the building. There is also no measurement of the amount of water run through the air conditioning system and discharged to the pond. Measurements cannot be made at the outlet to the pond because the discharge pipe is usually below the level of standing water in the pond.

The amount of steam metered at the building was converted into gallons of condensate water and is used as the basis for the estimated amount of water discharged to the pond. Before 1978, the measured steam use of the HVAC system in the 2101-M Building was reported to be approximately 5,000,000 gal/yr. In 1979, the HVAC system was upgraded, decreasing the amount of steam required. Table 6.1 provides the best estimates for steam condensate discharges to the pond from 1982 to 1988. This is a minimum value for water discharged to the pond. The amount of water run through the air conditioning units and discharged to the pond may be equal to or even greater than the amount of steam condensate. The amount of water discharged by the BWIP laboratories is also unknown, but is considered to be minor in comparison to the other sources.

TABLE 6.1. Steam Condensate Water Discharged to the 2101-M Pond from 1982 to 1988 (from DOE 1989)

Year	gal/yr
1982	979,464
1983[a]	1,391,296
1984	2,437,116
1985	1,560,756
1986	1,220,856
1987	869,892
1988	1,279,692
Total	9,739,072

(a) The value for 1983 is an average of the values for 1982 and 1984 through 1988.

6.2 HYDROLOGY OF THE VADOSE ZONE

The movement of water through the vadose zone to the underlying aquifer is controlled by many factors, including the thickness of the vadose zone, the hydraulic properties of the sediments in the vadose zone, and the moisture content of these sediments. The data collected on these factors during drilling of the monitoring wells at the 2101-M Pond are discussed below.

6.2.1 Physical Characteristics of the Vadose Zone

Moisture contents were measured for almost every sample collected using the drive-barrel drilling method. The data collected from the three downgradient boreholes 25 to 40 ft away from the pond show moisture contents ranging from 3.5% to 28.5% by weight. Fine-grained sediments in these boreholes have saturation levels reaching 70%. In contrast, the moisture contents of the sediments from the upgradient well nearly 300 ft away from the pond range from 1.5% to 3.3% and represent background conditions (i.e., not affected by pond discharges). This information suggests that water is spreading laterally beneath the surface of the pond to distances of at least 40 ft in the fine-grained sediments but less than 300 ft. These data also imply a saturation of the sediments directly beneath the pond equal to or greater than 70%.

Sediments of both the Hanford and Ringold Formations occur beneath the 2101-M Pond. Sand dominates the upper 230 ft and muddy sandy gravel dominating the lower 80 ft of the vadose zone. The upper 230 ft of sand can be grouped into two subtypes, "A" and "B," based on hydraulic conductivities [which are related to particle size (Table 6.2)] and water retention curves measured in the laboratory (Figures 6.1 and 6.2). The hydraulic conductivity of the muddy sandy gravel occurring below 230 ft (subtype "C" in Table 6.2) could not be measured in the laboratory because the sediments had been drilled using hard-tool methods and were therefore not entirely representative. The hydraulic conductivity for the muddy sandy gravel, shown in Table 6.2, is based on the aquifer tests conducted in the four monitoring wells.

Two-dimensional computer modeling was used to evaluate the extent of the wetted zone laterally beyond the edge of the pond. The PORFLO-3 program

TABLE 6.2. Hydraulic Conductivities of Sediments Beneath the 2101-M Pond

Well Number	Depth, ft	Lithology	Hydraulic Conductivity,[a] cm/sec	Lithologic Subtype
299-E18-1	40	Coarse sand	1.11×10^{-2}	A
	150	Fine sand	4.52×10^{-3}	A
299-E18-2	40	Coarse sand	1.10×10^{-2}	A
	150	Medium to fine sand	2.76×10^{-3}	A
299-E18-3	40	Coarse sand	2.71×10^{-2}	A
	62	Gravelly, muddy very fine sand	3.51×10^{-5}	B
	84	Muddy fine to very fine sand	3.36×10^{-4}	B
	97	Muddy very fine sand	3.41×10^{-5}	B
	150	Medium to fine sand	2.63×10^{-3}	B
	193	Muddy very fine sand	1.44×10^{-4}	B
	210	Medium to fine sand	2.77×10^{-3}	A
	235	Gravelly coarse sand	3.30×10^{-2}	A
299-E18-4	40	Sl. muddy medium sand	1.17×10^{-3}	A
	165	Sl. muddy medium to fine sand	6.48×10^{-4}	A
All wells	>230	Muddy sandy gravel	7.06×10^{-3}	C

(a) Each value is an average of at least two measurements, with the exception of 299-E18-3, 150 ft, for which there was not enough sediment.

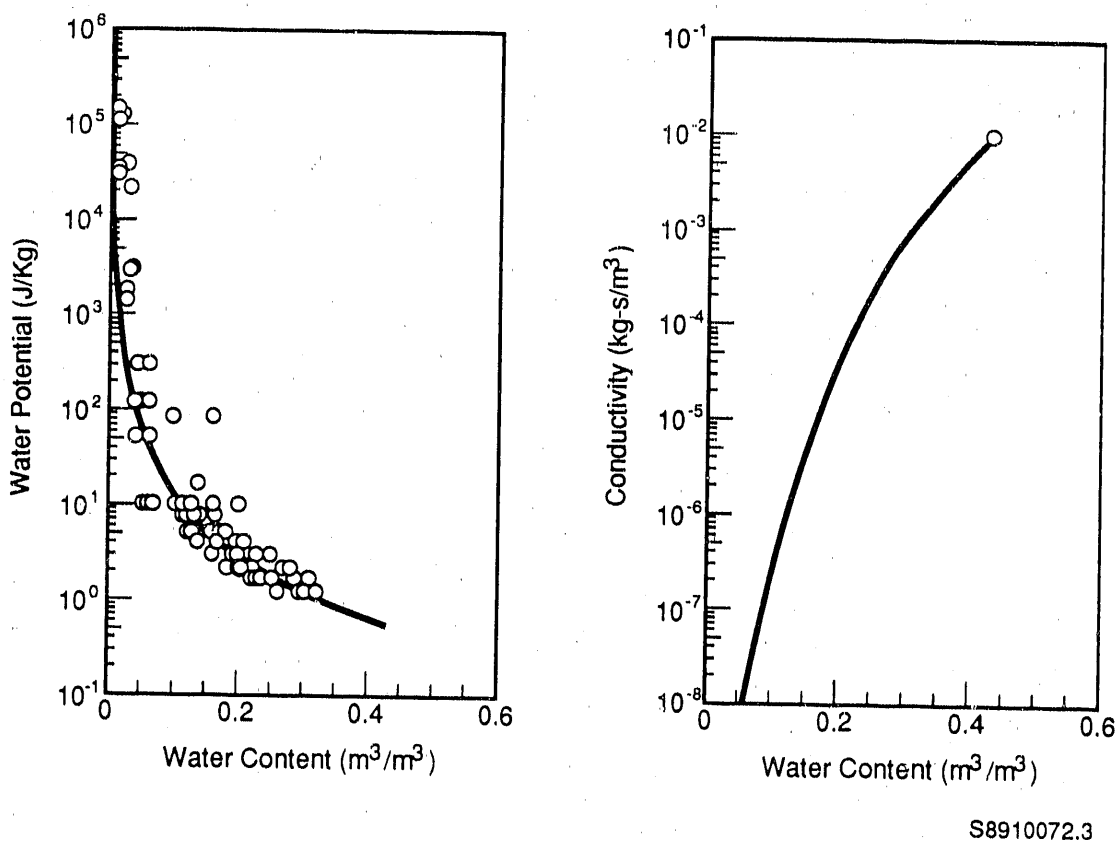


FIGURE 6.1. "A" Soil Water Potential and Conductivity Curves

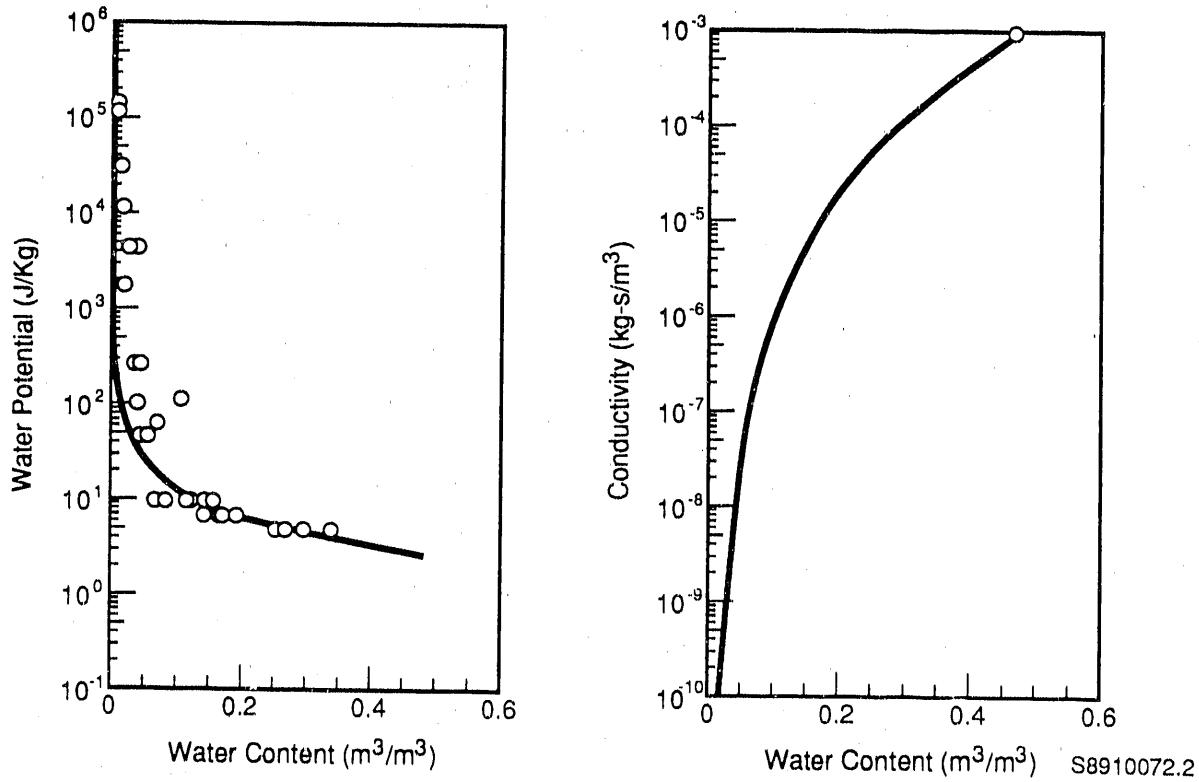


FIGURE 6.2. "B" Soil Water Potential and Conductivity Curves

used is currently being verified; consequently, the results of this modeling effort are used only as estimates. Parameters used in the modeling included the hydraulic conductivities for the three sediment subtypes, a pond 100 ft long with a 50-ft-wide dry border on either side, the moisture contents and particle sizes of the sediments beneath the pond, and a discharge of 1.2 million gal/yr of waste water to the pond. Based on this modeling, it is estimated that water from the pond would be present in vadose zone fine-grained sediments ("B" subtypes) up to 75 ft away from the pond.

6.3 SATURATED ZONE

The following subsections describe the ground-water hydrology beneath the 2101-M Pond. The hydrogeologic description, potentiometric levels, aquifer properties, ground-water chemistry, and direction and rate of ground-water movement are discussed for the uppermost portion of the unconfined aquifer.

6.3.1 Hydrogeologic Description

The uppermost aquifer beneath the 2101-M Pond is contained entirely in sediments of the Ringold Formation. The overlying Hanford formation does not extend down to the water table. Water-level data indicate that the water table immediately beneath the 2101-M Pond is at a depth of approximately 314 to 316 ft from top of casing, or 310 to 312 ft below ground surface (Table 6.3).

The uppermost aquifer beneath the 2101-M Pond is unconfined. The thickness of the unconfined aquifer is estimated to range between 40 ft and 170 ft, depending on whether the lower Ringold/basal Ringold Formation or the Elephant Mountain Member basalt forms the base of the unconfined aquifer. Geologic data (Chapter 5.0) indicate primarily muddy sandy gravel within the uppermost unconfined aquifer across the site; however, aquifer test results (discussed in Subsection 6.3.3) reveal some heterogeneity.

A water-table map of the Separations Areas for June 1989 (Kasza and Schatz 1989) is shown in Figure 6.3. The regional flow direction in the central portion of the Hanford Site is from west to east, but is affected by the two ground-water mounds that have resulted from discharges to U Pond and

TABLE 6.3. Water-Level Measurements and Elevation Data

Well Number	Top of Casing Elevation, ft	Correction Factor[a]	Measurement Date	Depth to Water, ft	Water-Level Elevation, ft
299-E18-1	720.24	+0.06	8/16/88[b,c]	----	----
			10/6/88	314.29	406.01
			10/14/88	314.24	406.06
			10/26/88	314.32	405.98
			11/10/88[c]	314.61	405.69
			11/14/88	314.49	405.81
			12/8/88	314.21	406.09
			2/9/89	314.47	405.83
			2/15/89[c]	----	----
			2/21/89	314.56	405.74
			4/24/89	314.70	405.60
			7/13/89	315.10	405.20
299-E18-2	721.21	+0.22	8/16/88[b,c]	----	----
			10/6/88	315.52	405.91
			10/14/88	315.52	405.91
			10/26/88	315.55	405.88
			11/10/88[c]	316.33	405.10
			11/14/88[d]	315.69	405.74
			12/8/88	315.47	405.96
			2/9/89	315.75	405.68
			2/15/89[c]	----	----
			2/21/89	315.84	405.59
			4/24/89	316.01	405.42
			7/13/89	316.37	405.06
299-E18-3	722.04	+0.03	8/16/88[b,c]	----	----
			10/6/88[b]	----	----
			10/14/88	316.13	405.94
			10/26/88	316.10	405.97
			11/10/89[c]	316.16	405.91
			11/14/88	316.21	405.86
			12/8/88[d]	316.02	406.05
			2/9/89[d]	316.31	405.76
			2/15/89[c]	----	----
			2/21/89	316.39	405.68
			4/24/89	316.58	405.49
			7/13/89	316.91	405.16
299-E18-4	721.57	+0.0	8/16/88[b,c]	----	----
			10/6/88	315.59	405.98
			10/14/88	315.66	405.91
			10/26/88	315.62	405.95
			11/9/89[c]	315.69	405.88
			11/14/88	315.74	405.83
			12/8/88	315.53	406.04
			2/9/89	315.81	405.76
			2/15/89[c]	----	----
			2/21/89	315.91	405.66
			4/24/89	316.08	405.49
			7/13/89	316.43	405.14
299-E13-10	738.84		6/8/88	333.51	405.33
			10/6/88	332.82	406.02
			11/14/88	333.29	405.55
			12/8/88	332.78	406.06
			2/9/89	332.87	405.97
			2/21/89	333.05	405.79
			4/24/89	333.18	405.66
			7/13/89	333.54	405.30

TABLE 6.3. (contd)

Well Number	Top of Casing Elevation (ft)	Correction Factor[a]	Measurement Date	Depth to Water (ft)	Water-Level Elevation (ft)
299-E23-2(0)	720.91		6/8/88	315.80	405.11
			10/6/88	315.12	405.79
			11/14/88	315.21	405.70
			12/8/88	314.92	405.99
			2/9/89	315.31	405.60
			2/21/89	315.35	405.56
			4/24/89	315.58	405.33
			7/13/89	315.91	405.00
299-E24-7	716.32		6/8/88	310.81	405.51
			10/6/88	310.09	406.23
			10/26/88	310.17	406.15
			12/8/88	309.93	406.39
			7/13/89	310.98	405.34
MW-10	735.96		6/8/88	330.54	405.42
			10/6/88	329.86	406.10
			12/8/88	329.67	406.29
			2/21/89[e]	----	----
			7/13/89	330.33	405.63
MW-13	724.10		10/6/88	315.57	408.53
			12/8/88	315.40	408.70
			2/21/89	315.92	408.18
			7/13/89	315.71	408.39

(a) Based on inclinometer measurements. This has already been calculated into the water-level elevation.
(b) Unable to make measurements.
(c) Measurements taken at time of sampling.
(d) Based on only one measurement instead of two.
(e) Could not get two measurements within 0.02 ft.

B Pond. Ground-water flow beneath the 200-East Area is poorly defined because ground-water flow converges near the 2101-M Pond from both the west and east and then diverges into two major components (see Figure 6.3). One of the two components flows northward between Gable Butte and Gable Mountain and the other flows southeast toward the Columbia River.

The high transmissivity of the unconfined aquifer beneath much of the 200-East Area is primarily responsible for the very small hydraulic gradient in this area. In addition, the ground-water mound beneath B Pond partly blocks eastward flow, causing a "stagnant" zone in the 200-East Area. Because of the extremely small gradient, ground-water flow directions may shift as a result of changing rates of waste water discharged into B Pond and other disposal sites. Much of the ground-water regime beneath the 200-East Area may actually be within a "mixing zone" caused by the repetitive changes in ground-water flow directions. Gradually fluctuating water levels in the

200-East Area indicate the influence of B Pond as far west as the 2101-M Pond and vicinity. These changes in flow paths and flow directions allow ground water moving from the 200-West Area to mix with water moving from B Pond and other facilities within the 200-East Area, creating a diverse ground-water chemistry.

Vertical ground-water flow occurs beneath the B Pond and U Pond ground-water mounds and parts of the Separations Areas (Gilmore 1989; Graham et al. 1981a; Last et al. 1989). On a regional scale, vertical hydraulic gradients are not expected in the unconfined aquifer beneath the western portion of the 200-East Area because no large sources of recharge are present and the geometry and hydraulic properties of the sedimentary facies would not appear to promote such vertical gradients.

Since at least 1970, regional scale water-table maps (e.g., Figure 6.3) have generally indicated ground water flows southwest to northeast beneath the southwest portion of the 200-East Area, where the 2101-M Pond is located. This is supported by water-table maps of the U.S. Ecology Site (see Figure 1.1) southwest of the 2101-M Pond (Figure 6.4). Recharge from 2101-M Pond could potentially result in a small mound under the site. A preliminary numerical model simulation was conducted before the actual transmissivities were known to examine the possibility for ground-water mounding at the site (Chamness et al. 1989). This investigation, which assumed a transmissivity of 20,000 ft^2/d beneath the site, indicated mounding would be insignificant.

Later, a two-dimensional model (McDonald and Harbaugh 1984) was run based on an aquifer transmissivity of 4000 ft^2/d, which is within the range of values measured during aquifer tests at the site (see Subsection 6.3.3). The model was set up with one 50-ft layer and a 50- by 50-node grid with a 20-ft spacing between nodes. A horizontal hydraulic gradient of 5×10^{-4} was imposed on the model. Constant-head boundaries were set up at the upgradient and downgradient ends of the model, and no-flow boundaries were set up on each side. There was essentially no discrepancy in the mass balance. A recharge rate of 18,000 gal/d was induced on an 80- by 120-ft area in the center of the grid. The model was run to steady state. The model simulated

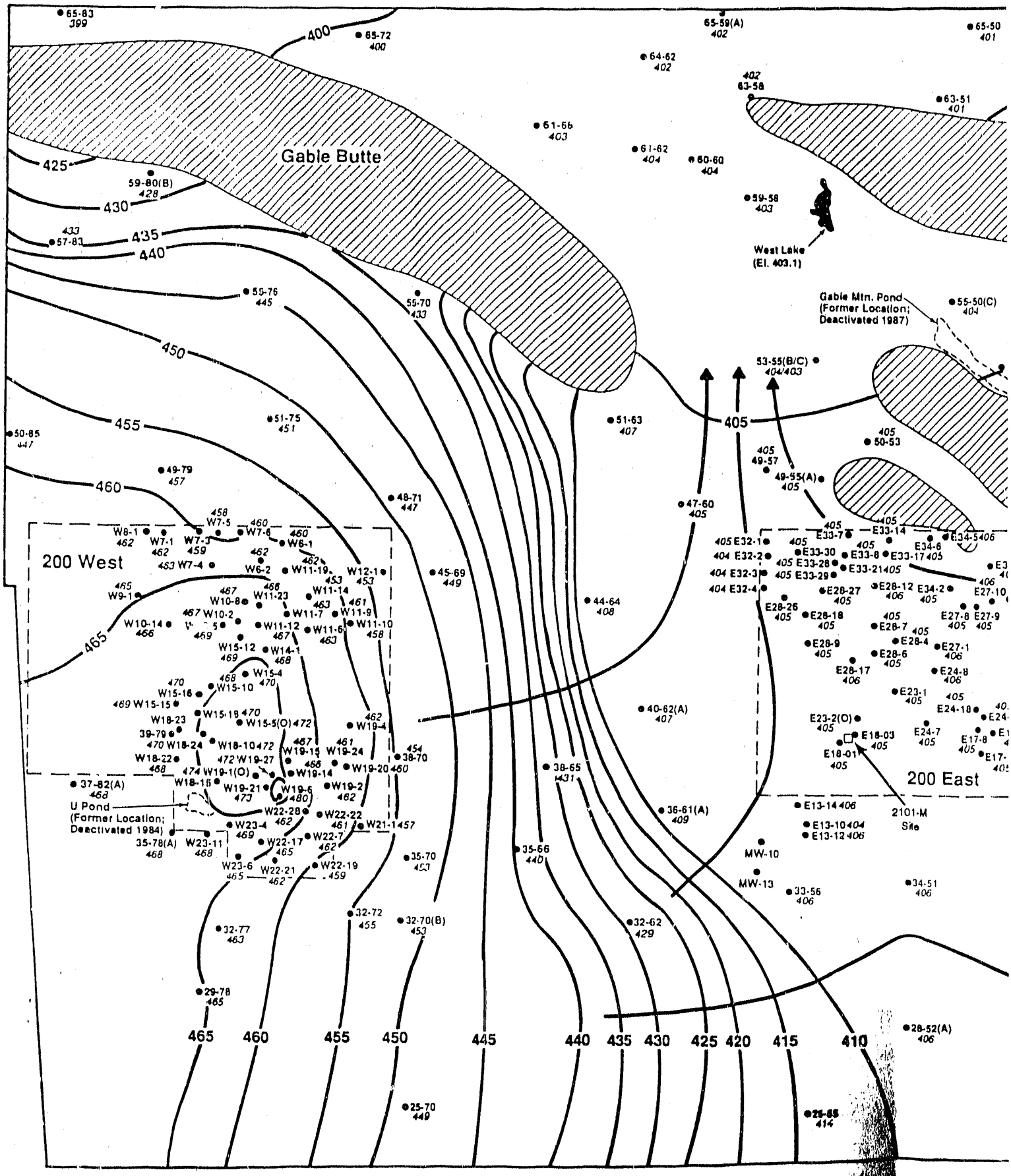
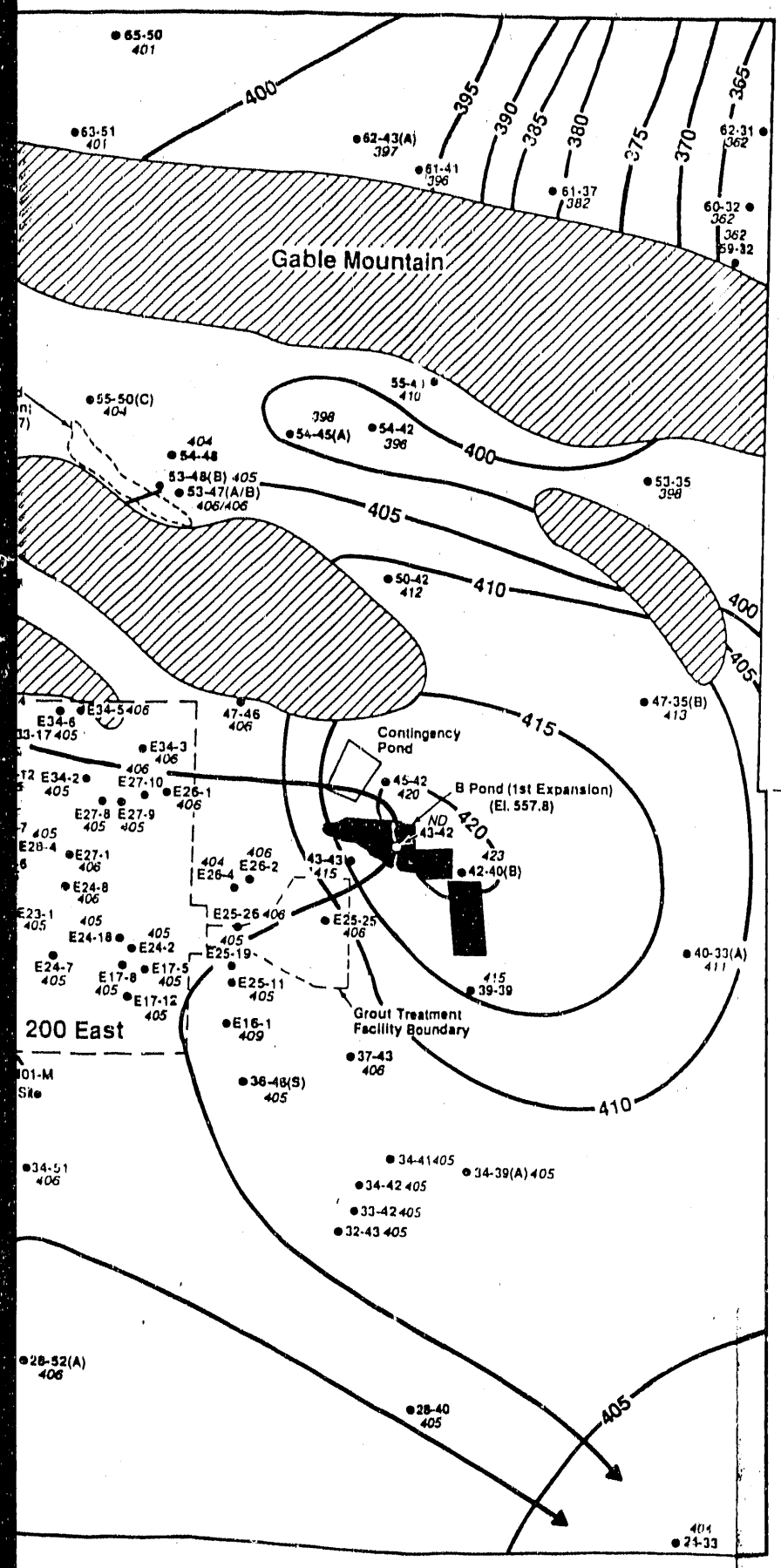


FIGURE 6.3. June 1989 Water Table Map for the 200 Areas [illegible] Kasza and



Separations Area Water-Table Elevation Map June 1989

—395— Water-Table Contour (ft Above MSL)

404 Water-Table Elevation (ft MSL)

W22-26 Wells Used in Preparation of Map

Ponds, Water Surface Elevation (ft MSL)

Basalt Outcrops Above Water-Table, as Inferred 6/84

The separations area water-table map is prepared by the environmental science and technology function of the environmental division of Westinghouse Hanford Company. This map complements the Hanford site water-table map being prepared by Pacific Northwest Laboratory.

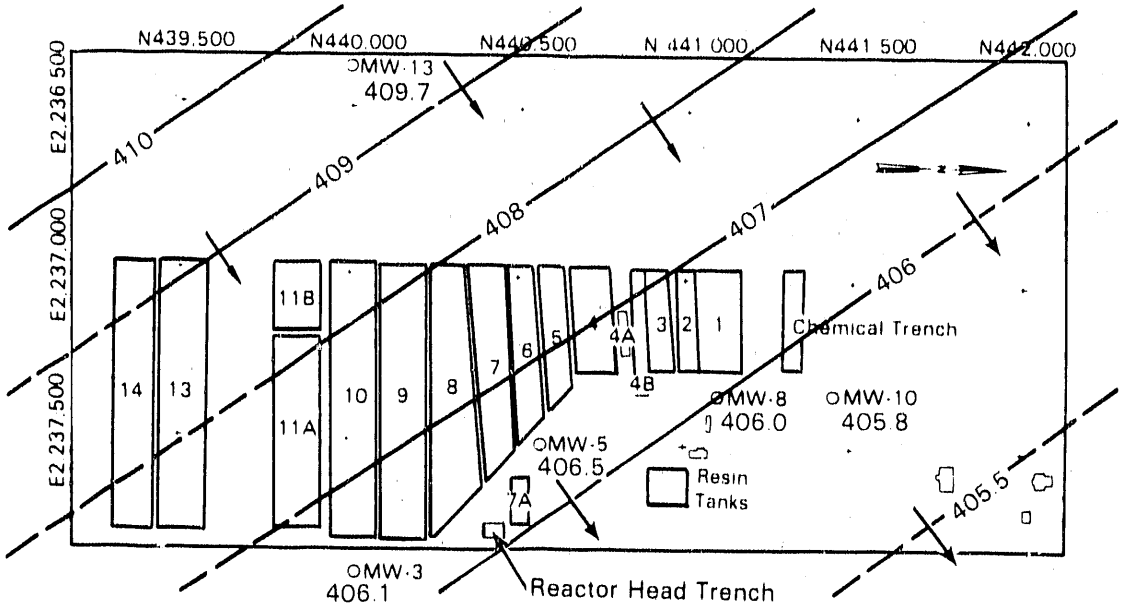
Note: To convert to metric, multiply elevation (ft) by 0.3048 to obtain elevation (m).

0 — 1 Mile

0 — 1 Kilometer

Kasza and Schatz 1989)

18 Feb 1986



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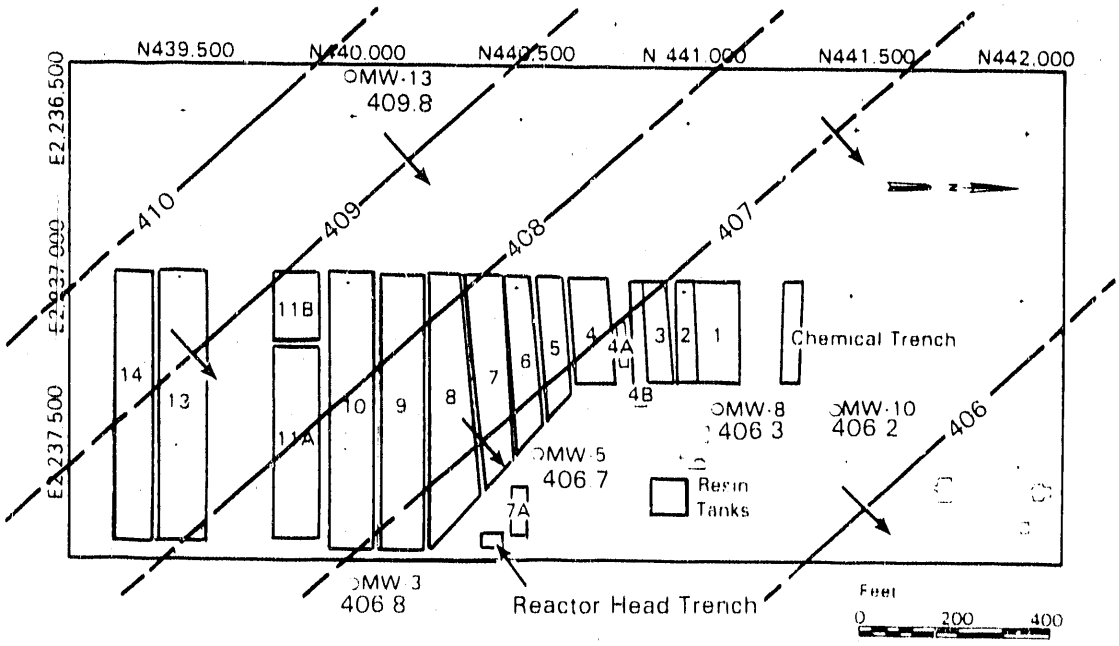
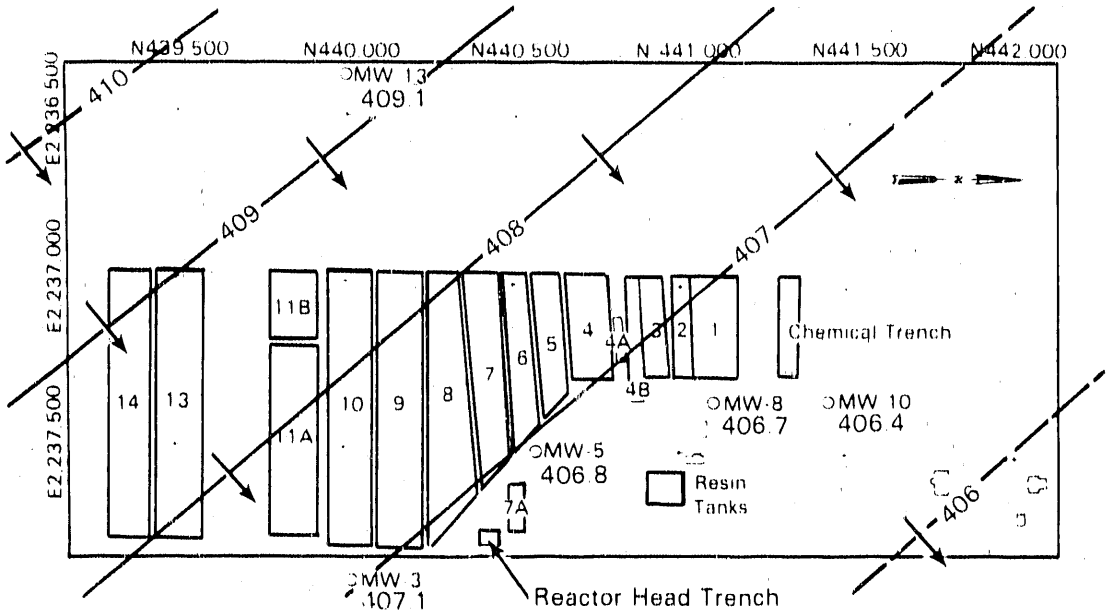


407 Water Table Contour in Feet Above Mean Sea Level. Dashed Where Location is Inferred Contour Interval 1 Foot

Direction of Ground Water Flow

FIGURE 6.4. 1986 Water Table Maps for the U.S. Ecology Site (used with permission of U.S. Ecology, Inc.)

22 July 23 July 1986



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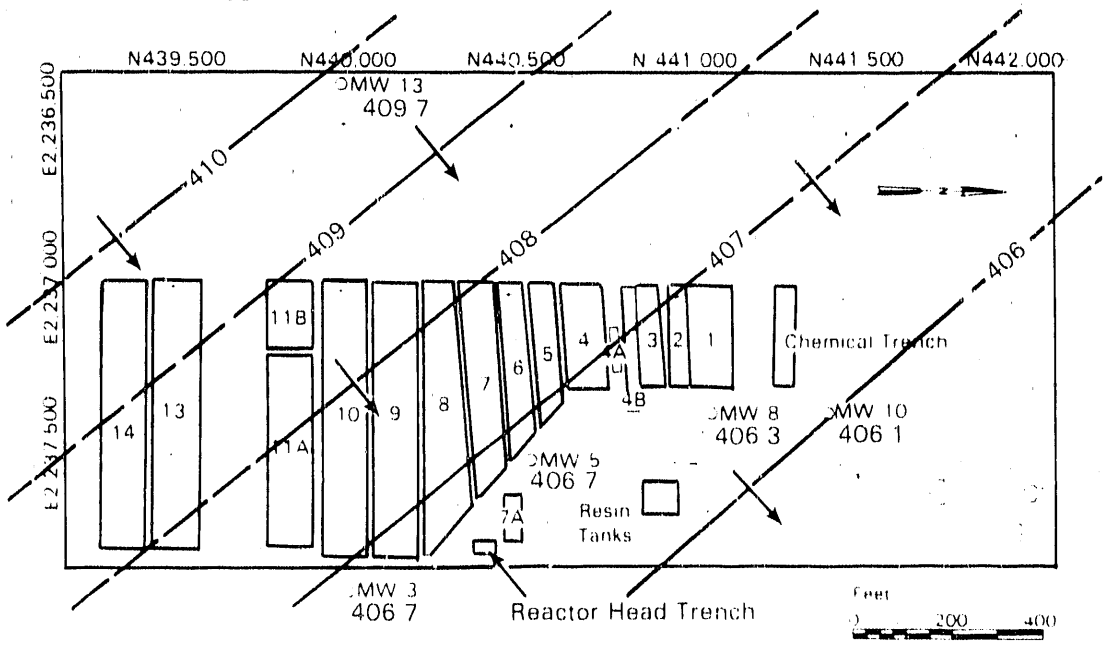


407 Water Table Contour in Feet Above Mean Sea Level Dashed Where Location is Inferred Contour Interval 1 Foot

Direction of Ground Water Flow

FIGURE 6.4. (contd)

a mound beneath the region of recharge. At its highest point, the simulated mound was approximately 0.3 ft above the beginning water level.

As discussed below, water-level measurements from the monitoring wells at the pond cannot prove or disprove the presence of a shallow mound. Because none of the wells were completed deeper than the upper 20 ft of the aquifer, it will not be possible to determine the vertical gradient at present.

6.3.2 Potentiometric Levels

Water-level measurements have been collected whenever possible at the four monitoring wells before sampling. In addition, water levels in these wells and several others within 1 mi of the site were also measured periodically to try to better understand the ground-water flow regime in this portion of the 200-East Area (Table 6.3). Because of better consistency in measurements, only the latter data set is discussed in this report. These data indicate that the water table immediately beneath the pond is at a depth of about 310 to 312 ft below ground surface (approximately 405 ft above mean sea level; Figure 6.5).

Hydrographs indicate water-level elevations reached a high between December 1988 and January 1989 and have steadily declined since that time (Figure 6.6). The hydrographs for all the wells in the area display very similar trends, suggesting that the responses occur regionally and are not a result of localized effects. These fluctuations are thought to be a result of changes in the volume of waste water discharged to B Pond and other facilities in the Separations Areas. The similar trends also indicate the ground-water flow direction near the 2101-M Pond has not changed significantly over time even when the elevation of the water table changes.

Evaluation of water-level measurements taken shortly after the new wells were completed indicated an extremely small hydraulic gradient. Therefore, it was necessary to reduce possible uncertainties caused by measurement errors, surveying errors, or boreholes that may deviate from vertical. After evaluating each of these possible sources of uncertainty, a borehole deviation probe was run in each borehole to determine the extent of deviation from vertical, if any. Three of the boreholes were found to

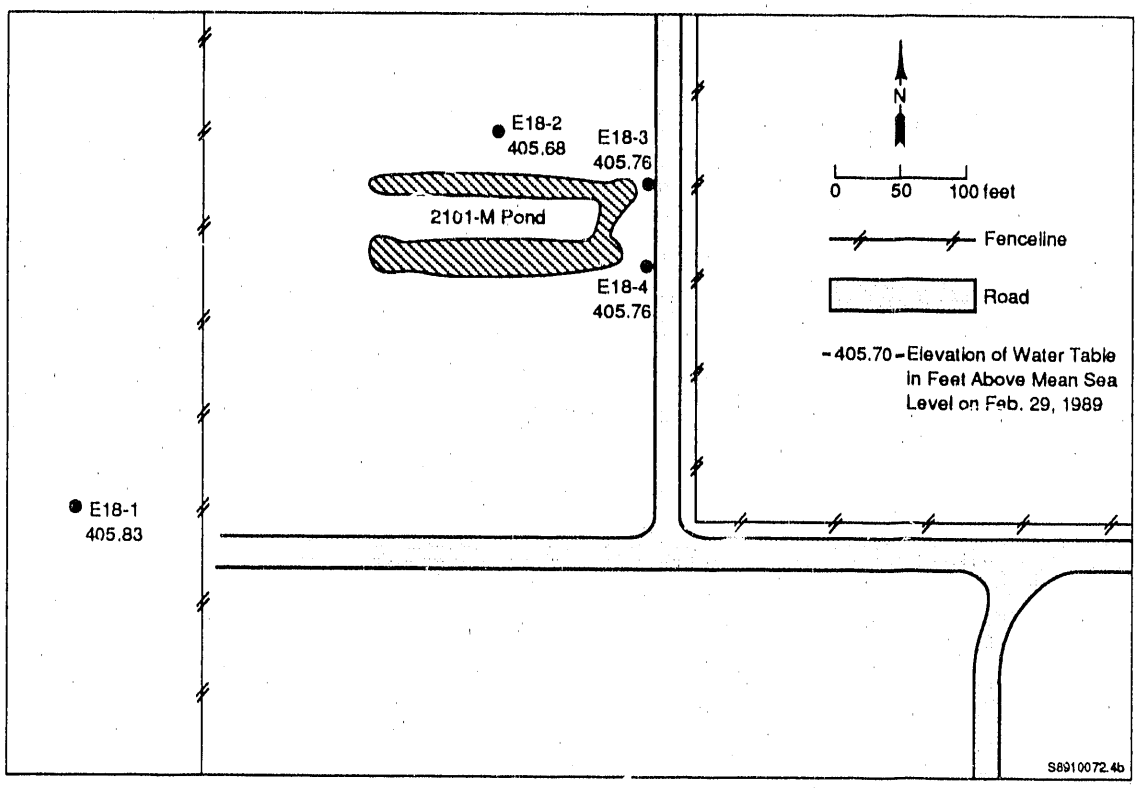
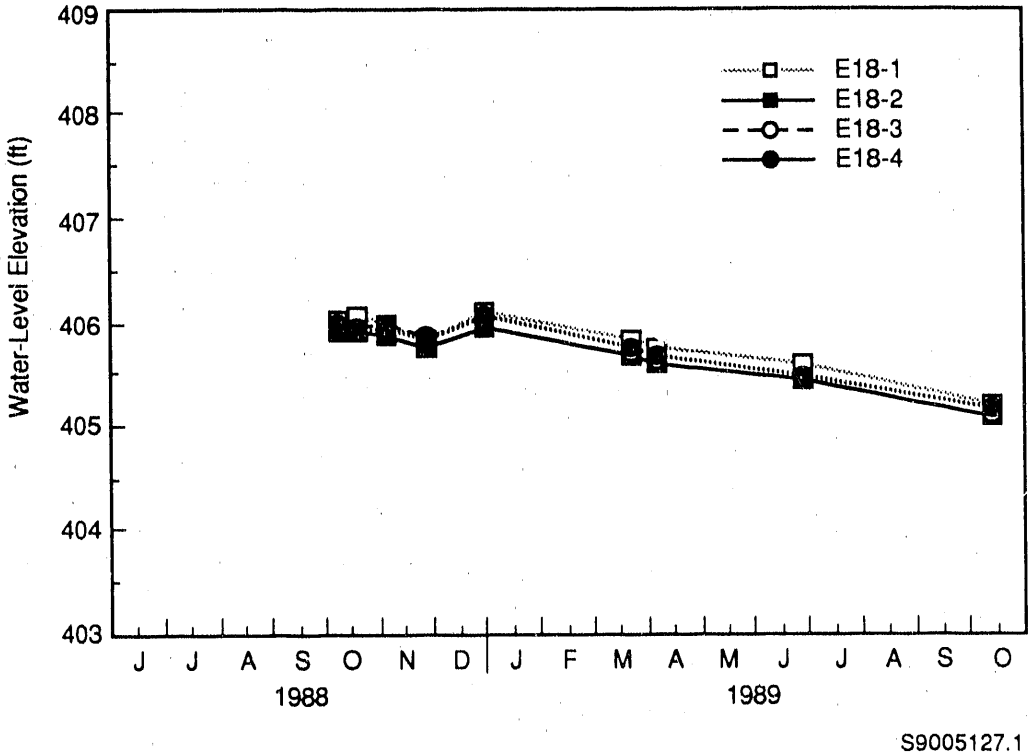


FIGURE 6.5. Water Table Map of the 2101-M Pond Area

deviate from vertical and correction factors were applied to the water-level measurement data. The correction factors range from 0 to 0.22 ft and are given with the water-level data in Table 6.3. These factors are used each time the water-level elevation is calculated. Even with these correction factors included, the difference in water-level elevations in the four wells at the site is generally less than or equal to 0.2 ft, and generally less than 0.5 ft for all of the wells within nearly 1 mi of the site (Table 6.3; Figure 6.6). Additional variations in the water table may be caused by aquifer heterogeneities and variable discharge to the pond. When the total possible surveying and measurement errors of approximately ±0.2 ft or more are compared to the differences between wells, the distinctions between the wells disappear.



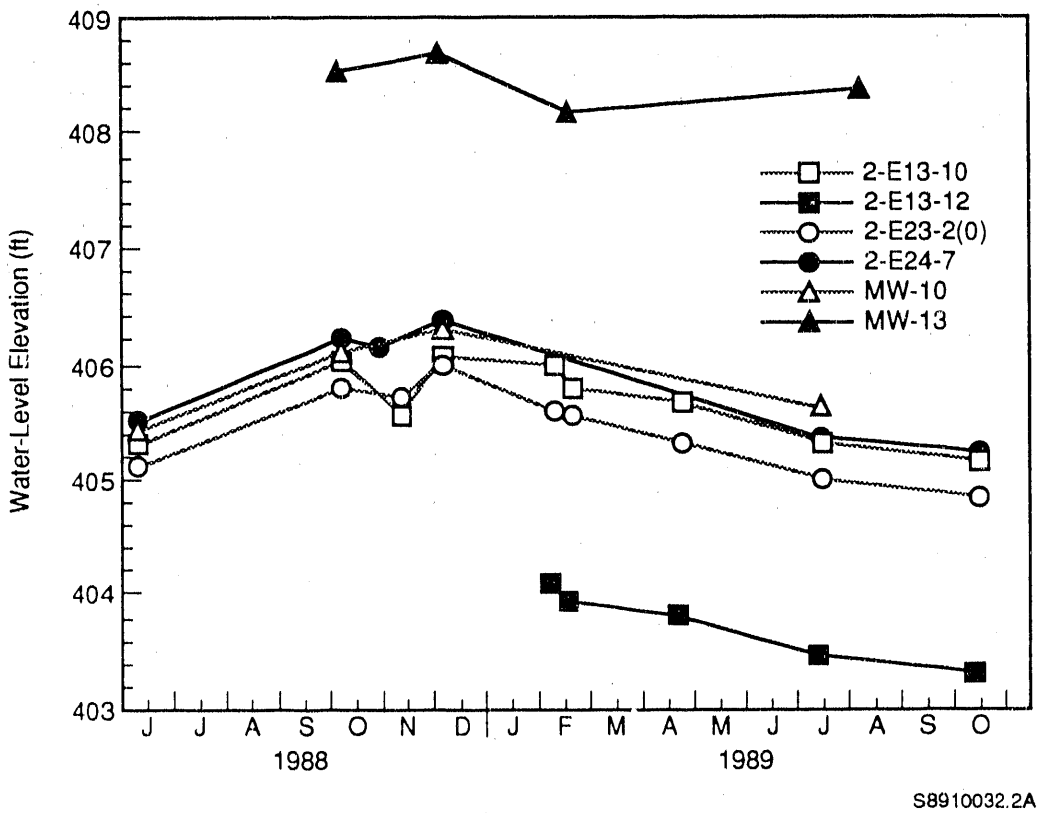


FIGURE 6.6. Hydrographs for 2101-M Pond and Nearby Wells

6.3.3 Aquifer Properties

Aquifer tests were conducted in the wells installed around the 2101-M Pond. Pumps were set close to the bottom of each well. Results of the aquifer test analyses, as well as the drawdown data trends, indicate that heterogeneous aquifer materials underlie the 2101-M Pond. The wells were not designed for aquifer testing but rather were designed as ground-water monitoring wells; therefore, the results are considered to provide qualitative estimates of transmissivity and storativity. A summary of the test analyses is presented in Table 6.4. The data used for analyses are included in Appendix C. The tests for each well are summarized below. Equations used to calculate transmissivity and storativity for each specific analysis method are presented only on the first figure on which they are used.

6.3.3.1 299-E18-1 Aquifer Test

A single-well, constant-discharge test was conducted on August 3, 1988. No response was measured in well 299-E18-2, which is located approximately 465 ft away.

The average discharge rate was approximately 13.3 gpm and fluctuated between approximately 12.7 and 13.7 gpm. The discharge rate was calculated by measuring the time it took to fill a bucket of known volume (5.73 gal). An in-line flowmeter was not available. The duration of pumping was 236 min. A 1.5-hp submersible pump was used and was set at a depth of approximately 327 ft below land surface.

Drawdown and recovery data were collected. Water-level measurements for both drawdown and recovery were made with an electric tape. The transducer system that was used in support of aquifer tests at the 2101-M Pond could not be lowered to the water level because the pump discharge pipe and electrical wires created an obstruction.

Data Analysis. The water level initially dropped slightly more than 1 ft, then continued a consistent downward trend until the water level stabilized about 140 min after pumping started. The initial rapid drop

TABLE 6.4. Summary of Aquifer Test Results for 2101-M Pond Wells

Well Number	Screened Interval Tested, ft	Type of Test	Transmissivity, ft^2/d	Storativity	Pumping Well Number	Analysis Method	Date Tested
299-E18-1	308.5-329	Constant Discharge	700	---	299-E18-1	Cooper-Jacob (1946)	8/3/88
		Recovery	700	---	299-E18-1	Cooper-Jacob (1946)	8/3/88
		Constant Discharge	700-800	---	299-E18-1	Theis (1935), Wenzel (1942)	8/3/88
299-E18-2	309-329.5	Constant Discharge	2,000	---	299-E18-2	Cooper-Jacob (1946)	11/4/88
		Constant Discharge	9,000[a]	0.01[a]	299-E18-3	Theis (1935), Wenzel (1942)	8/3/88
299-E18-3	309.5-330	Constant Discharge	6,000[b]	---	299-E18-3	Cooper-Jacob (1946)	8/12/88
		Recovery	3,000[b]	---	299-E18-3	Cooper-Jacob (1946)	8/12/88
299-E18-4	308-328.5	Constant Discharge	---[c,d]	---	299-E18-4	---	11/2/88
		Constant Discharge	---[d]	---[c,d]	299-E18-3	---	8/12/88
		Recovery	---[d]	---[d]	299-E18-3	---	8/12/88

(a) Results are qualitative and may be unreliable due to insufficient stress and/or an insufficient length of pumping.
(b) Results were determined from later time data.
(c) No discernible slope was present in the data, indicating relatively high transmissivity.
(d) Data were not analyzed because the magnitude of response was too small and/or data were unreliable.

in water level is attributed to well losses. The maximum drawdown was approximately 3 ft. Borehole storage effects were calculated to be dissipated after approximately 1 min.

Drawdown and recovery data were plotted on semilogarithmic paper and analyzed using the Cooper-Jacob method (Figures 6.7 and 6.8). Drawdown was plotted against time (t), and recovery was plotted against time since pumping started divided by time since pumping ceased (t/t′). Both the drawdown and recovery data indicate a transmissivity of approximately 700 ft^2/d.

Drawdown data were also plotted on full logarithmic paper and analyzed using the Theis type-curve fitting technique as a corroborative check of the Cooper-Jacob analyses (Figure 6.9). Transmissivity was calculated to be approximately 800 ft^2/d, which is consistent with the results obtained using the straight-line solutions.

Discussion. The major limitation is the well's partial penetration of the aquifer; thus, the transmissivity could be greater than the estimated 700 to 800 ft^2/d. The actual value or the range of error, however, cannot be determined because no information is available on the nature of the sediments underlying the bottom of the well and the total thickness of the aquifer. In addition, the effects of well losses could not be quantified.

The slope of the drawdown data changed about 140 min after the start of pumping, when the water levels had apparently stabilized. The data beyond this time were not analyzed. The stabilization of the water levels may be caused by several factors including higher-permeability materials some distance from the well, continued development of the well, delayed-yield response, and effects of partial penetration.

6.3.3.2 299-E18-2 Aquifer Test

A single-well, constant-discharge test was conducted on November 4, 1988. This test was conducted in conjunction with redevelopment of the well, which was the primary purpose for pumping the well. No response was measured in well 299-E18-3, which is located approximately 128 ft away.

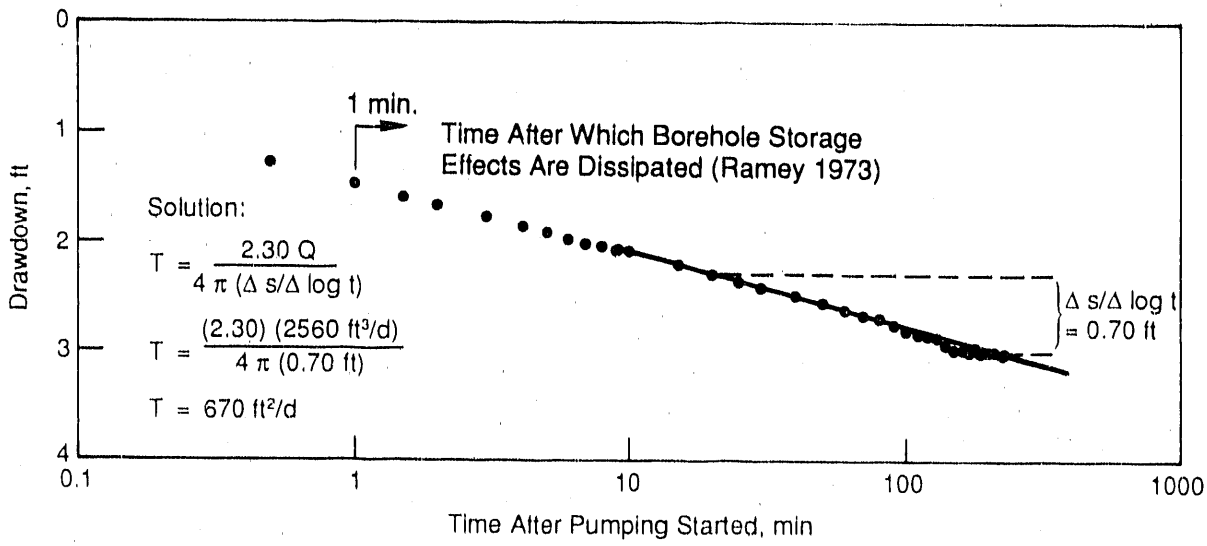


FIGURE 6.7. Well 299-E18-1 Semilogarithmic Plot and Cooper-Jacob Analysis of Drawdown Data Measured with an Electric Tape

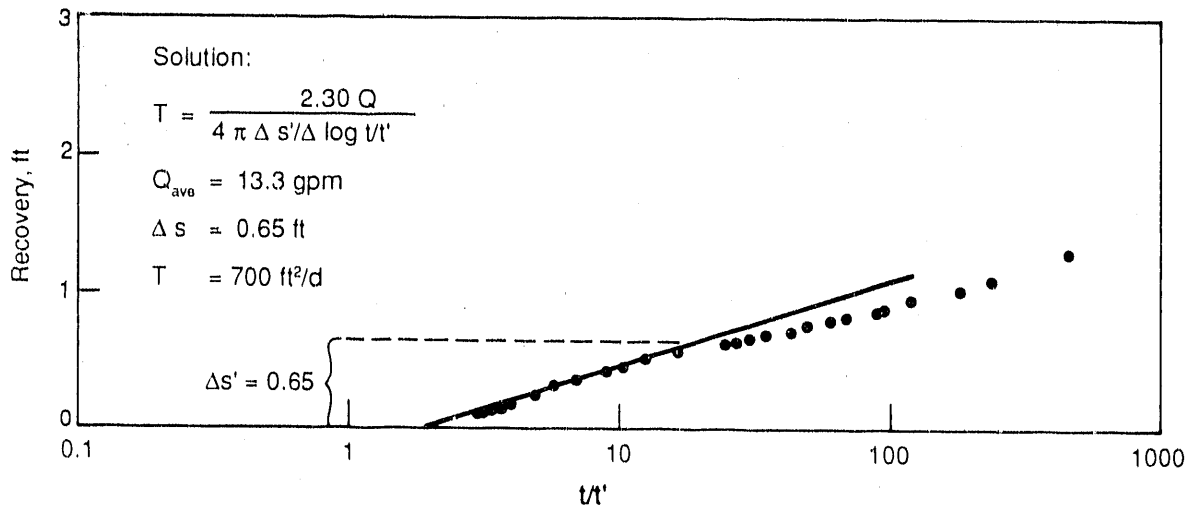


FIGURE 6.8. Well 299-E18-1 Semilogarithmic Plot and Cooper-Jacob Analysis of Recovery Data Measured with an Electric Tape

The average discharge rate was approximately 9 gpm and fluctuated between approximately 8.8 and 9.5 gpm. The discharge rate was calculated by measuring the time it took to fill a bucket of known volume (5.73 gal). An in-line flowmeter was not available. The duration of pumping was 220 min. A 1.5-hp submersible pump was used and was set at a depth of approximately 326.5 ft below land surface.

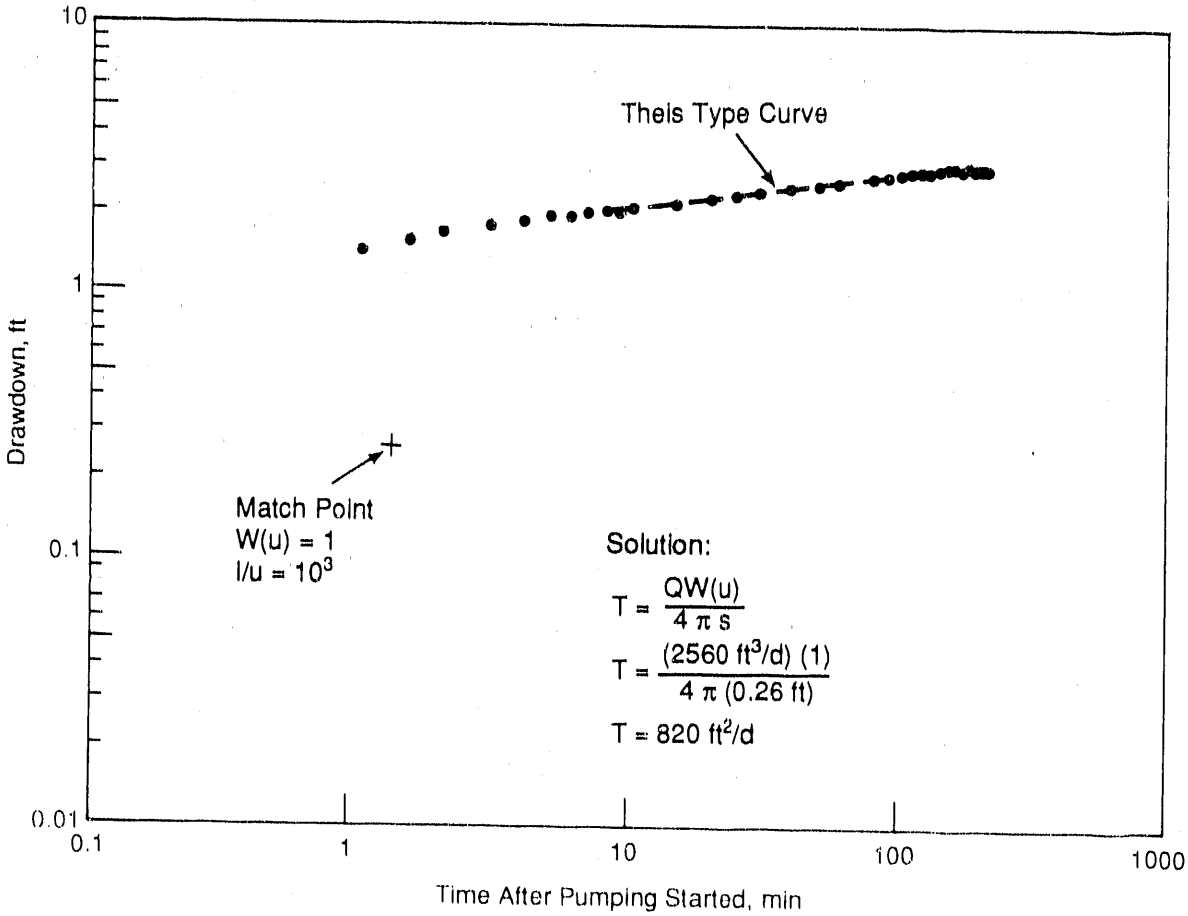


FIGURE 6.9. Well 299-E18-1 Full Logarithmic Plot and Theis Analysis of Drawdown Data Measured with an Electric Tape

No recovery water-level data were collected because the pump's check valve had been removed, allowing water in the pump column to drain back into the well. Water-level measurements were made with an E-tape. The transducer system was not used.

Data Analysis. The water level initially dropped about 1.5 ft, then gradually declined until approximately 100 min after pumping began, at which time the water level had apparently stabilized. The initial decline in water level is attributed to well losses. The maximum drawdown was approximately 1.8 ft. Borehole storage effects were calculated to be dissipated after approximately 1.4 min.

Drawdown was plotted against time on semilogarithmic paper and the data were analyzed using the Cooper-Jacob straight-line method (Figure 6.10). The transmissivity was calculated to be approximately 2000 ft^2/d.

Discussion. The analyses provide an estimate for transmissivity of approximately 2000 ft^2/d. One major limitation is the well's partial penetration of the aquifer; thus, the transmissivity could be greater than this. The actual value, or the range of error, however, cannot be determined because no information is available on the nature of the sediments underlying the bottom of the well and the total thickness of the aquifer. Another limitation is that the amount of drawdown was small (0.3 ft) after the initial 1.5 ft of drawdown occurred. In addition, the effects of well losses could not be quantified.

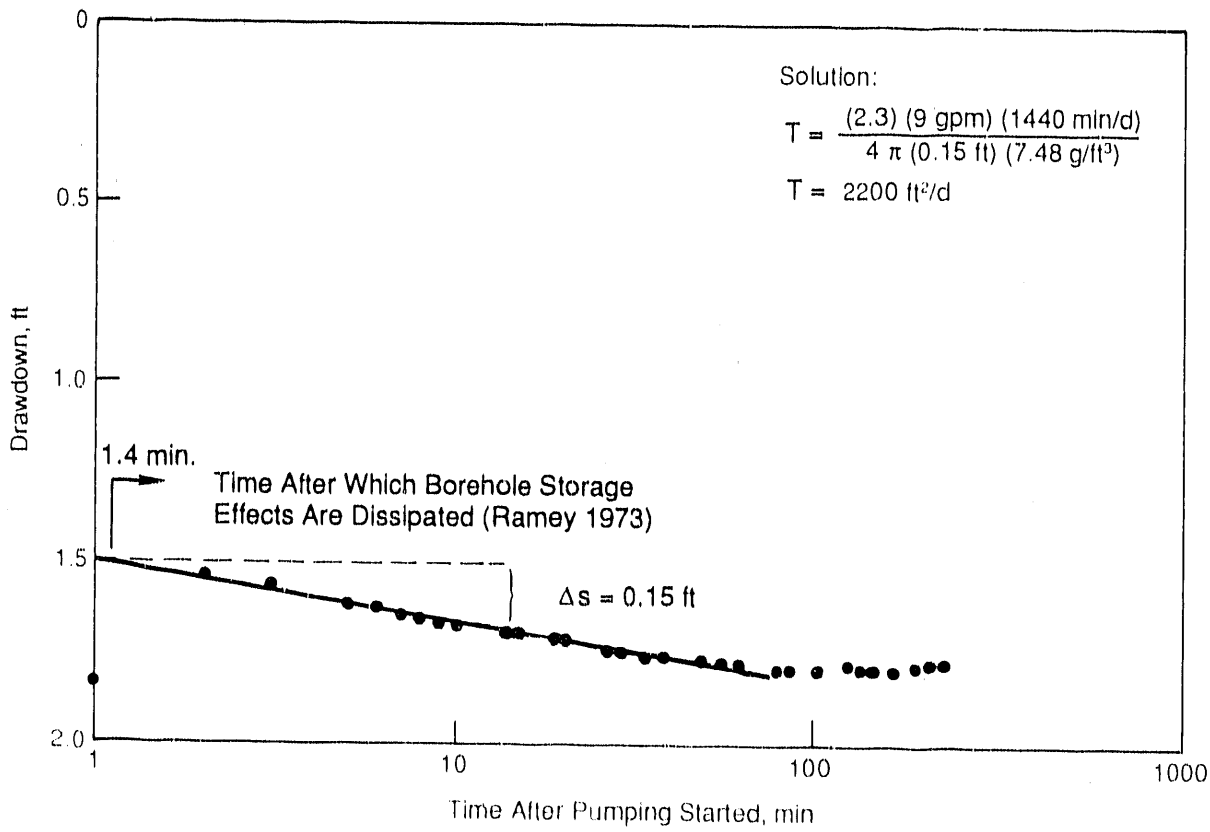


FIGURE 6.10. Well 299-E18-2 Semilogarithmic Plot and Cooper-Jacob Analysis of Drawdown Data Measured with an Electric Tape

The slope of the drawdown data changed about 30 min after the start of pumping and again after 100 min. The water level apparently stabilized at this later time, and the data beyond this time were not analyzed. The stabilization of the water levels may indicate higher-permeability materials some distance from the well, continued development of the well, and/or partial penetration effects.

6.3.3.3 299-E18-3 Aquifer Test

Several aquifer pumping tests were attempted at this well. The first attempt was made when an 8-in. telescoping screen was in the well and before the final well materials were installed. On July 20, 1988, a 40-hp submersible pump was installed in the well. It was anticipated that the aquifer in the vicinity of the 2101-M Pond had high transmissivity (100,000 ft^2/d or more), and thus a high discharge rate would be necessary to achieve measurable drawdown in the observation wells. This pump was too large, because it presumably drew the water level down to the intake, as indicated by a highly fluctuating discharge rate that could not be sustained at more than an estimated 50 gpm. The discharge line could not be kept full and thus the in-line flowmeter would not operate effectively. The 40-hp pump was removed, and a 25-hp pump was installed on July 21. This pump was also too large for the possible well yield, and the flow could not be reduced by a valve because the pressure that built up caused a rubber boot to blow out. To prevent schedule delays, well completion was necessary before again attempting an aquifer test.

A multiple-well, constant-discharge test was conducted on August 12, 1988. Water was discharged from well 299-E18-3. Wells 299-E18-2 and 299-E18-4 were used as observation wells. Well 299-E18-2 is located approximately 128 ft from well 299-E18-3, and well 299-E18-4 is located approximately 61 ft from well 299-E18-3.

The average discharge rate was approximately 34 gpm. Discharge was measured with a 1.5 in. in-line totalizing flowmeter. The duration of pumping was 300 min. A 5-hp submersible pump was used, and the intake was set at a depth of approximately 323 ft below land surface.

Drawdown and recovery measurements were taken for each well. Measurement methods for each well are indicated below.

- 299-E18-3: Drawdown and recovery data were collected with E-tape. The pressure transducer would not fit into the well.
- 299-E18-2: Drawdown data were collected with an E-tape and a pressure transducer. Recovery data were collected with a pressure transducer for 40 min only.
- 299-E18-4: Drawdown and recovery data were collected with E-tape and a pressure transducer.

Data Analysis, Well 299-E18-3. Water levels in the pumping well trended downward during the first 10 min of the pumping test. Water levels continued to decline after this time, although at a decreased rate. The maximum drawdown was approximately 2.9 ft. Borehole storage effects were calculated to be dissipated at approximately 20 min by the Earlougher method.

Drawdown and recovery data were plotted on semilogarithmic paper and analyzed using the Cooper-Jacob method (Figures 6.11 and 6.12). Drawdown was plotted against time (t), and residual drawdown was plotted against t/t'. Both portions, or slopes, of the drawdown data were evaluated; however, the late-time data are considered to represent true formation response. The early-time data are dominated by borehole storage and well loss effects. The late-time data results show a transmissivity of approximately 6000 ft^2/d.

The late-time recovery data were also used for analysis. The data indicate a transmissivity of approximately 3000 ft^2/d. No explanation can be given for the factor of two difference between results determined from drawdown and recovery data; however, this is not a significant difference in light of the qualitative nature of the results.

The drawdown data were also plotted on full logarithmic graph paper (Figure 6.13). The unit-slope straight line is plotted on the data, and the approximate time beyond which borehole casing effects are dissipated is shown. Data were not considered adequate for a Theis type-curve analysis.

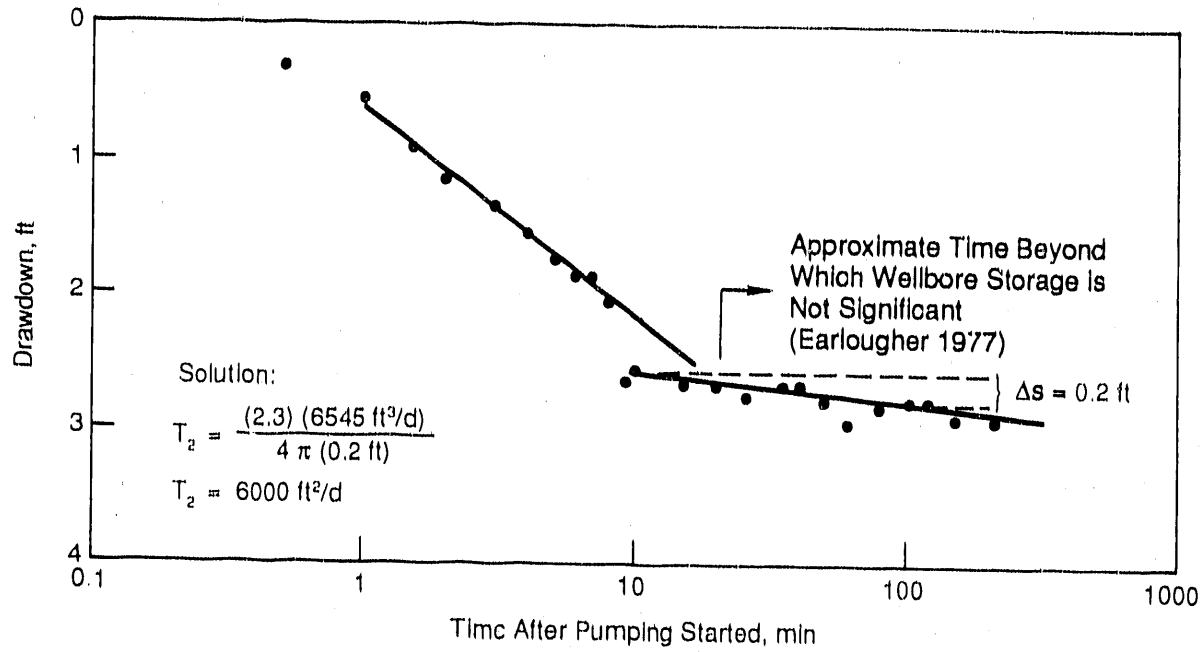


FIGURE 6.11. Well 299-E18-3 Semilogarithmic Plot and Cooper-Jacob Analysis of Drawdown Data Measured with an Electric Tape

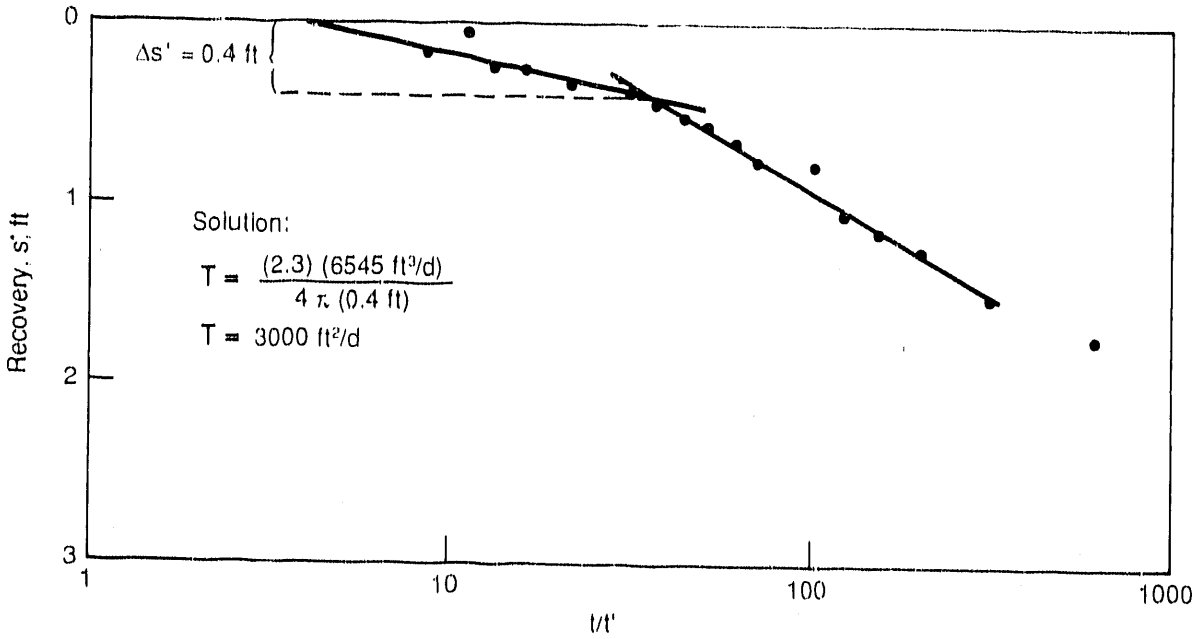


FIGURE 6.12. Well 299-E18-3 Semilogarithmic Plot and Cooper-Jacob Analysis of Recovery Data Measured with an Electric Tape

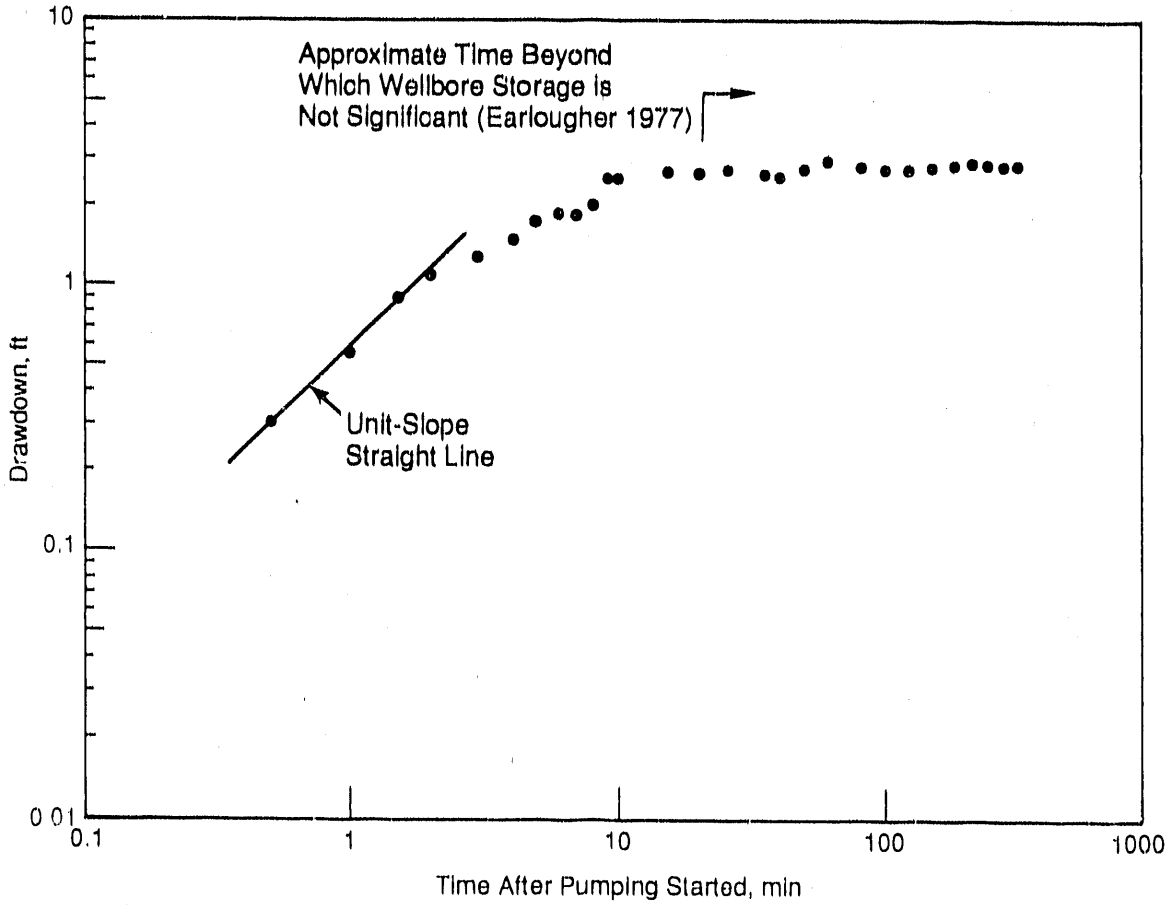


FIGURE 6.13. Well 299-E18-3 Full Logarithmic Plot of Drawdown Data Measured with an Electric Tape

Discussion. The analyses of the data result in a range for transmissivity of approximately 3000 to 6000 ft^2/d. One major limitation is the well's partial penetration of the aquifer, and these effects are unknown. The actual value or the range of error cannot be determined because no information is available on the nature of the sediments underlying the bottom of the well and the total thickness of the aquifer. The data may also be indicating effects of delayed yield within the portion of the data set that was analyzed.

The late-time data are considered to be most representative of the aquifer properties surrounding the pumping well. The early-time data are considered to be affected by borehole storage and well-loss effects.

Data Analysis, Observation Well 299-E18-2. The E-tape and pressure transducer drawdown data were not in agreement. The E-tape data did not provide a trend and indicated a maximum drawdown of 0.04 ft. A "stilling pipe" was not used in this well; thus, water cascading down the inside of the screen from slowly draining aquifer materials may have "shorted out" the E-tape above the actual water surface.

Drawdown data obtained from the pressure transducer system were used for analysis. The transducer data indicated a maximum drawdown of approximately 0.2 ft. Recovery measurements were not recorded long enough to permit analysis.

The drawdown data were plotted on semilogarithmic and logarithmic paper (Figures 6.14 and 6.15). The Cooper-Jacob method of analysis was not valid because the duration of the test was not long enough for 'u' to be ≤ 0.01. The Theis type-curve fitting method results in a transmissivity of approximately 9000 ft^2/d and a storativity of approximately 0.01.

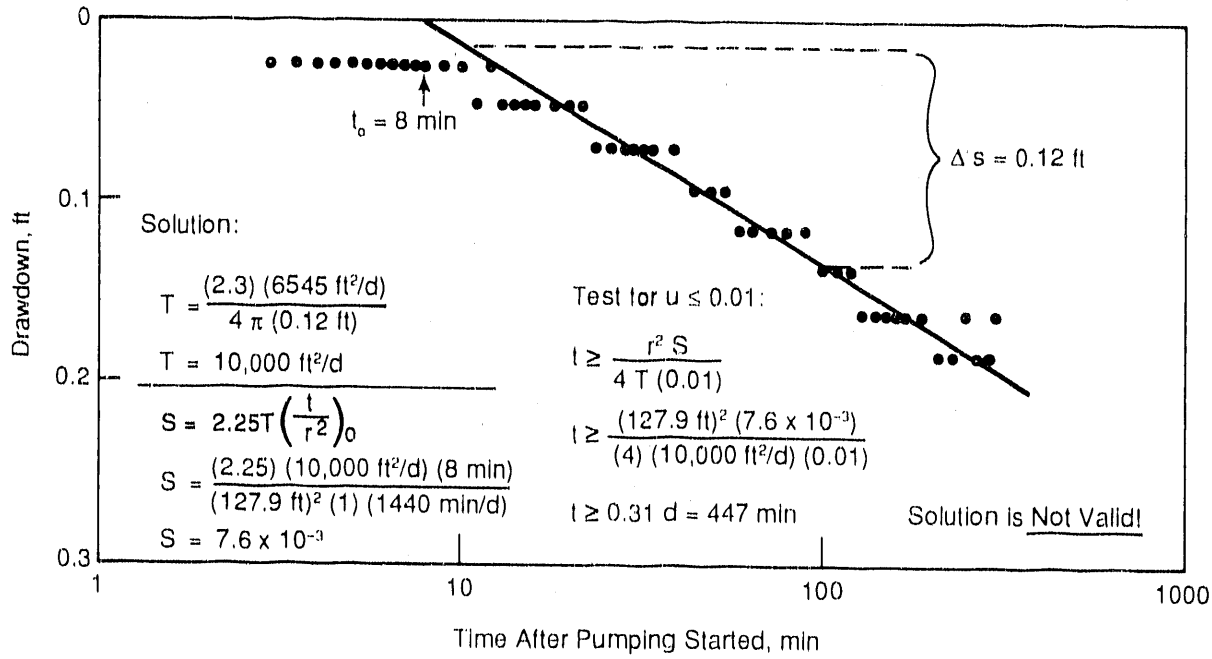


FIGURE 6.14. Well 299-18-2 Semilogarithmic Plot and Cooper-Jacob Analysis of Drawdown Data Measured with a Pressure Transducer (pumping well was 299-E18-3)

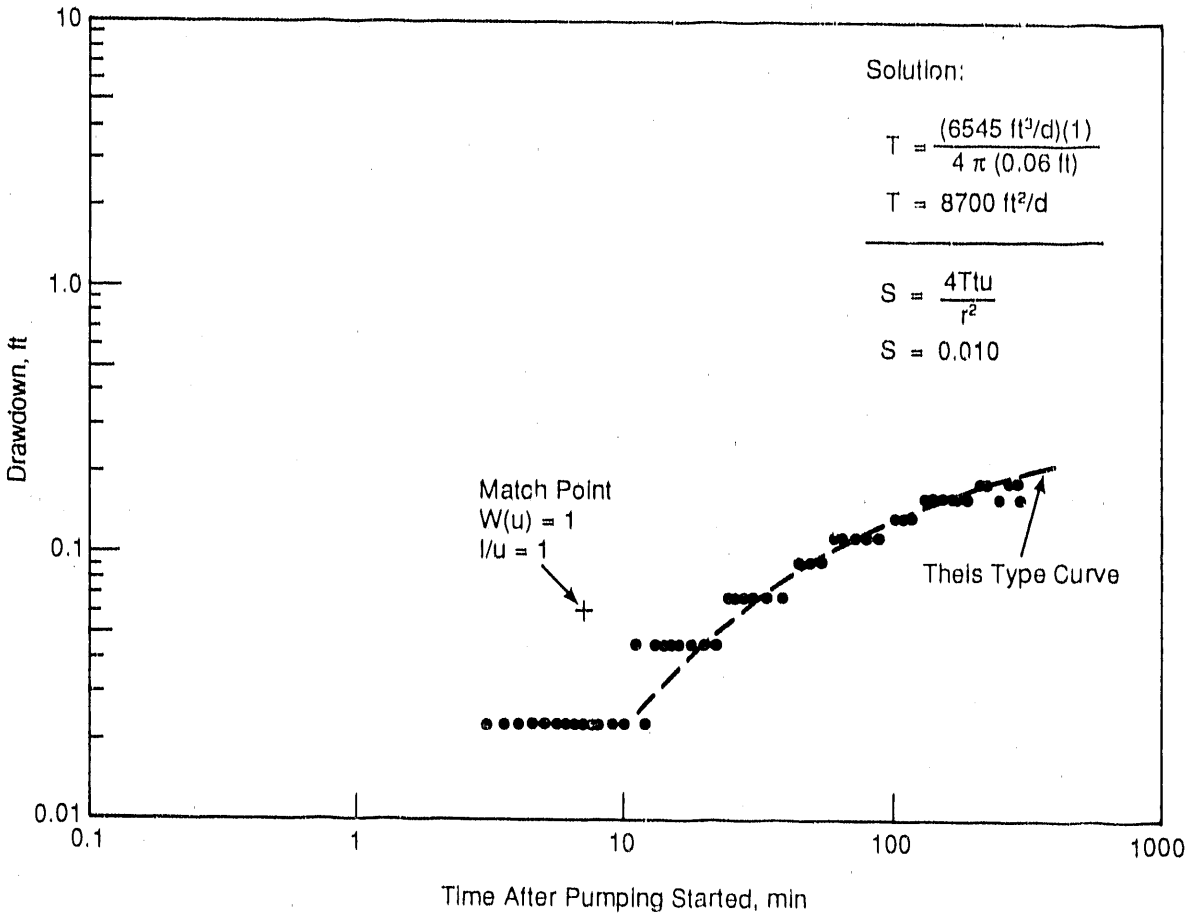


FIGURE 6.15. Well 299-E18-2 Full Logarithmic Plot and Theis Analysis of Drawdown Data Measured with a Pressure Transducer (pumping well was 299-E18-3)

Discussion. The analysis provides estimates for transmissivity and storativity at well 299-E18-2 of approximately 9000 ft^2/d and 0.01, respectively. However, because of the small amount of drawdown (0.2 ft) resulting from inadequate stress and an insufficient length of pumping, these results are considered to be only qualitative.

Data Analysis, Observation Well 299-E18-4. The amount of drawdown for this observation well was also small (0.07 ft for E-tape, 0.08 ft for transducer data) and somewhat erratic. Several questionable measurements were made between 20 and 60 min into the test. The drawdown data from E-tape measurements are plotted on semilogarithmic paper (Figure 6.16). These data are considered inadequate for analysis because the magnitude of observed drawdown is less than two times the precision level of the E-tape and is also less than the magnitude of daily fluctuations caused by

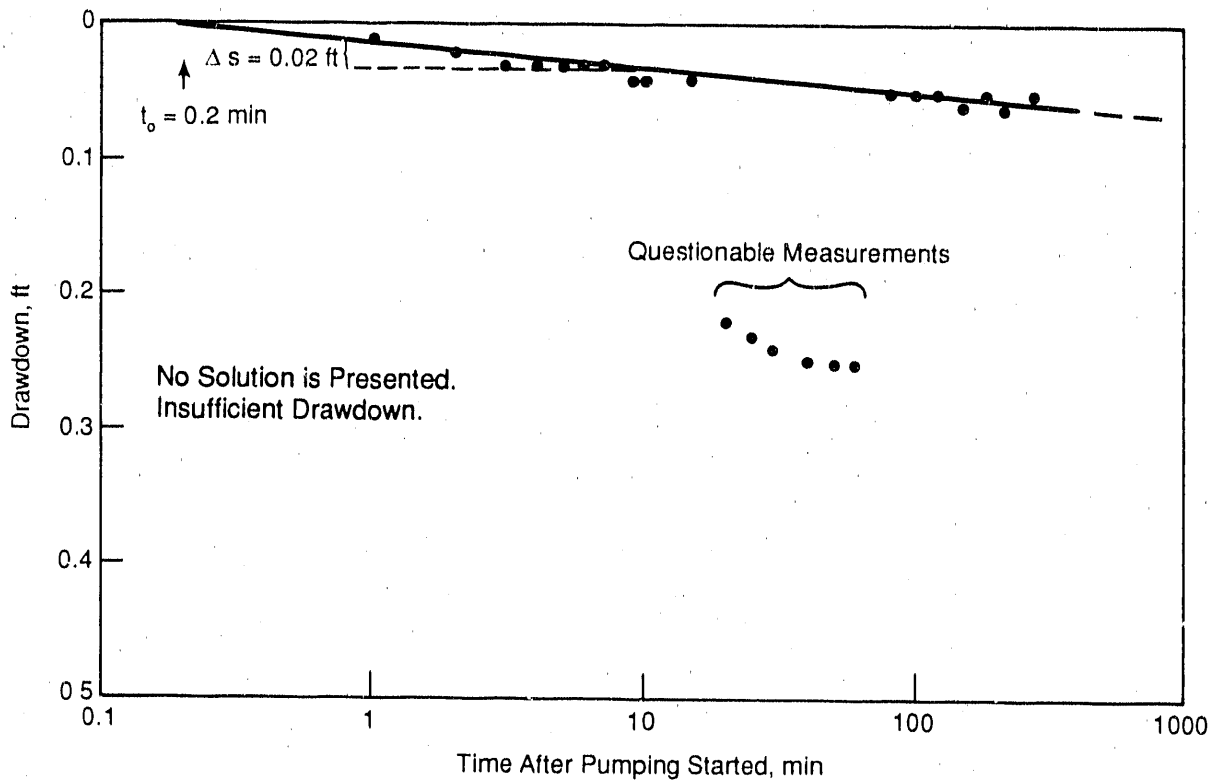


FIGURE 6.16. Well 299-E18-4 Semilogarithmic Plot and Cooper-Jacob Analysis of Drawdown Data Measured with an Electric Tape (pumping well was 299-E18-3)

barometric responses that were observed in well 299-E18-3. However, a transmissivity on the order of 10,000 ft^2/d or greater is possibly indicated. The Cooper-Jacob equation was used to calculate the change in drawdown at various transmissivity values. For a transmissivity of 10,000 ft^2/d, the change in drawdown over a log cycle is 0.03 ft. The pressure transducer drawdown data and analysis are not presented because the data exhibit a large amount of variability and are therefore considered to be unreliable.

Both the E-tape and pressure transducer recovery data are plotted on semilogarithmic paper (Figure 6.17). Electric tape measurements were made during only a portion of the recovery period. Recovery water levels are plotted against t/t′. Two slopes are indicated by the data.

The water level in the well recovered approximately 0.15 ft above its original level during the period monitored after pumping stopped. This

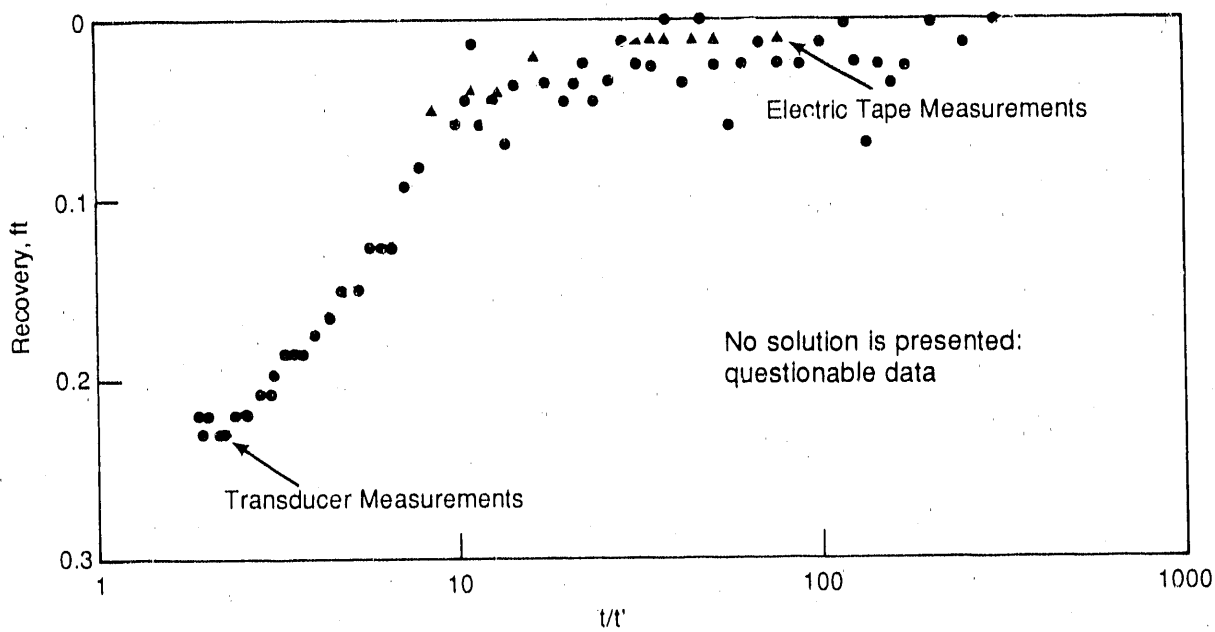


FIGURE 6.17. Well 299-E18-4 Semilogarithmic Plot and Cooper-Jacob Analysis of Recovery Data Measured with a Pressure Transducer and an Electric Tape (pumping well was 299-E18-3)

over-recovery indicates either external influences on the water level (e.g., rising water table or barometric effects) or transducer drift. These influences cannot be differentiated or quantified. Consequently, the recovery data are considered questionable and were not analyzed.

The recovery data plotted on full logarithmic paper are shown in Figure 6.18. Recovery water levels are plotted against time rather than t/t'. Plotting the data in this manner assumes that there were no residual trends occurring at the time that pumping ceased. Extrapolation of the slope of the drawdown data (see Figure 6.16) indicates less than 0.01 ft of change in water level between 300 and 600 min after the start of pumping, which coincides with the recovery period. A Theis curve-fit analysis of these data was not performed for the reasons discussed above.

Discussion. Neither drawdown nor recovery data were analyzed due to insufficient drawdown (0.08 ft) during pumping and questionable data during recovery. However, drawdown data do indicate a transmissivity possibly greater than 10,000 ft^2/d.

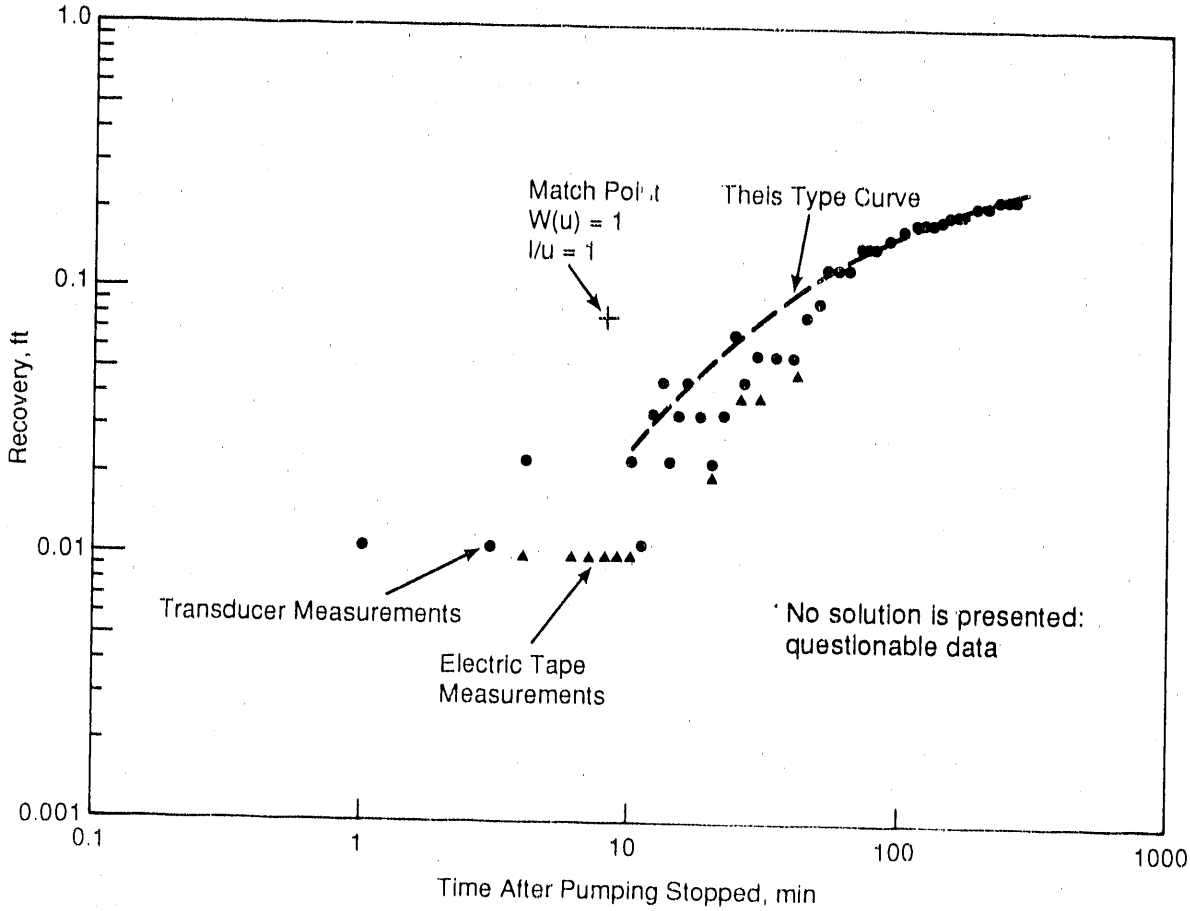


FIGURE 6.18. Well 299-E18-4 Full Logarithmic Plot and Theis Analysis of Recovery Data Measured with a Pressure Transducer and an Electric Tape (pumping well was 299-E18-3)

6.3.3.4 299-E18-4 Aquifer Test

A multiple-well, constant-discharge test was conducted on November 2, 1988. This test was conducted in conjunction with well redevelopment, which was the primary purpose for pumping the well. Well 299-E18-3, which is located 61 ft away, was used as an observation well.

The average discharge rate was approximately 9 gpm, fluctuating between approximately 9.0 and 9.5 gpm. The discharge rate was calculated by measuring the time it took to fill a bucket of known volume (5.73 gal). An in-line flowmeter was not available. The duration of pumping was 200 min. A 1.5-hp submersible pump was used and was set at a depth of approximately 325 ft below land surface.

No recovery water-level data were collected because the pump's check valve had been removed, allowing water in the pump column to drain back down into the well. An E-tape was used to measure water levels in both wells. The transducer system was not used.

Data Analysis. Water levels in the pumping well declined approximately 0.06 ft within the first minute of pumping and then remained nearly constant throughout the test. Water levels in well 299-E18-3 began to decline after about 90 min of pumping and declined slowly, to a maximum of 0.04 ft, until pumping ceased. A preliminary analysis of the observation well data indicates that the test was not conducted long enough for 'u' to be ≤ 0.01.

The pumping well data were not evaluated quantitatively because no drawdown trend was established. However, a transmissivity on the order of 10,000 ft^2/d or greater is possibly indicated. The Cooper-Jacob equation was used to calculate the change in drawdown at various transmissivity values. For a transmissivity of 10,000 ft^2/d, the change in drawdown over a log cycle is 0.03 ft. This magnitude of drawdown may be masked by uncertainties in taking the water-level measurements or by external effects (e.g., barometric effects).

Discussion. Data from this test cannot provide estimates of transmissivity. This test was constrained by several factors including 1) the well's partial penetration of the aquifer, 2) the insufficient stress imposed (thus no drawdown trend in the pumping well), and 3) insufficient test duration to allow analysis of observation well data.

6.3.3.5 Summary of Aquifer Test Results

The results obtained from the aquifer tests conducted at the 2101-M Pond provide estimates of hydraulic properties for the uppermost part of the aquifer. A summary of the results is provided in Table 6.4. Limitations were caused by well design (partial penetration), how the test was conducted (insufficient stress and length of pumping), and uncertainties in measurements of discharge rate and water levels.

The overall range of transmissivity values obtained is from approximately 700 ft^2/d at well 299-E18-1 to approximately 9000 ft^2/d at

well 299-E18-2. Transmissivity values for wells 299-E18-2 and 299-E18-3 range from approximately 2000 ft^2/d to approximately 9000 ft^2/d. The data from well 299-E18-4 indicated the transmissivity at this location may be greater than 10,000 ft^2/d; however, the data were not analyzed for a quantitative solution. It is unknown whether the lower values determined at well 299-E18-1 represent actual aquifer characteristics or whether the analysis was severely affected by well loss or other factors.

The value determined for storativity is 0.01 at well 299-E18-2.

6.3.4 Ground-Water Chemistry

The chemistry of the ground water beneath the 2101-M Pond can be divided into two somewhat overlapping categories. The first consists of the principal chemical components of the ground water, while the second deals with the quality of the ground water as influenced by the pond and whether it has been adversely affected by the pond. The former is discussed in this subsection, while the latter is discussed in Chapter 7.0.

To evaluate the chemistry of the ground water upgradient of the 2101-M Pond, data from wells up to 2 mi away were examined (Figures 6.19 and 6.20). Cation and anion data from these wells were used to create Piper trilinear diagrams (Figure 6.20), revealing similarities and differences between samples. The classification scheme of the ground water is then based on the dominance of various cations or anions. Most of the wells plot fairly close together on the Piper diagram, representing calcium or sodium-calcium/ carbonate ground-water types. The only well that appears to be significantly different is well 299-E18-1, which has a lower carbonate and higher percentage of sulfate than the other wells and represents a calcium/ sulfate ground-water type. The cause for the increased percentage of sulfate in this well is discussed in Chapter 7.0 in greater depth. The Piper diagram does indicate a somewhat lower percentage of calcium in well 299-E18-2, which may be caused by dilution of the aquifer through recharge from the pond.

Additional indications of the differences between well 299-E18-1 and the wells adjacent to the pond (and consequently that well 299-E18-1 is unaffected by recharge from the pond) are the consistently higher concentrations of boron, sodium, strontium, selenium, magnesium, and calcium, and

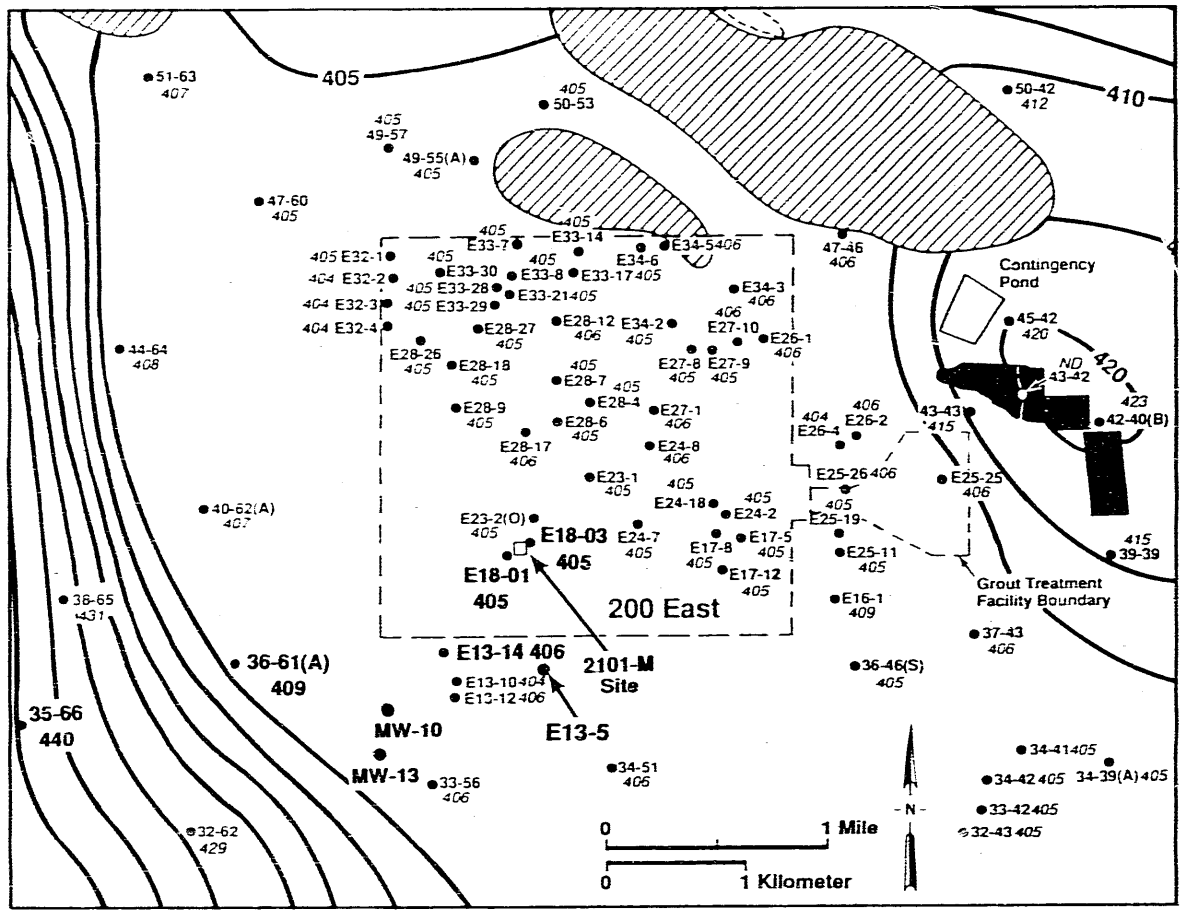


FIGURE 6.19. Location of Wells Used for Hydrochemical Comparison (modified from Serkowski et al. 1988). Data from wells in bold are shown in Figure 6.20.

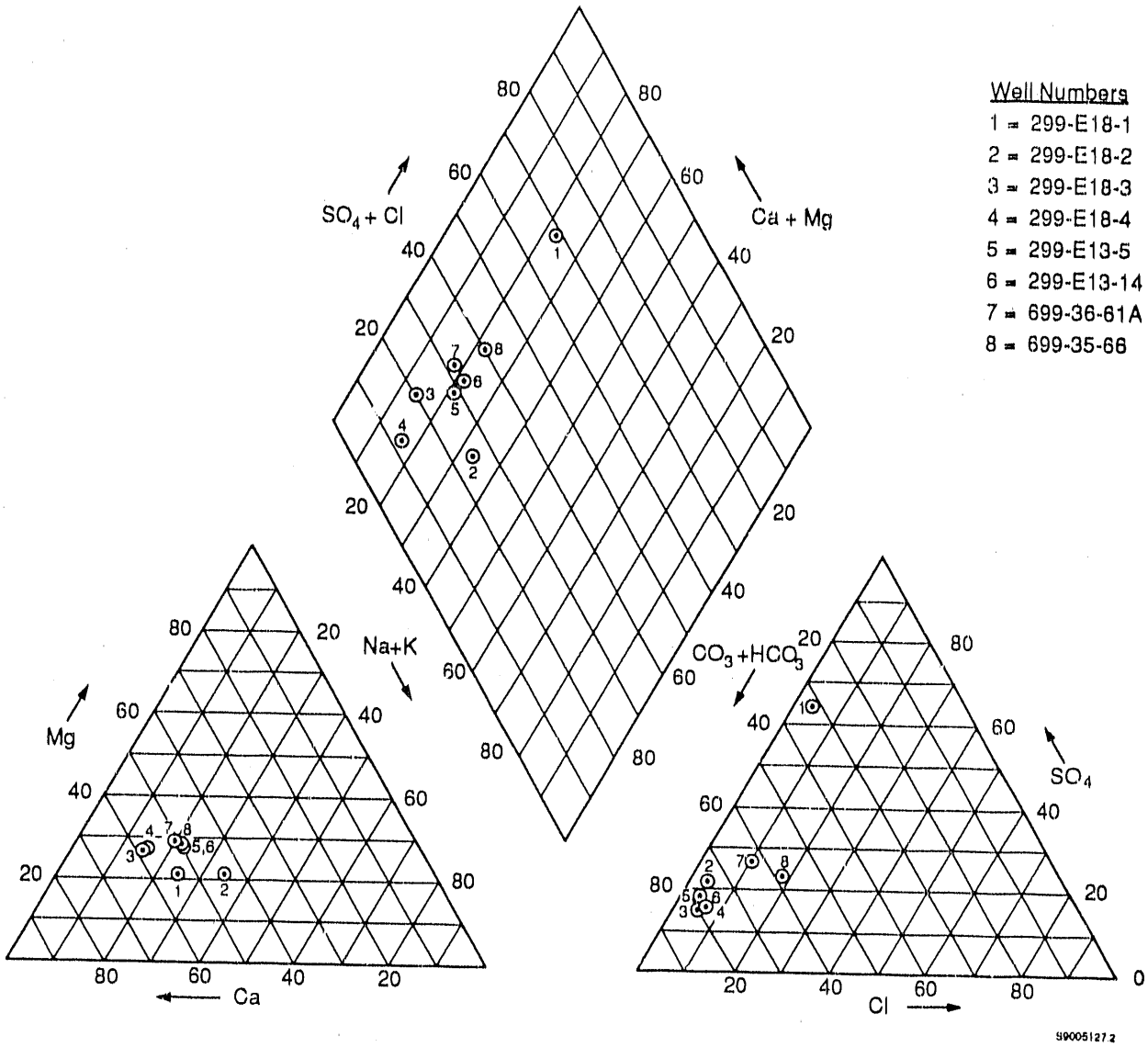


FIGURE 6.20. Piper Diagram

the consistently lower concentrations of vanadium and silicon. One reason for the differences in concentrations may be the leaching effects of the water discharged to the pond on the elements naturally present in the sediments. For instance, silicon may be present in greater concentrations in the wells adjacent to the pond because the artificial recharge from the pond is leaching silicon from the sediments and into the ground water. On the other hand, strontium and magnesium are normally present in Hanford Site ground water in concentrations similar to those in well 299-E18-1, and the

lower values in the wells adjacent to the pond are probably due to the dilution effect of artificial recharge. Constituents such as nitrate and sulfate are also higher in well 299-E18-1 than the other wells, but are because of waste water discharges in the upgradient 200-West Area. These constituents are discussed in more detail in Chapter 7.0.

6.3.5 Direction and Rate of Ground-Water Movement

As discussed in Subsection 6.2.1, regional ground-water flow is to the northeast in the general vicinity of the 2101-M Pond (Figure 6.3). Because the differences in the water-level elevations in the four monitoring wells at the pond are equal to or less than the total possible error in measurement, the flow direction beneath the pond is not immediately obvious. However, the hydrographs (Figure 6.6) indicate that the wells southwest of the pond (299-E18-1, MW-10, and MW-13 on Figure 6.3) show an increase in water-level elevations proportional to the distance from the pond, while the rest of the wells measured in other directions had elevations equal to or less than those found beneath the pond. Well 299-E18-1 consistently shows higher water levels than the three other wells. In addition, the presence of elevated sulfate in well 299-E18-1 is thought to come from an old well (299-E19-1) located 1600 ft southwest of the pond, which was backfilled with drilling mud containing petroleum by-products (see Chapter 7.0 for a more detailed discussion). If well 299-E19-1 is the source of the sulfate, then the ground-water flow direction must be to the northeast to have carried a plume of sulfate to well 299-E18-1.

As discussed in Subsection 6.3.1, there is a possibility of a small ground-water mound beneath the pond. Based on modeling and the slight water-level differences between the three wells adjacent to the pond and upgradient well 299-E18-1, it is thought that any mounding is probably on the order of hundredths to a few tenths of a foot high. Consequently, any vertical gradient should be relatively insignificant in comparison to the horizontal gradient.

Ground-water velocity was estimated for the vicinity of the 2101-M Pond. When possible, the values assigned to the parameters controlling ground-water

velocity were based on tests or measurements made at the pond. Minimum and maximum values for ground-water velocity are calculated and presented, based on a range of input values.

The equation from which the ground-water velocity is calculated is a form of Darcy's Law taken from Freeze and Cherry (1979). It is expressed as

$$v = \frac{KI}{n}$$

where v = average linear velocity

K = hydraulic conductivity

I = hydraulic gradient

n = effective porosity.

Assumptions used for the calculation of ground-water velocity are

- K = 25 to 150 ft/d (based on an assumed "most representative" range of transmissivity from approximately 1000 to 6000 ft^2/d and an assumed aquifer thickness of 40 ft)
- I = 4×10^{-4} ft/ft (based on several sets of water-level measurements made in the wells near the pond)
- n = 0.1 (conservative estimate based on Graham et al. 1981a).

Minimum and maximum calculated values for ground-water velocity are

for K = 25 ft/d v = 0.1 ft/d

and

for K = 150 ft/d v = 0.6 ft/d.

7.0 GROUND-WATER QUALITY

This chapter discusses ground-water quality related to potential contamination, while Subsection 6.3.4 discussed the chemical components representing ground-water types. Information on ground-water quality is derived from two principal sources: 1) chemical analyses of ground-water samples collected from the four new wells for background and indicator evaluation monitoring, and 2) data from other nearby wells. Appendix B provides a list of all the constituents for which analyses were performed and their contractual detection limits (i.e., detection limits accepted in the contract between the analytical laboratory and PNL). Appendix B also provides all results for any constituents detected at least once in any of the four wells. If a constituent does not appear in Appendix B, it is because the constituent has never been detected in any of the samples from any of the four wells. Each monitoring well has been sampled five times (August and November 1988, and February, May, and August 1989) for the minimum required constituents as required by 40 CFR 265 and WAC 173-303 and occasionally for tritium, turbidity, and alkalinity. In addition, each well was sampled once (November 1988) for the constituents listed in Appendix VIII of 40 CFR 261 and WAC 173-303-9905. Each well was also resampled for metals only in September 1988. The interpretation of the results is discussed below.

7.1 BACKGROUND GROUND-WATER QUALITY

Background (upgradient) ground-water quality data provide a baseline against which the downgradient well data can be compared. This comparison indicates whether the site is adversely affecting the ground water. The background monitoring well, 299-E18-1, has been sampled quarterly since August 1988 for the contamination indicator, ground-water quality, and drinking water quality parameters required by 40 CFR 265.92(b) and WAC-173-303. Statistical analyses were performed as required by these regulations for the contamination indicator parameters, which are pH, specific conductance, total organic carbon, and total organic halogen. It should be noted that data are reported for both field and laboratory

measurements of pH and specific conductance. However, the laboratory measurements are presented as ancillary information only and are not included in the final statistical analyses to determine if the facility is affecting ground-water quality. Table 7.1 provides the background contamination indicator data that were used for the background statistical analysis. Tables 7.2 and 7.3 provide the average replicate statistics and the background statistics, respectively.

The statistical analyses presented here are based on guidance in Appendix B of the RCRA Ground-Water Monitoring Technical Enforcement Guidance Document (TEGD) (EPA 1986a). The Bonferroni critical values given in Appendix B of the TEGD contain several problems. These include numerous typographical errors in the tables and the use of an approximation method for computing the Bonferroni critical values, which performs poorly for small degrees of freedom. Consequently, a formula was used to calculate exact Bonferroni critical values, and a more extensive set of tables was created for use in the t-test.

The TEGD states that there is a statistical indication of contamination if the test statistic (t*) is larger than the Bonferroni critical value (tc), (i.e., t* > tc). Because of the nature of the test statistic (t*) given in the TEGD (i.e., the results to be compared to background do not contribute to the estimate of the variance), the test can be reformulated in such a way that a critical mean (mc) can be obtained, without waiting for the fifth quarter of data to be collected. Any subsequent average replicate (ar) mean that exceeds the critical mean (ar > mc) then gives the identical indication of contamination as t* > tc. The critical means and the information used to construct them are given in Table 7.4.

7.2 GROUND-WATER QUALITY BENEATH THE 2101-M POND

Each well has been sampled six times in the past year, four times for the indicator, drinking water quality, and ground-water quality parameters; once for the list contained in WAC 173-303-9905, and the extra sampling performed in September 1988 for metals analysis only. The quality of the

TABLE 7.1. Background Contamination Indicator Parameter Data
(Data collected from August 1988 to June 1989)

Well Name	Collection Date	Duplicate Sample Number	CONDFLD µmho 1/700(w)	CONDLAB µmho NA/700(w)	PH-LAB 0.01/8.5(s)	PHFIELD 0.1/8.5s	TOC ppb 2000/NA	TOXLDL ppb 10/NA	Constituent Name Analysis Units Contractual Detection Limit/ Drinking Water Standard
			Quadruplicate Contamination Indicator Parameters						
299-E18-1	16AUG88		812	534	7.9	7.8	#532	#1.3	
		1	812	531	7.9	7.8	#890	#11.5	
		2	811	529	7.9	7.9	#382	#11.4	
		3	809	521	7.9	7.8	#397	#-4.8	
299-E18-1	10NOV88		595	571	7.9	8.6	#400	#4	
		1	594	586	7.9	8.6	#300	#0	
		2	593	588	8	8.5	#300	#3	
		3	594	583	7.9	8.5	#300	#3	
299-E18-1	15FEB89		537	514	7.9	7	#200	#5	
		1	534	512	7.8	7	#200	#5	
		2	532	510	7.7	6.9	#200	#0	
		3	531	517	7.8	6.9	#200	#5	
299-E18-1	26MAY89		550	503	8	7.89	#500	#4	
		1	549	474	8	7.89	#500	#3	
		2	549	484	8	7.89	#300	#3	
		3	549	498	8	7.89	#600	#3	

w - Based on additional Secondary Maximum Contaminant Levels in WAC 248-54, Public Water Supplies.
s - Based on Secondary Maximum Contaminant Levels in 40 CFR 143, National Secondary Drinking Water Regulations.
- Less than Contractual Detection Limit, measured value reported.
Note: Contractual Detection limit for TOC changed from 1000 ppb to 2000 ppb on January 1, 1989. Contractual Detection limit for TOXLDL changed from 20 ppb to 10 ppb on January 1, 1989.

TABLE 7.2. Average Replicate Statistics for Well 299-E18-1

Constituent Name, units	Collection Date	N	Replicate Average	Replicate Standard Deviation	Replicate Coefficient of Variation
Conductivity-laboratory, µmho	16 Aug 88	4	528.8	5.56	1.1
	10 Nov 88	4	582.0	7.62	1.3
	15 Feb 89	4	513.3	2.99	0.6
	26 May 89	4	489.8	13.23	2.7
Conductivity-field, µmho	16 Aug 88	4	811.0	1.41	0.2
	10 Nov 88	4	594.0	0.82	0.1
	15 Feb 89	4	533.5	2.65	0.5
	26 May 89	4	549.3	0.50	0.1
pH field	16 Aug 88	4	7.83	0.050	0.6
	10 Nov 88	4	8.55	0.058	0.7
	15 Feb 89	4	6.95	0.058	0.8
	26 May 89	4	7.89	0.000	0.0
pH laboratory	16 Aug 88	4	7.9	0.00	0.0
	10 Nov 88	4	7.9	0.05	0.6
	15 Feb 89	4	7.8	0.08	1.0
	26 May 89	4	8.0	0.00	0.0
TOC, ppb	16 Aug 88	4	550	236	42.9
	10 Nov 88	4	325	50	15.4
	15 Feb 89	4	200	0	0.0
	26 May 89	4	475	126	26.5
TOX, ppb	16 Aug 88	4	4.9	8.1	165.3
	10 Nov 88	4	2.5	1.7	69.3
	15 Feb 89	4	3.8	2.5	66.7
	26 May 89	4	3.3	0.5	15.4

ground water based on the statistical evaluation of indicator parameters (per WAC 173-303 and 40 CFR 265.93) is discussed separately from the discussion of the rest of the overall ground-water quality to facilitate regulatory review.

7.2.1 Statistical Evaluation of the Contamination Indicator Parameters

The regulations require the comparison of the background data discussed in Section 7.1 with the data collected each quarter from the three downgradient wells. The three downgradient wells are within the area of lateral

TABLE 7.3. Background Statistics for Well 299-E18-1

Constituent Name, units	N	Background Average	Standard Deviation	Variance	Covariance
Conductivity-laboratory, μmho	N	528.4	39.1	1,532	7.4
Conductivity-field, μmho	4	621.9	128.6	16,543	20.7
pH field	4	7.80	0.66	0.431	8.4
pH laboratory	4	7.91	0.08	0.0068	1.0
TOC, ppb	4	387.6	156.2	24,402	40.3
TOX-low detection limit, ppb	4	3.59	0.99	0.972	27.5

TABLE 7.4. Critical Means for Sixteen Comparisons

Constituent, unit	Low Criteria	High Criteria
Conductivity-laboratory, μmhho	NA	1052.9
Conductivity-field, μmho	NA	2345.2
pH laboratory	6.5076	9.3049
pH field	-3.316	18.923
TOC, ppb	NA	2480.5
TOX-low detection limit, ppb	NA	16.799

spreading in the vadose zone, as indicated by the moisture contents of the sediments, and will detect contamination entering the ground water. A statistical evaluation comparing the background well, 299-E18-1, to the downgradient wells was performed. Table 7.5 gives the contamination indicator parameter data collected from the 2101-M Pond monitoring network in August 1989, and Table 7.6 gives the statistical summaries for the replicates. Comparison of the replicate averages (Table 7.6) against the

TABLE 7.5. August 1989 Contamination Indicator Parameter Evaluation Data

Well Name	Collection Date	Duplicate Sample Number	CONDFLD µmho 1/700(w)	CONDLAB µmho NA/700(w)	PH-LAB 0.01/8.5(s)	PHFIELD 0.1/8.5s	TOC ppb 2000/NA	TOXLDL ppb 10/NA	Constituent Name Analysis Units Contractual Detection Limit/ Drinking Water Standard
			Quadruplicate Contamination Indicator Parameters						
299-E18-1	08AUG89		564	533	8.00	7.89	#300	#3	
		1	567	532	8.00	7.89	#400	#4	
		2	568	534	8.00	7.88	#300	#4	
		3	567	535	8.00	7.88	#300	#2	
299-E18-2	11AUG89		288	285	7.90	8.01	#300	15	
		1	285	284	8.00	8.00	#700	13	
		2	285	288	8.00	8.00	#500	12	
		3	286	288	8.00	8.00	#800	13	
299-E18-3	08AUG89		156	232	8.10	8.20	#500	#8	
		1	156	233	8.10	8.20	#600	#7	
		2	156	232	8.10	8.20	#700	#3	
		3	157	234	8.20	8.20	#600	#8	
299-E18-4	08AUG89		171	253	8.00	8.09	#500	#6	
		1	171	254	8.10	8.08	#400	10	
		2	171	254	8.00	8.08	#500	#5	
		3	171	251	8.10	8.09	#400	14	

w - Based on additional Secondary Maximum Contaminant Levels in WAC 248-54, Public Water Supplies.
s - Based on Secondary Maximum Contaminant Levels in 40 CFR 143, National Secondary Drinking Water Regulations.
- Less than Contractual Detection Limit, measured value reported.

TABLE 7.6. August 1989 Contamination Indicator Parameter Replicate Averages

Constituent Name	Units	Well Name	Sample Date	Reps	Replicate Average	Standard Deviation	Minimum	Maximum	Coefficient of Variation
Conductivity Laboratory	µmho	299-E18-1	08AUG89	4	534	1.3	532	535	0.2
		299-E18-2	11AUG89	4	286	2.1	284	288	0.7
		299-E18-3	08AUG89	4	233	1.0	232	234	0.4
		299-E18-4	08AUG89	4	253	1.4	251	254	0.6
Conductivity Field	µmho	299-E18-1	08AUG89	4	567	1.7	564	568	0.3
		299-E18-2	11AUG89	4	286	1.4	285	288	0.5
		299-E18-3	08AUG89	4	156	0.5	156	157	0.3
		299-E18-4	08AUG89	4	171	0.0	171	171	0.0
pH Field		299-E18-1	08AUG89	4	7.89	0.01	7.88	7.89	0.1
		299-E18-2	11AUG89	4	8.00	0.01	8.00	8.01	0.1
		299-E18-3	08AUG89	4	8.20	0.00	8.20	8.20	0.0
		299-E18-4	08AUG89	4	8.09	0.01	8.08	8.09	0.1
pH Laboratory		299-E18-1	08AUG89	4	8.00	0.00	8.0	8.0	0.0
		299-E18-2	11AUG89	4	7.98	0.05	7.9	8.0	0.6
		299-E18-3	08AUG89	4	8.13	0.05	8.1	8.2	0.6
		299-E18-4	08AUG89	4	8.05	0.06	8.0	8.1	0.7
TOC	ppb	299-E18-1	08AUG89	4	325	50.1	300	400	15.4
		299-E18-2	11AUG89	4	575	222.0	300	800	38.6
		299-E18-3	08AUG89	4	600	81.6	500	700	13.6
		299-E18-4	08AUG89	4	450	57.7	400	500	12.8
TOX-low detection limit	ppb	299-E18-1	08AUG89	4	3.25	0.96	2	4	29.5
		299-E18-2	11AUG89	4	10.80	3.86	5	13	35.9
		299-E18-3	08AUG89	4	6.50	2.38	3	8	36.6
		299-E18-4	08AUG89	4	8.75	4.11	5	14	47.0

critical means (Table 7.4) indicates that none of the contamination indicator parameters are statistically higher (or lower for pH) than background. Therefore, according to 40 CFR 265.93 (and WAC 173-303-400), the 2101-M Pond is not contaminating the ground water at this time.

7.2.2 Evaluation of Constituents Other than Contamination Indicator Parameters

A variety of analyses other than those for the contamination indicators were performed on samples from all four of the ground-water monitoring wells to determine whether any contaminants were present in the ground water. These analyses included quarterly analyses for ground-water quality and drinking water quality parameters as required by 40 CFR 265.92 and one set of samples from each well for analysis of constituents listed in Appendix VIII of 40 CFR 261 (Appendix IX of 40 CFR 264 was not yet in place). Except for some indications of low levels of acetone, none of the constituents in Appendix VIII were detected. After resampling all of the wells for volatile organic compounds and having both UST and PNL laboratories analyze samples from each well, it was decided the acetone was caused by laboratory contamination and was not present in the ground water. Results from both laboratories are provided in Appendix B.

Analysis of the first ground-water samples collected from 2101-M Pond monitoring wells in August 1988 detected levels of chromium, arsenic, selenium, manganese, and iron above or near drinking water standards, which were confirmed by the extra samples taken in September 1988 (Table 7.7). In addition, aluminum, nickel, and radium trends are also higher, although far below any drinking water standards, in these first samples compared with later samples. Although all of these metals are naturally present in the sediments (see Subsection 5.3.3 and Appendix D), the concentrations found in the ground water were higher than anticipated. Although there is no documented information indicating any discharges of these metals to the pond, further investigation of the source of the metals was desired. A simple one-dimensional calculation was performed to determine whether these metals could have reached the ground water beneath the pond, if they were discharged to the pond during the years the BWIP laboratory was in operation (1981 to

TABLE 7.7. Results of Specific Metals Analyses (ppb)

Arsenic	8/88	9/88	11/88	2/89	5/89	8/89
299-E18-1	<5	<5	<5	<5	<5	<5
299-E18-1[a]			<5			
299-E18-2	5	5	6	6	7	6
299-E18-2[a]				6		
299-E18-3	51	11	11	13	14	11
299-E18-3[a]					13	
299-E18-4	11	9	11	11	11	10
299-E18-4[a]						10

Drinking water standard of 50 ppb

Arsenic (F)	8/88	9/88	11/88	2/89	5/89	8/89
299-E18-1	<5	<5	<5	<5	<5	<5
299-E18-1[a]			<5			
299-E18-2	5	5	5	6	5	6
299-E18-2[a]				6		
299-E18-3	12	12	14	12	14	11
299-E18-3[a]					13	
299-E18-4	9	8	9	10	12	10
299-E18-4[a]						9

Drinking water standard of 50 ppb

Chromium	8/88	9/88	11/88	2/89	5/89	8/89
299-E18-1	30	104	30	22	20	100
299-E18-1[a]			20			
299-E18-2	30	87	20	50	28	18
299-E18-2[a]				79		
299-E18-3	62	67	21	104	30	95
299-E18-3[a]					36	
299-E18-4	54	159	21	42	24	65
299-E18-4[a]						80

Drinking water standard of 50 ppb

Chromium (F)	8/88	9/88	11/88	2/89	5/89	8/89
299-E18-1	<10	<10	<10	<10	<10	<10
299-E18-1[a]			<10			
299-E18-2	<10	<10	<10	<10	<10	<10
299-E18-2[a]				<10		
299-E18-3	<10	<10	<10	<10	<10	<10
299-E18-3[a]					12	
299-E18-4	<10	<10	<10	<10	<10	<10
299-E18-4[a]						<10

Drinking water standard of 50 ppb

TABLE 7.7. (contd)

Iron	8/88	9/88	11/88	2/89	5/89	8/89
299-E18-1	1250	1810	355	162	546	531
299-E18-1(a)			265			
299-E18-2	250	535	142	303	124	156
299-E18-2(a)				423		
299-E18-3	963	1440	325	858	284	574
299-E18-3(a)					294	
299-E18-4	493	1580	261	325	121	412
299-E18-4(a)						465

Drinking water standard of 300 ppb

Iron (F)	8/88	9/88	11/88	2/89	5/89	8/89
299-E18-1	33	<30	<30	<30	<30	<30
299-E18-1(a)			<30			
299-E18-2	39	<30	<30	39	<30	<30
299-E18-2(a)				40		
299-E18-3	40	32	53	41	39	<30
299-E18-3(a)					31	
299-E18-4	67	68	<30	<30	32	31
299-E18-4(a)						32

Drinking water standard of 300 ppb

Manganese	8/88	9/88	11/88	2/89	5/89	8/89
299-E18-1	70	46	12	<5	12	12
299-E18-1(a)			12			
299-E18-2	6	13	<5	8	9	<5
299-E18-2(a)				9		
299-E18-3	15	22	<5	18	7	12
299-E18-3(a)					7	
299-E18-4	13	32	5	10	<5	10
299-E18-4(a)						12

Drinking water standard of 50 ppb

Manganese (F)	8/88	9/88	11/88	2/89	5/89	8/89
299-E18-1	51	19	<5	<5	<5	<5
299-E18-1(a)			<5			
299-E18-2	<5	<5	<5	<5	<5	<5
299-E18-2(a)				<5		
299-E18-3	<5	<5	<5	<5	<5	<5
299-E18-3(a)					<5	
299-E18-4	8	11	<5	<5	6	<5
299-E18-4(a)						5

Drinking water standard of 50 ppb

TABLE 7.7. (contd)

Selenium	8/88	9/88	11/88	2/89	5/89	8/89
299-E18-1	14.9	10	7	7	6	7
299-E18-1[a]			7			
299-E18-2	8.9	<5	<5	<5	<5	<5
299-E18-2[a]				<5		
299-E18-3	48.6	<5	<5	<5	<5	<5
299-E18-3[a]					<5	
299-E18-4	<5	<5	<5	<5	<5	<5
299-E18-4[a]						<5

Drinking water standard of 10 ppb

Selenium (F)	8/88	9/88	11/88	2/89	5/89	8/89
299-E18-1	10.7	8.6	7	7	7	7
299-E18-1[a]			6			
299-E18-2	7.0	<5	<5	<5	<5	<5
299-E18-2[a]				<5		
299-E18-3	<5	<5	<5	<5	<5	<5
299-E18-3[a]					<5	
299-E18-4	<5	<5	<5	<5	<5	<5
299-E18-4[a]						<5

Drinking water standard of 10 ppb

(a) Duplicate sample collected in the field.

1988). To support the calculation, retardation factors for the three primary drinking water constituents (chromium, selenium, and arsenic) were calculated using soil columns and spiked water solutions. A sample of a slightly muddy medium sand (from well 299-E18-4 at 40 ft) and a coarse sand (from well 299-E18-4 at 70 ft) were packed into two separate soil columns. Ground water collected from well 299-E18-3 was run through the soils to determine whether these metals could be leached from the sediments naturally. Spiked mixtures of the ground water were then run through the sediments to determine how much of the metals would sorb onto the sediment particles, thereby slowing their movement through the sediments. This provided the retardation values (Table 7.8) used in the model to determine the time it would take for chromium, arsenic, and selenium to travel from the surface of the pond to the ground water, assuming an annual discharge of 1.2 million gal of water to the pond each year.

TABLE 7.8. Retardation Factors for Chromium, Arsenic, and Selenium

Constituent	Retardation Factors 40-ft Sample	70-ft Sample
Chromium	1.2	0.67
Arsenic	18.9	3.73
Selenium	10.8	3.87

Using the hydraulic conductivity values, moisture contents, and retardation factors for chromium (the most mobile of the three metals), a rough estimate of the time it would take water to move from the pond to the unconfined aquifer was calculated. A key assumption used was the amount of lateral spreading of water beneath the pond. Two different assumptions were used. The first assumption was that the sediments directly beneath the pond were 90% saturated, with minor lateral spreading out to the wells indicated by the 70% saturation. It was assumed that this minor lateral spreading did not contribute significantly to the flow. The second assumption was that spreading occurred out to the distance of the wells, and that the sediments both beneath and adjacent to the pond were 70% saturated. Under these two assumptions, water containing chromium could reach the water table in 0.2 and 0.45 yr, respectively, while the other metals would take between 0.9 and 3.8 yr depending on the amount of lateral spreading assumed and the retardation factor of the metal. Chromium and iron have continued to be elevated in at least one well each sampling period. There is no evidence of a plume of metal-bearing ground water migrating from other sites in the vicinity.

The high concentration of the metals all occurred in the unfiltered samples and are generally below detection limits in the filtered samples. This difference indicates that the metals are occurring in particulate form rather than in solution. Several different possibilities for the source of the metals are given below.

- The metals can all occur naturally in Hanford Site sediments (see Tables 5.2, 5.3, and 5.4). They may be naturally occurring sediment particles small enough to fit through the screen and filter pack.

- The metals may be derived from pieces of metal abraded from the carbon and stainless steel casing and drilling tools, or slag generated during cutting of casing used during the drilling and installation of the monitoring wells.

- The metals may be leached out of the stainless steel casing and pump, adsorbing onto iron hydroxide. Colloidal iron hydroxide has a high affinity for adsorbing these metals. The colloidal hydroxide then would be filtered out as a particulate.

Because the elevated metals have been noted sporadically in a number of the new RCRA wells drilled in the 200 Areas (but almost never in older carbon steel wells), it is assumed that one of the latter two possibilities is tne most likely source. The first possibility is not considered the source, because metals would be expected to be found in both carbon and stainless steel wells. It also does not seem probable that the metals originated in the pond discharge water, because the upgradient well has elevated metal concentrations even though it is not affected by the pond.

As discussed in Chapter 6.0, the ground-water chemistry in well 299-E18-1 is different from that of the downgradient wells, another indication that it is not affected by the pond. The difference is because of the high concentration of sulfate (SO_4). The sulfate concentration is 153 ppm in the background well, while the downgradient well's concentrations range from 14 to 45 ppm (Figure 7.1 and Appendix B).

The sulfate source in well 299-E18-1 is believed to be from a nearby well (299-E19-1). This well is approximately 1600 ft southwest of the pond, in the presumed upgradient direction. Cored to the top of basalt in 1977, the borehole of well 299-E19-1 was then partially filled with drilling mud. This drilling mud contained a natural bitumen, a petroleum by-product. Samples were taken of the drilling mud and the water standing above it as a part of this characterization effort. These samples were analyzed for metals and VOCs with both the mud and water showing relatively high concentrations of sulfur (Table 7.9). It is not known what the original concentration of sulfur in the mud was, but the sulfur may have been leached from the mud, undergoing oxidation into sulfate in the process. Sulfate concentration data from other wells around the pond (Figure 7.1) were reviewed to examine the

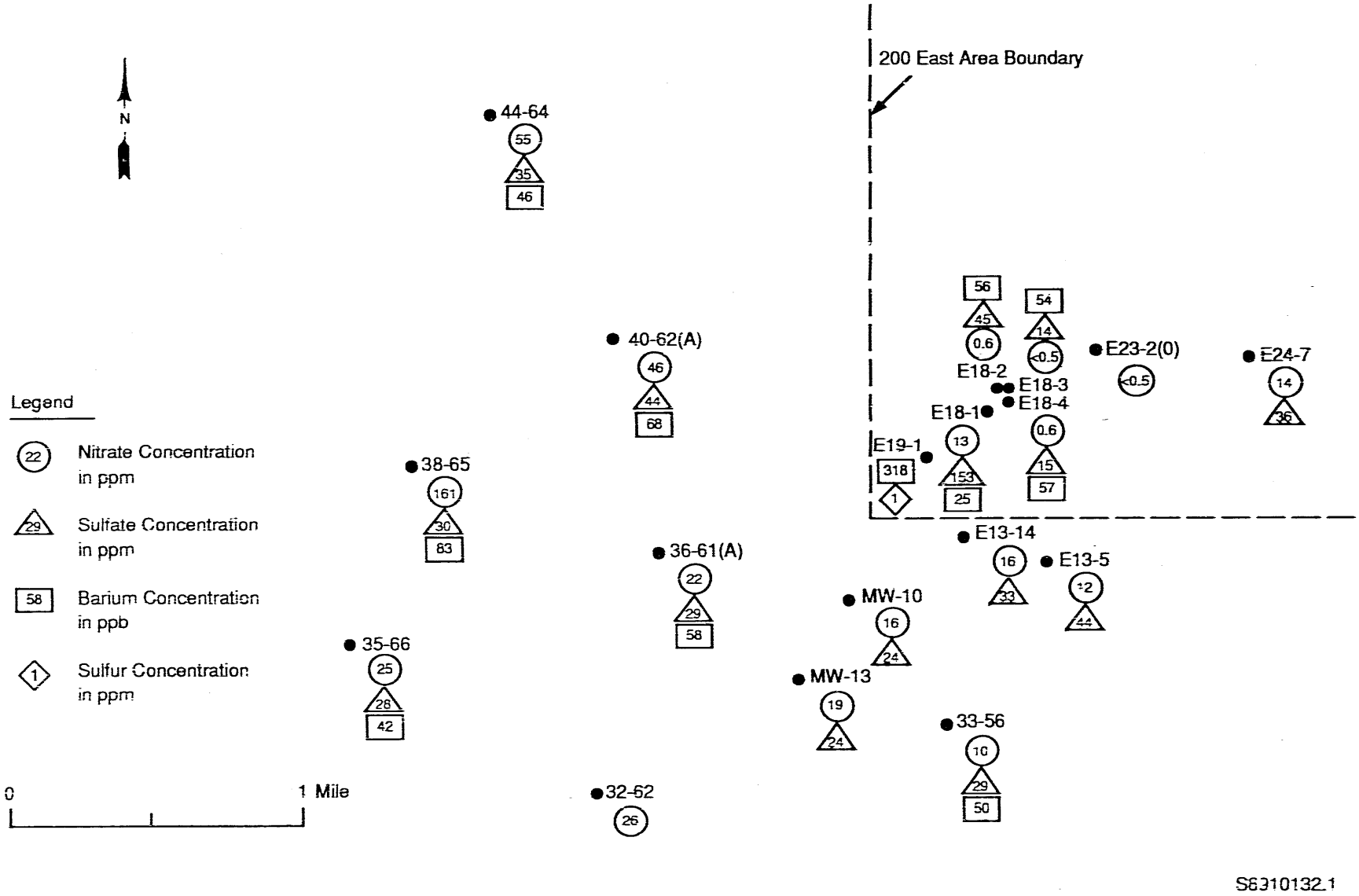


FIGURE 7.1. Location and Hydrochemical Data for Wells Near 2101-M Pond

possibility of a widespread sulfate plume migrating into the pond area. Concentrations are similar to those found in the pond's downgradient wells.

Using the ground-water velocities given in Subsection 6.3.5, sulfate would take between 4 and 25 yr to reach well 299-E18-1, assuming the flow path is directly from one to the other. Because the drilling mud was added to well 299-E19-1 in 1977, there has been adequate time for the movement of mobile contaminants to the area near the pond. Given the lack of elevated sulfate anywhere else in the vicinity and the ground-water velocity in the area, it is believed the sulfate is migrating from well 299-E19-1. This also helps refine the flow direction as being from the southwest, as discussed in Subsection 6.3.1.

Barium was noted to be consistently higher in the three downgradient wells than the upgradient well, although below drinking water standards. Because barium was the primary contaminant reported to have been discharged to the pond, the differences were evaluated to determine whether they were caused by natural chemical reactions or contamination from the pond. The geochemical code MINTEQ (Felmy et al. 1984) was used to estimate the mineral equilibria for the ground-water/sediment system within the aquifer. Based on the data from two separate sampling periods, MINTEQ determined that the ground water in all of the wells is in equilibrium with the mineral barite ($BaSO_4$). Consequently, changes in the sulfate concentration would result in an opposing change in the barium concentration. The downgradient wells show less sulfate and more barium than does the upgradient well. When sufficient sulfate is added to MINTEQ's downgradient ground-water chemistry to be equal to that found in the upgradient well, the concentration of barium decreases to levels similar to those found in the upgradient well. These data suggest that the differences in the barium concentrations are associated with the natural system influenced by the differences in sulfate concentration as discussed above and not a barium source introduced via the 2101-M Pond. The higher concentration of nitrate in the upgradient well may be the front edge of a nitrate plume moving east from the 200-West Area, as shown in Serkowski et al. (1988). Figure 7.1 indicates the nitrate levels at a number of wells

TABLE 7.9. Results of Mud and Water Analyses from Well 299-E19-1

Constituent	Mud Results, ppb	Water Results, ppb
Beryllium	<5.0E+2	<5.0
Strontium	62.5E+3	84.0
Zinc	21.6E+5	10.5E+2
Calcium	27.0E+6	13.5E+3
Barium	35.8E+4	31.8E+1
Cadmium	14.1E+3	<2.0
Chromium	73.9E+3	16.0
Silver	<1.0E+3	<10.0
Sodium	73.1E+4	23.2E+3
Nickel	47.1E+3	<10.0
Copper	20.7E+5	11.0E+1
Vanadium	26.1E+3	12.0
Antimony	<10.0E+3	<10.0E+1
Aluminum	16.2E+6	89.0E+2
Manganese	93.4E+4	42.5E+1
Potassium	74.3E+4	50.2E+2
Iron	17.4E+7	64.0E+3
Magnesium	89.0E+5	82.6E+2
Arsenic	99.1E+2	<5.0
Selenium	<0.5E+3	<5.0
1,2-dichlorobenzene	<1.0E+3	<10.0
1,3-dichlorobenzene	<1.0E+3	<10.0
1,4-dichlorobenzene	<1.0E+3	<10.0
hexachlorobenzene	<1.0E+3	<10.0
pentachlorobenzene	<1.0E+3	<10.0
1,2,4,5-tetrachlorobenzene	<1.0E+3	<10.0
1,2,4-trichlorobenzene	<1.0E+3	<10.0
hexachlorophene	<1.0E+3	<10.0
napthalene	<1.0E+3	<10.0
1,2,3-trichlorobenzene	<1.0E+3	<10.0
phenol	<1.0E+3	<10.0
1,3,5-trichlorobenzene	<1.0E+3	<10.0
1,2,3,4-tetrachlorobenzene	<1.0E+3	<10.0
1,2,3,5-tetrachlorobenzene	<1.0E+3	<10.0
kerosene	<10.0E+7	<10.0E+3
tributylphosphoric acid	<1.0E+3	<10.0
molecular sulfur	2.1E+3	94.0
unknown	---	53.0
unknown	---	12.0
bis(2-ethylhexyl)phthalate	3.9E+3	----

upgradient of and closer to the 200-West Area; these levels corroborate this hypothesis. Unfortunately, there are no reliable analyses for nitrate from well 299-E19-1.

Interpretation of the ground-water quality at the 2101-M Pond is complicated by three factors:

1. The pond lies above an area where water from the 200-West Area and the 200-East Area converge. This creates a changing pattern of flow paths that can affect the quality of the ground water as water from contaminated sources moves in different directions at different times.

2. The water discharged to the pond is of drinking water quality, which has a dilution effect on the natural ground-water chemistry.

3. There may be a plume of constituents from upgradient sources that are being detected by the 2101-M Pond upgradient well.

Consequently, the chemistry of the water in well 299-E18-1 is not only a different type, but also of a poorer (lower) quality than the ground water nearby. Well 299-E18-1 provides representative chemistry of the ground water before it is diluted by recharge from the pond. Nonetheless, it appears that the 2101-M Pond has not adversely affected the quality of the ground water.

7.3 QUALITY ASSURANCE AND QUALITY CONTROL

The quality of the analytical results has been evaluated and documented in a number of ways. A quality control (QC) program has been in place since the beginning of the project, providing duplicates, blanks, standards, and interlaboratory checks for the primary analytical laboratory. Additional efforts have been made to check on training and certain aspects of the analyses to provide quality results. The WHC Quality Assurance (QA) group has also performed surveillances of nearly all of the sampling events at the 2101-M pond. Only two deficiencies were found: one concerning calibration of a digital thermometer used to measure the temperature of the ground water, and the other the failure to collect water-level measurements before the first sampling event. These deficiencies were resolved by providing a thermometer for calibration purposes and by using water-level measurements taken approximately 1 to 2 weeks before the sampling event.

There is a large amount of data generated by the different QA and QC activities, all of which occur in various forms. Consequently, the raw data used below to evaluate the overall quality of the analytical results are not provided in this report. These raw data are maintained at PNL.

7.3.1 Quality Control Program

The ground-water monitoring program is covered by a QA plan designed in accordance with QAMS-005/80 (Stanley and Verner 1983). The PNL QC program to assess both the sampling and analysis aspects includes 1) submission of blind standards, blanks, and duplicate samples to the primary analytical laboratory, 2) submission of replicate samples to alternate laboratories, and 3) participation of the primary analytical laboratory in interlaboratory comparison programs. The QC program is based on guidance from EPA Region 10 and the TEGD (EPA 1986a). Analyses are performed by the primary analytical laboratory in accordance with the current edition of Test Methods for Evaluating Solid Waste: Physical/Chemical Methods (EPA 1986b).

Blind standard samples, where the concentration is known, are considered acceptable when the results fall within ±2 standard deviations of the expected value. If the results fall outside the 95% confidence interval, a request for data verification is warranted (ASTM 1987). Values from interlaboratory comparisons of field samples must fall within 2.8 standard deviations, based on EPA Water Supply or Water Pollution Laboratory Performance Evaluation Studies, to be considered equivalent analyses. These calculations take into account the uncertainties associated with two sources of analyses.

In addition to the above QC program, the analytical laboratory also has their own QC program requiring blanks, matrix spikes, surrogates, and standards. The U.S. Testing Company, Incorporated, also submitted analytical results to EPA Water Pollution and Water Supply Performance Evaluations studies starting in 1986. The laboratory also submitted analytical results to the Washington State Water Certification Program. These data are used to evaluate the quality of the results and the laboratory's accuracy and precision using the various analytical methods.

7.3.2 Training

Training documentation for the Radiation Protection Technologists performing the sampling at the 2101-M wells was reviewed for completeness. All personnel involved in the sampling process have been trained on the PNL procedures applicable at the time for performing sampling activities and have received the Occupational Health and Safety Administration 40-h hazardous worker training and any pertinent refresher courses.

7.3.3 Holding Times

Holding times for anions, arsenic, mercury, ICP metals, lead, selenium, and VOCs were evaluated for samples collected during August 1988 through August 1989. All holding times met the requirements given in SW-846 (EPA 1986b) or Test Method 300.0 (EPA 1984) for that time.

7.3.4 Frequency of Duplicates, Blanks, Matrix Spikes, and Surrogates

To evaluate whether the analytical laboratory was performing the necessary QC checks, the chemists' sheets were reviewed for the frequency at which duplicates, blanks, matrix spikes, and surrogates were performed for August 1988 through August 1989. The criteria used were those specified in the appropriate SW-846 procedures (EPA 1986b) or Test Method 300.0 (EPA 1984). The constituents evaluated were those considered to be of concern (i.e., those constituents discharged to the pond or found in the ground water in higher than expected concentrations). These constituents consist of anions, arsenic, mercury, ICP metals, lead, selenium, and VOCs. As can be seen in Table 7.10, all duplicates, blanks, matrix spikes, and surrogates met the frequency criteria of their respective procedures.

7.3.5 Quality of the Analytical Results

To help evaluate the quality of the analytical results, data from the blanks, matrix spikes, and surrogates provided by the laboratory were evaluated. Evaluation of these QC analyses provides important information on overall problems with the analytical technique for a given time at the laboratory.

TABLE 7.10. 2101-M Pond - U.S. Testing Company Samples August 1988 Through August 1989

ANALYSIS	DUPLICATES						SPIKES						BLANKS						SURROGATES					
	08/88	09/88	11/88	02/89	05/89	08/89	08/88	09/88	11/88	02/89	05/89	08/89	08/88	09/88	11/88	02/89	05/89	08/89	08/88	09/88	11/88	02/89	05/89	08/89
Anions[1]	X	*	X	X	X	X	X	*	X	X	X	X	X	*	X	X	X	X	N/A	*	N/A	N/A	N/A	N/A
As	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	N/A	N/A	N/A	N/A	N/A	N/A
Hg	X	*	X	X	X	X	X	*	X	X	X	X	X	*	X	X	X	X	N/A	N/A	N/A	N/A	N/A	N/A
ICP Met.	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	N/A	N/A	N/A	N/A	N/A	N/A
Pb	X	*	X	X	X	X	X	*	X	X	X	X	X	X	X	X	X	X	N/A	N/A	N/A	N/A	N/A	N/A
Se	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	N/A	N/A	N/A	N/A	N/A	N/A
VOA	*	*	X	*	*	*	*	*	X	*	*	*	*	*	X	*	*	*	*	*	X	*	*	*

(a) The following notations are used in this table:
X = All samples collected during this sampling event did not exceed holding times and had the appropriate frequency of quality control analyses performed, as required in SW-846 (EPA 1986b) or Test Method 300.0 (EPA 1984).
N/A = Not required for test method.
* = Ground-water samples were taken; specific analysis was not requested.
1 = Duplicate recommended, but not required.

Surrogate recovery ranges for volatile and semivolatile organic compounds were compared to the ranges specified in SW-846 (EPA 1986b) for the third quarter of 1988, when these analyses were run on samples from the 2101-M Pond ground water. All results for the quarter were within the specified recovery ranges.

Matrix spikes recoveries were evaluated for volatile and semivolatile organic compounds, ICP metals, arsenic, selenium, and anions because they are the primary constituents of concern. There are no recovery ranges specified in the procedures for volatile and semivolatile organic matrix spikes; therefore, recovery percentages from the third calendar quarter of 1988 (when volatile and semivolatile organic compounds were sampled at the pond) were compared to QC acceptance criteria for spiked reagent water provided with each appropriate procedure in SW-846 (EPA 1986b). This comparison offers a more stringent determination of the quality of the analyses than would normally be expected. All of the constituents listed in the QC acceptance criteria tables met those criteria.

Recovery ranges for the metals matrix spikes are specified in their respective procedures. Most of the matrix spike recovery outliers reported in the laboratory quarterlies for the time between August 1988 and August 1989 were found in the metals. Most of these outliers appeared to be caused by one of two things: 1) the spike concentration was too low compared to the concentration found in the sample, or 2) the analysis was affected by the matrix of the sample, causing a yield of less than 100%. The one exception occurred in antimony matrix spikes performed between July 9 and September 30, 1988, when four low results were attributed to a volatile compound forming during analysis. It is unclear what happened in this case, but it is not considered a problem because the interlaboratory results do not indicate unusual concentrations of antimony, and because this constituent is not expected to be of concern at the 2101-M Pond. Blanks for metals in November were apparently contaminated with zinc, calcium, and iron, and the duplicate samples from well 299-E18-2 had a discrepancy for zinc. This discrepancy is thought to have been caused by sample preparation or laboratory contamination.

From August 1988 through August 1989, mean recoveries of matrix spikes for anions were generally within ±25%, which is the target recovery range used by the analytical laboratory because there are no ranges specified in the test method (EPA 1984). The only exception was in September 1988, when nitrate, sulfate, and phosphate were all above 25%. These outliers were based on the mean of only two samples, however, while the mean of the other 82 samples run during the same time are all acceptable. Consequently, the outliers do not seem to indicate a consistent problem.

Last to be evaluated were the blanks for the ICP metals, arsenic, selenium, and anions. Only one of the blanks reported in the quarterlies during the period August 1988 through August 1989 was found to contain levels above the method detection limit set by PNL for UST. This was for boron, from April 5 through June 30, 1989, when the mean blank concentration for 37 samples was 14.4 ppb while the method detection limit was 10 ppb. This is thought to be because of the dissolution of boron from the glassware used in the laboratory and is not of concern with regard to the quality of the 2101-M Pond ground-water samples.

Overall, the quality of the data from the 2101-M Pond samples appears to be good. Although there have been individual instances of results falling outside the target ranges, overall trends of the data appear to be consistent over time, with no abrupt changes or outliers in the 2101-M Pond results. This conclusion is confirmed by the interlaboratory results performed by PNL, which generally confirm the UST results and help point out any problems. Appendix B provides the tables of analytical results for all data above detection limits. For selected constituents, plots of these data have also been provided to allow easier comparison of the trends in the data. These plots also make it easier to see the differences in the upgradient wells versus the downgradient wells and the consistency of those differences.

8.0 CONCLUSIONS

Four ground-water monitoring wells have been installed, one southwest of the pond and three east, northeast, and north of the pond. The following are the conclusions derived from the installation, sampling, and water-level measurements collected from these wells for the five quarters between August 1988 and September 30, 1989.

All four wells were drilled approximately 17 ft into the uppermost unconfined aquifer beneath the 2101-M Pond, which resides in a muddy sandy gravel to gravelly sand of the Ringold Formation. The three wells closest to the pond, 299-E18-2, 299-E18-3, and 299-E18-4, all penetrated partially saturated sediments, while well 299-E18-1, the well farthest from the pond, encountered dry sediments. The elevated moisture contents of the three wells indicate they are within the influence of the pond and can detect any contaminants reaching the ground water from the pond. In addition, the dryness of the sediments in 299-E18-1 indicates that the vadose zone of this well is not affected by the pond.

Transmissivities were estimated from aquifer tests performed on all four of the wells and range from 700 to approximately 9000 ft^2/d. Storativity is estimated to be approximately 0.01 to 0.04. Based on modeling efforts, it is estimated that water discharged to the pond can reach the ground water within 0.2 to 0.45 yr and that the vadose zone may be affected up to 75 ft away laterally. Horizontal ground-water velocities in the region near the pond are estimated to be 0.1 to 0.6 ft/d.

Water-level measurements have been made at least once a quarter, and often more frequently since August 1988. These data indicate the water table in the region around the 2101-M Pond is very flat, with a gradient on the order of 8×10^{-4} ft/ft. Hydrographs show that well 299-E18-1 consistently appears to have slightly higher water levels than any of the other three, which is consistent with the overall regional ground-water flow direction to the northeast. This helps demonstrate that well 299-E18-1 is upgradient of the 2101-M Pond, although it cannot provide conclusive evidence that water flowing through this well will flow directly beneath the pond. Hydrographs

also indicate the water level in all four wells is dropping uniformly throughout the nearby area, apparently in response to decreased artificial recharge in other portions of the 200 Areas.

Analytical results and sampling techniques generally appear to meet federal and state regulations necessary to evaluate the effect of discharges to the 2101-M Pond on the ground water. Sporadic, anomalously high concentrations of chromium, iron, arsenic, selenium, and manganese have been detected in all four of the wells; these metals are thought to be from materials used during the drilling and construction of the monitoring wells and do not reflect the true quality of the ground water beneath the pond. The only other constituent detected to date at levels of concern is acetone. Resampling of the wells and running the second set of samples through two different laboratories indicates the acetone was introduced through incidental contamination, which was confirmed by the presence of acetone in the blanks. Statistical evaluation of the fifth quarter of data against the first four quarters indicates no contamination of the ground water is occurring beneath the 2101-M Pond. The ground-water chemistry also illustrates that well 299-E18-1 has a slightly different chemistry than the three wells adjacent to the pond, probably caused by the introduction of constituents in wells or at facilities to the southwest of this well. This confirms that well 299-E18-1 is not affected by the pond.

Ground water will continue to be monitored semiannually at the four monitoring wells until the 2101-M Pond site is closed under RCRA regulations. At a minimum, the ground-water quality, drinking water quality, and contamination indicator parameters will be analyzed each time the ground water is sampled.

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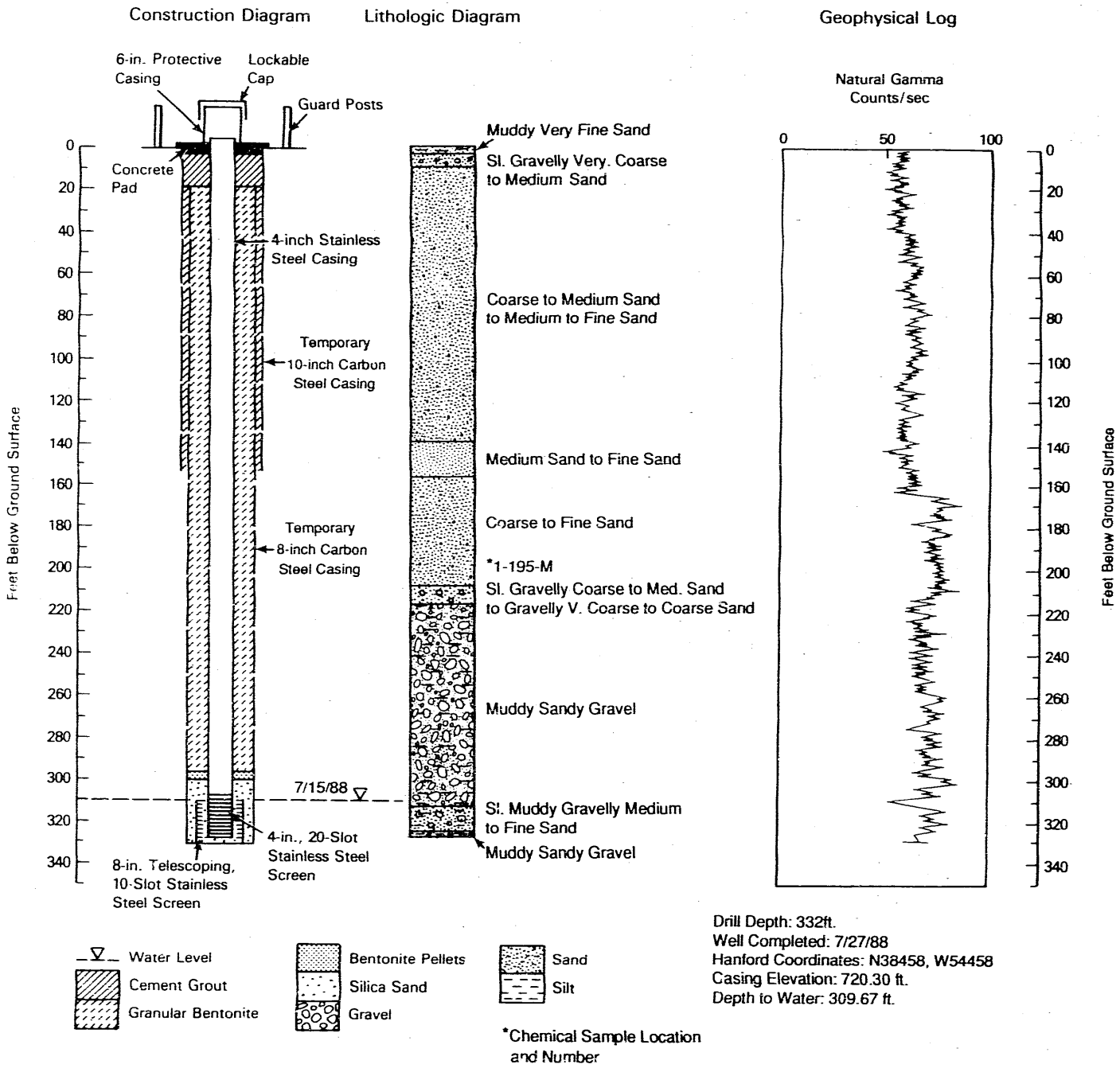
APPENDIX A

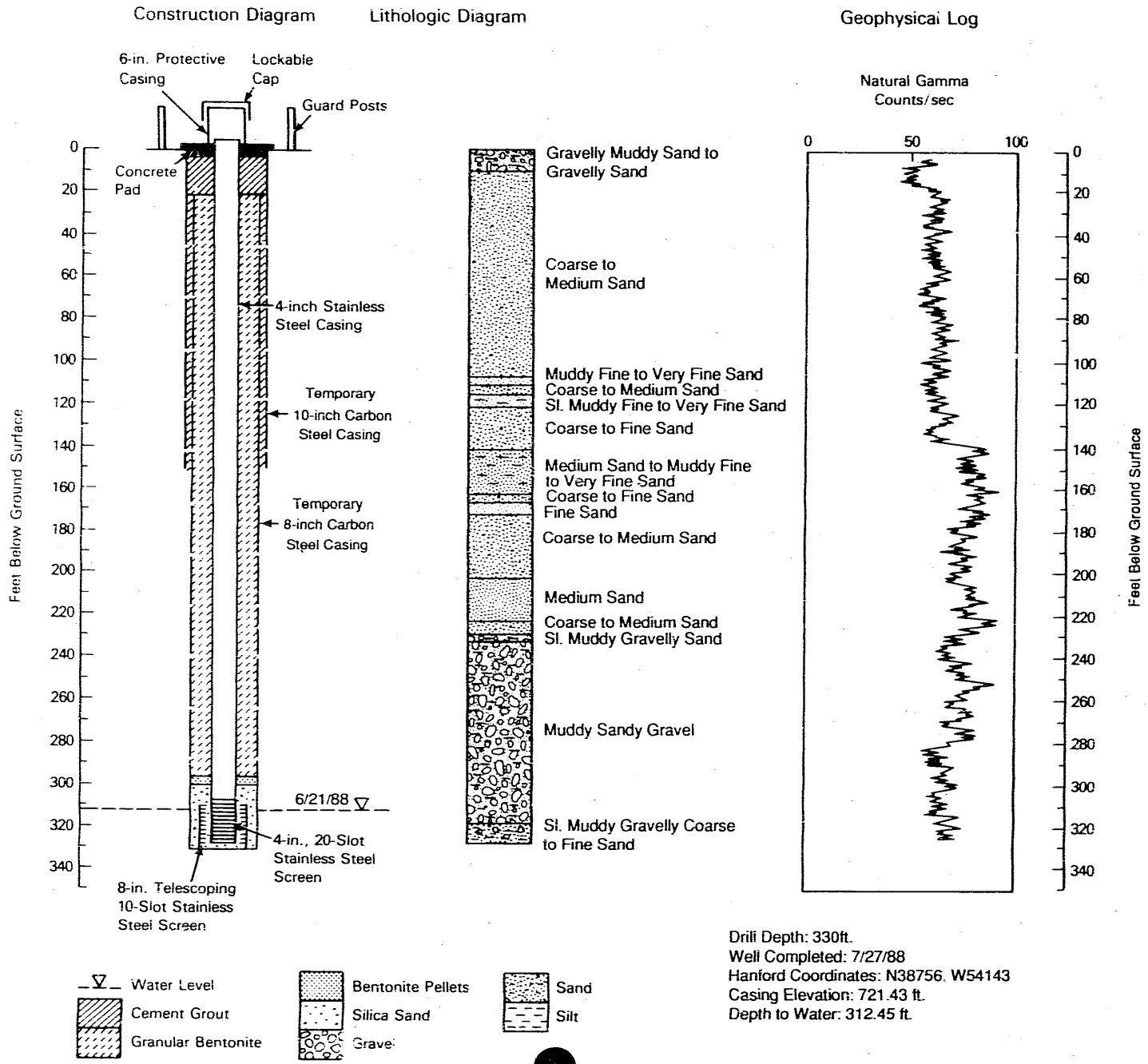
AS-BUILT DIAGRAMS

Well 299-E18-1



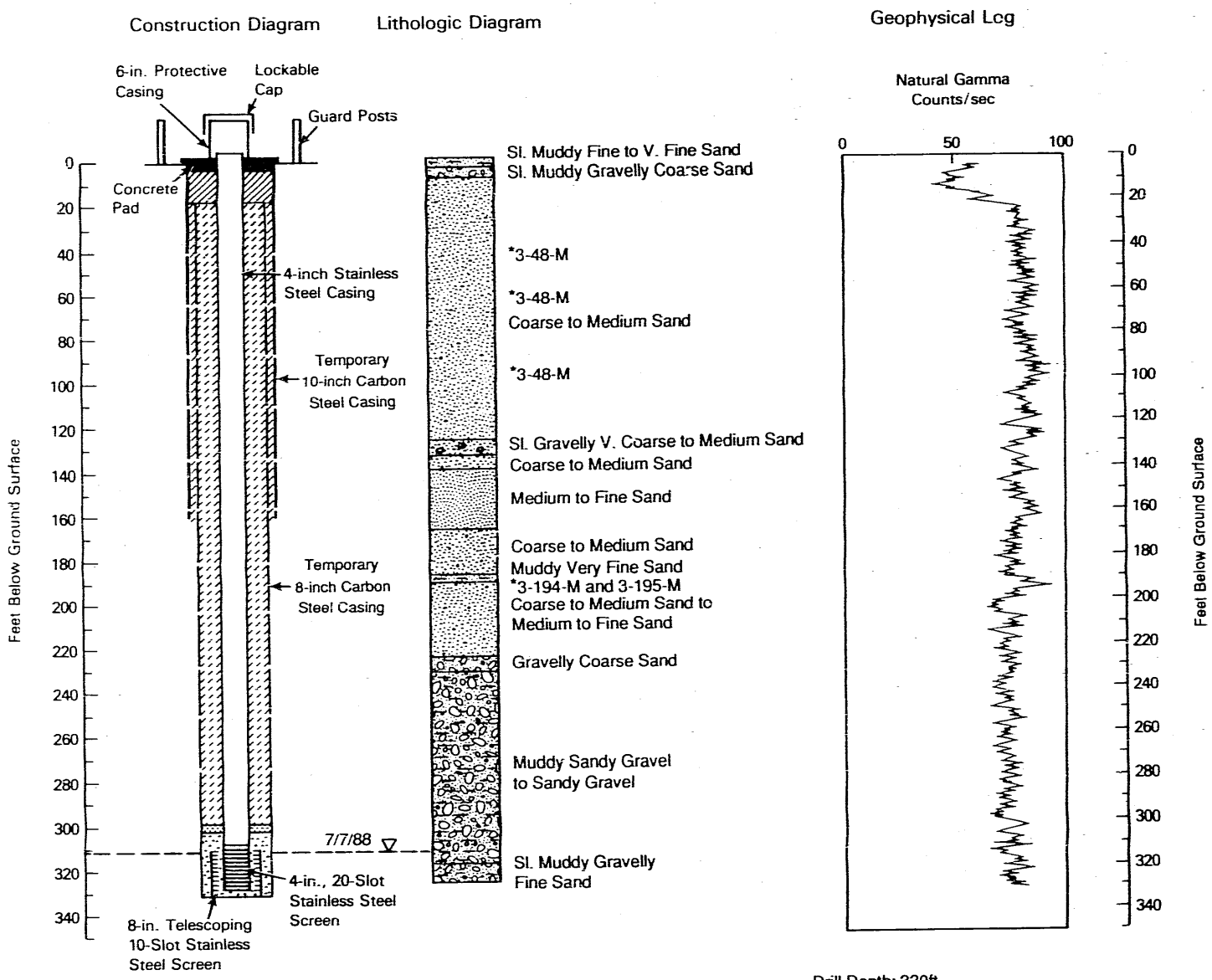
Drill Depth: 332ft.
Well Completed: 7/27/88
Hanford Coordinates: N38458, W54458
Casing Elevation: 720.30 ft.
Depth to Water: 309.67 ft.

Well 299-E18-2



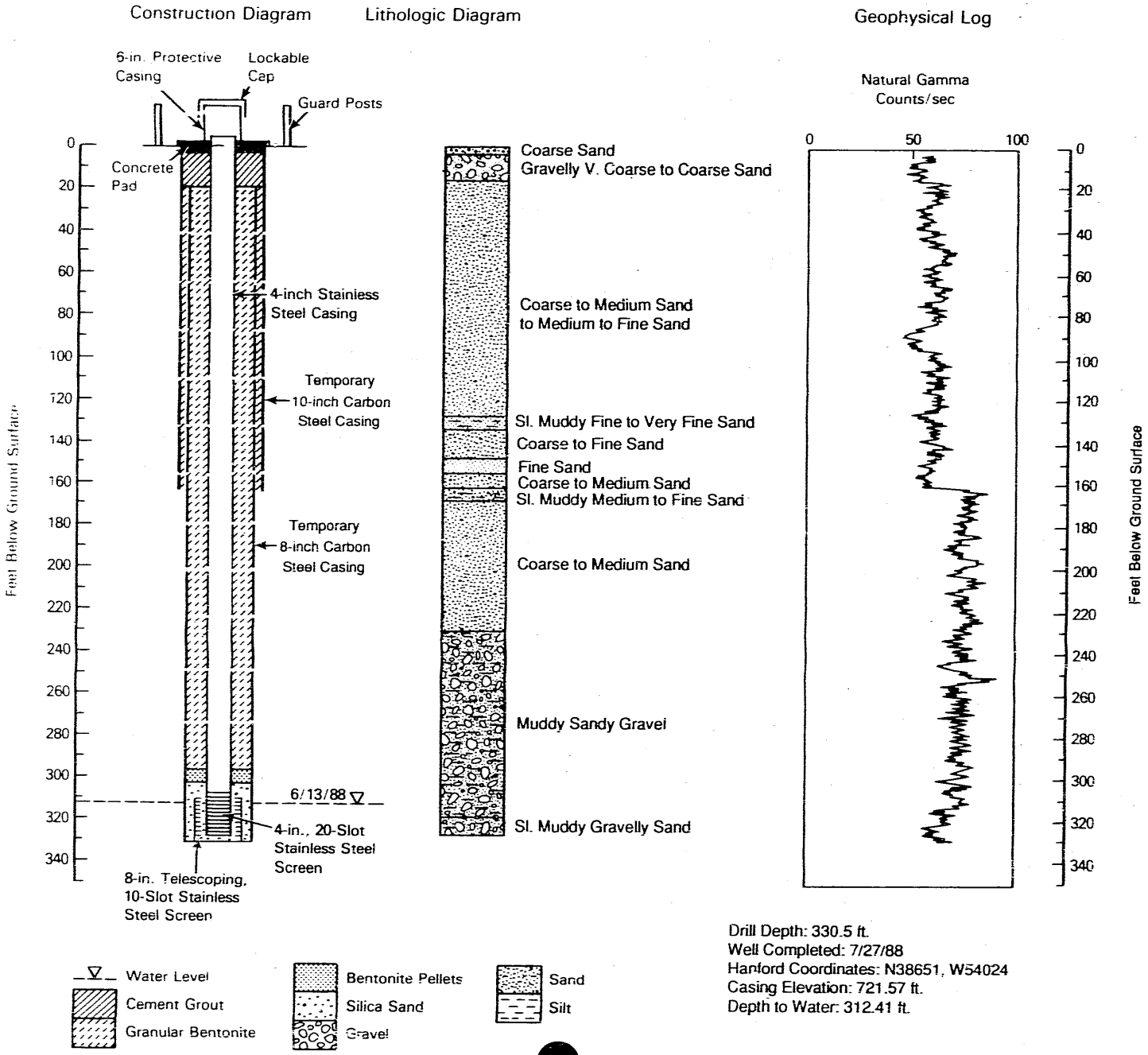
Drill Depth: 330ft.
Well Completed: 7/27/88
Hanford Coordinates: N38756, W54143
Casing Elevation: 721.43 ft.
Depth to Water: 312.45 ft.

Well 299-E18-3



Drill Depth: 330ft.
Well Completed: 7/27/88
Hanford Coordinates: N38712, W54023
Casing Elevation: 722.07 ft.
Depth to Water: 311.38 ft.

Well 299-E18-4



Drill Depth: 330.5 ft.
Well Completed: 7/27/88
Hanford Coordinates: N38651, W54024
Casing Elevation: 721.57 ft.
Depth to Water: 312.41 ft.

APPENDIX B

GROUND-WATER CHEMISTRY

APPENDIX B

TABLE B.1. Predevelopment Sample Results

Constituent and Units	Well Numbers (prefixed by 299-) E18-1	E18-2	E18-3	E18-4
Gross Alpha (pCi/L)	2.85	13.2	4.90	3.04
Gross Beta (pCi/L)	8.23	27.2	10.3	6.96
Cobalt-60 (pCi/L)	BDL	BDL	BDL	BDL
Cesium-137 (pCi/L)	BDL	BDL	BDL	BDL
Ruthenium-106 (pCi/L)	BDL	BDL	BDL	BDL
Iodine-129 (pCi/L)	NA	NA	2.97	NA
Zinc (ppb)	25.0	107	20.0	41.0
Calcium (ppb)	65900	32200	29900	31700
Barium (ppb)	44.0	277	108	109
Cadmium (ppb)	BDL	BDL	BDL	BDL
Chromium (ppb)	BDL	38.0	11.0	15.0
Silver (ppb)	BDL	BDL	BDL	BDL
Sodium (ppb)	28300	17900	6460	7590
Nickel (ppb)	32.0	37.0	12.0	30.0
Copper (ppb)	10.0	21.0	13.0	38.0
Vanadium (ppb)	BDL	58.0	24.0	30.0
Aluminum (ppb)	BDL	16200	4000	4320
Manganese (ppb)	267	1160	280	362
Potassium (ppb)	7350	7790	5820	6210
Iron (ppb)	9078	4500	21000	25800
Magnesium (ppb)	16100	12900	9350	9950
Carbon Tetrachloride (ppb)	BDL	BDL	BDL	BDL
Methyl Ethyl Ketone (ppb)	BDL	BDL	BDL	BDL
1,1,1-Trichloroethane (ppb)	BDL	BDL	BDL	BDL
1,1,2-Trichloroethane (ppb)	BDL	BDL	BDL	BDL
Trichloroethylene (ppb)	BDL	BDL	BDL	BDL
Tetrachloroethylene (ppb)	BDL	BDL	BDL	BDL
Xylene-o,p (ppb)	BDL	BDL	BDL	BDL
Chloroform (ppb)	BDL	BDL	BDL	BDL
Methylene Chloride (ppb)	BDL	BDL	BDL	BDL
Xylene-m (ppb)	BDL	BDL	BDL	BDL
Methyl Isobutyl Ketone (ppb)	BDL	BDL	BDL	BDL

TABLE B.2. Constituents and Associated Contractual Detection Limits (ppb) Analyzed for in the Ground Water for the 2101-M Pond

Constituent Long Name	Detection Limit
1,1,1,2-tetrachlorethane	1.0000E+01
1,1,1-trichloroethane	5.0000E+00
1,1,2,2-tetrachlorethane	5.0000E+00
1,1,2-trichloroethane	5.0000E+00
1,1-dichloroethane	5.0000E+00
1,1-dichloroethylene	1.0000E+01
1,2,3,4-tetrachlorobenzene	1.0000E+01
1,2,3,5-tetrachlorobenzene	1.0000E+01
1,2,3-trichlorobenzene	1.0000E+01
1,2,3-trichloropropane	1.0000E+01
1,2,4,5-tetrachlorobenzene	1.0000E+01
1,2,4-trichlorobenzene	1.0000E+01
1,2-dibromo-3-chloropropane	1.0000E+01
1,2-dibromoethane	1.0000E+01
1,2-dichlorobenzene	1.0000E+01
1,2-dichloroethane	5.0000E+00
1,2-dichloropropane	5.0000E+00
1,2-diphenylhydrazine	1.0000E+01
1,3,5-trichlorobenzene	1.0000E+01
1,3-dichlorobenzene	1.0000E+01
1,3-dichloropropene	5.0000E+00
1,4-Dioxane	5.0000E+02
1,4-dichloro-2-butene	1.0000E+01
1,4-naphthoquinone	1.0000E+01
1-(o-chlorophenyl) thiourea	2.0000E+02
1-Butanol	1.0000E+04
1-acetyl-2-thiourea	2.0000E+02
1-chloro-2,3-epoxypropane	1.0000E+01
1-naphthyl-2-thiourea	2.0000E+02
1-naphthylamine	1.0000E+01
2,3,4,6-tetrachlorophenol	1.0000E+01
2,4,5-T	2.0000E+00
2,4,5-TP silvex	2.0000E+00
2,4,5-Trichlorophenol	1.0000E+01
2,4,6-trichlorophenol	1.0000E+01
2,4-D	2.0000E+00
2,4-dichlorophenol	1.0000E+01
2,4-dimethylphenol	1.0000E+01
2,4-dinitrophenol	1.0000E+01
2,4-dinitrotoluene	1.0000E+01
2,6-dichlorophenol	1.0000E+01
2,6-dinitrotoluene	1.0000E+01
2-Propanol	1.0000E+04
2-acetylaminofluorene	1.0000E+01
2-chloroethyl vinyl ether	5.0000E+00
2-chloronaphthalene	1.0000E+01
2-chlorophenol	1.0000E+01
2-cyclohexyl-4,6-dinitrophenol	1.0000E+01
2-methyl-2-(methylthio) propionaldehyde-	1.0000E+01
2-methylaziridine	1.0000E+01
2-methyllactonitrile	1.0000E+01
2-naphthylamine	1.0000E+01
2-picoline	1.0000E+01
2-propyn-1-ol	1.0000E+04

TABLE B.2. (contd)

Constituent Long Name	Detection Limit
2-sec-butyl-4,6-dinitrophenol	1.0000E+01
3,3'-dichlorobenzidine	1.0000E+01
3,3'-dimethoxybenzidine	1.0000E+01
3,3'-dimethylbenzidine	1.0000E+01
3-chloropropionitrile	1.0000E+04
3-methylcholanthrene	1.0000E+01
4,4'-methylenebis(2-chloroaniline)	1.0000E+01
4,6-dinitro-o-cresol and salts	1.0000E+01
4-aminobyphenyl	1.0000E+01
4-bromophenyl phenyl ether	1.0000E+01
5-(aminomethyl)-3-isoxazolol	1.0000E+01
5-nitro-o-toluidine	1.0000E+01
7,12-dimethylbenz[a]anthracene	1.0000E+01
7H-dibenzo[c,g]carbazole	1.0000E+01
Acetone by VOA	1.0000E+01
Acetonitrile	1.0000E+01
Acetophenone	1.0000E+01
Acrolein	1.0000E+01
Acrylamide	1.0000E+04
Acrylonitrile	1.0000E+01
Aldrin	1.0000E-01
Alkalinity	2.0000E+04
Allyl alcohol	1.0000E+04
Alpha, High Detection Level	4.0000E+00
Alpha,alpha-dimethylphenethylamine	1.0000E+01
Alpha-BHC	1.0000E-01
Aluminum	1.5000E+02
Aluminum, filtered	1.5000E+02
Amitrole	1.0000E+01
Ammonium ion	5.0000E+01
Aniline	1.0000E+01
Antimony	1.0000E+02
Antimony, filtered	1.0000E+02
Aramite	1.0000E+01
Arochlor 1016	1.0000E+00
Arochlor 1221	1.0000E+00
Arochlor 1232	1.0000E+00
Arochlor 1242	1.0000E+00
Arochlor 1248	1.0000E+00
Arochlor 1254	1.0000E+00
Arochlor 1260	1.0000E+00
Arsenic	5.0000E+00
Arsenic, filtered	5.0000E+00
Auramine	1.0000E+01
Barium	6.0000E+00
Barium, filtered	6.0000E+00
Benz[a]anthracene	1.0000E+01
Benz[c]acridine	1.0000E+01
Benzene	5.0000E+00
Benzene, dichloromethyl	1.0000E+01
Benzenethoil	1.0000E+01
Benzidine	1.0000E+01
Benzo[a]pyrene	1.0000E+01
Benzo[b]fluoranthene	1.0000E+01

TABLE B.2. (contd)

Constituent Long Name	Detection Limit
Benzo[j]fluoranthene	1.0000E+01
Benzyl chloride	1.0000E+01
Beryllium	5.0000E+00
Beryllium, filtered	5.0000E+00
Beta-BHC	1.0000E-01
Bis(2-chloroethoxy) methane	1.0000E+01
Bis(2-chloroethyl) ether	1.0000E+01
Bis(2-chloroisopropyl)ether	1.0000E+01
Bis(2-ethylhexyl) phthalate	1.0000E+01
Bis(chloromethyl) ether	5.0000E+00
Boron	1.0000E+01
Boron, filtered	1.0000E+01
Bromide	1.0000E+03
Bromoacetone	5.0000E+00
Bromoform	5.0000E+00
Butyl benzyl phthalate	1.0000E+01
Cadmium	2.0000E+00
Cadmium, filtered	2.0000E+00
Calcium	5.0000E+01
Calcium, filtered	5.0000E+01
Carbon Tetrachloride by GC/MS	5.0000E+00
Carbon disulfide	1.0000E+01
Carbophenothion	2.0000E+00
Chlordane	1.0000E+00
Chloride	5.0000E+02
Chlornaphazine	1.0000E+01
Chloroacetaldehyde	1.6000E+04
Chloroalkyl ethers	1.0000E+01
Chlorobenzene	5.0000E+00
Chlorobenzilate	3.0000E+02
Chloroform	5.0000E+00
Chloromethyl methyl ether	1.0000E+01
Chromium	1.0000E+01
Chromium, filtered	1.0000E+01
Chrysene	1.0000E+01
Citrus red	1.0000E+03
Cobalt	2.0000E+01
Cobalt, filtered	2.0000E+01
Coliform (Membrane Filter)	1.0000E+00
Coliform bacteria	2.2000E+00
Conductivity, Laboratory	-1.6543E+37
Copper	1.0000E+01
Copper, filtered	1.0000E+01
Cresols	1.0000E+01
Crotonaldehyde	1.0000E+01
Cyanide	1.0000E+01
DDD	1.0000E-01
DDE	1.0000E-01
DDT	1.0000E-01
Delta-BHC	1.0000E-01
Di-n-butyl phthalate	1.0000E+01
Di-n-octyl phthalate	1.0000E+01
Di-n-propylnitrosamine	1.0000E+01
Dibenz[a,h]acridine	1.0000E+01

TABLE B.2. (contd)

Constituent Long Name	Detection Limit
Dibenz[a,h]anthracene	1.0000E+01
Dibenz[a,j]acridine	1.0000E+01
Dibenzo[a,e]pyrene	1.0000E+01
Dibenzo[a,h]pyrene	1.0000E+01
Dibenzo[a,i]pyrene	1.0000E+01
Dibromomethane	1.0000E+01
Dibutyl Phosphate	1.0000E+04
Dichlorodifluoromethane	1.0000E+01
Dieldrin	1.0000E-01
Diethyl phthalate	1.0000E+01
Diethylarsine	1.0000E+01
Diethylstilbesterol	2.0000E+02
Dihydrosafrole	1.0000E+01
Dimethoate	2.0000E+00
Dimethyl phthalate	1.0000E+01
Dinitrobenzene	1.0000E+01
Dioxin	1.0000E-01
Diphenylamine	1.0000E+01
Disulfoton	2.0000E+00
Endosulfan I	1.0000E-01
Endosulfan II	1.0000E-01
Endrin	1.0000E-01
Ethanol	1.0000E+04
Ethyl carbamate	1.0000E+04
Ethyl cyanide	1.0000E+04
Ethyl methacrylate	1.0000E+01
Ethyl methanesulfonate	1.0000E+01
Ethylene oxide	1.0000E+01
Ethyleneimine	1.0000E+01
Ethylenethiourea	2.0000E+02
Fluoranthene	1.0000E+01
Fluoride	5.0000E+02
Formalin	5.0000E+02
Gamma-BHC	1.0000E-01
Gross alpha	4.0000E+00
Gross beta	8.0000E+00
Heptachlor	1.0000E-01
Heptchlor epoxide	1.0000E-01
Hexachlorobenzene	1.0000E+01
Hexachlorobutadiene	1.0000E+01
Hexachlorocyclopentadiene	1.0000E+01
Hexachloroethane	1.0000E+01
Hexachlorophene	1.0000E+01
Hexachloropropene	1.0000E+01
Hydrazine	3.0000E+03
Hydrazine, Low Detection Level	3.0000E+01
Hydrogen sulfide	1.0000E+01
Indeno(1,2,3-cd)pyrene	1.0000E+01
Iodomethane	1.0000E+01
Iron	3.0000E+01
Iron, filtered	3.0000E+01
Isobutyl alcohol	1.0000E+04
Isosafrole	1.0000E+01
Kerosene	1.0000E+04

TABLE B.2. (contd)

Constituent Long Name	Detection Limit
Lead (graphite furnace)	5.0000E+00
Lead, filtered	5.0000E+00
Lithium	1.0000E+01
Lithium, filtered	1.0000E+01
Magnesium	5.0000E+01
Magnesium, filtered	5.0000E+01
Maleic hydrizide	5.0000E+02
Malononitrile	1.0000E+01
Manganese	5.0000E+00
Manganese, filtered	5.0000E+00
Melphalan	1.0000E+01
Mercury	1.0000E-01
Mercury, filtered	1.0000E-01
Methacrylonitrile	1.0000E+01
Methanethiol	1.0000E+01
Methapyrilene	1.0000E+01
Metholonyl	1.0000E+01
Methoxychlor	3.0000E+00
Methyl Isobutyl Ketone	1.0000E+01
Methyl bromide	1.0000E+01
Methyl chloride	1.0000E+01
Methyl ethyl ketone	1.0000E+01
Methyl methacrylate	1.0000E+01
Methyl methanesulfonate	1.0000E+01
Methyl parathion	2.0000E+00
Methylene Chloride (by VOA GC/MS)	5.0000E+00
Methylthiouracil	1.0000E+01
Molybdenum	4.0000E+01
Molybdenum, filtered	4.0000E+01
Monobutyl Phosphate	1.0000E+04
N,N-diethylhydrazine	1.0000E+01
N-nitroso-N-methylurethane	1.0000E+01
N-nitrosodi-n-butylamine	1.0000E+01
N-nitrosodiethanolamine	1.0000E+01
N-nitrosodiethylamine	1.0000E+01
N-nitrosodimethylamine	1.0000E+01
N-nitrosomethylethylamine	1.0000E+01
N-nitrosomethylvinylamine	1.0000E+01
N-nitrosomorpholine	1.0000E+01
N-nitrosonornicotine	1.0000E+01
N-nitrosopiperidine	1.0000E+01
N-phenylthiourea	5.0000E+02
N-propylamine	1.0000E+04
Naphthalene	1.0000E+01
Nickel	1.0000E+01
Nickel, filtered	1.0000E+01
Nicotinic acid	1.0000E+02
Nitrate	5.0000E+02
Nitrite	1.0000E+03
Nitrobenzine	1.0000E+01
Nitrosopyrrolidine	1.0000E+01
O,O,O-triethyl phosphorothioate	1.0000E+01
O-toluidine hydrochloride	1.0000E+01
P benzoquinone	1.0000E+01

TABLE B.2. (contd)

Constituent Long Name	Detection Limit
P-chloro-m-cresol	1.0000E+01
P-chloroaniline	1.0000E+01
P-dimethylaminoazobenzene	1.0000E+01
P-nitroaniline	1.0000E+01
Paraldehyde	1.0000E+04
Parathion	2.0000E+00
Pentachlorobenzene	1.0000E+01
Pentachloroethane	1.0000E+01
Pentachloronitrobenzene	1.0000E+01
Pentachlorophenol	5.0000E+01
Perchlorate	5.0000E+02
Phenacetin	1.0000E+01
Phenol	1.0000E+01
Phenol, low DL	1.0000E+01
Phenylenediamine	1.0000E+01
Phosphate	1.0000E+03
Phthalic acid esters	1.0000E+01
Potassium	1.0000E+02
Potassium, filtered	1.0000E+02
Pronamide	1.0000E+01
Pyridine	5.0000E+02
Radium	1.0000E+00
Reserpine	1.0000E+01
Resorcinol	1.0000E+01
Safrol	1.0000E+01
Selenium	5.0000E+00
Selenium, filtered	5.0000E+00
Silicon	5.0000E+01
Silicon, filtered	5.0000E+01
Silver	1.0000E+01
Silver, filtered	1.0000E+01
Sodium	2.0000E+02
Sodium, filtered	2.0000E+02
Specific conductance	1.0000E+00
Strontium	1.0000E+01
Strontium, filtered	1.0000E+01
Strychnine	5.0000E+01
Sulfate	5.0000E+02
Sulfide	1.0000E+03
Sym-trinitrobenzene	1.0000E+01
Tetrachloroethylene	5.0000E+00
Tetraethylpyrophosphate	2.0000E+00
Tetrahydrofuran	1.0000E+01
Thallium	5.0000E+00
Thallium, filtered	5.0000E+00
Thiofanox	1.0000E+01
Thiourea	2.0000E+02
Thiuram	1.0000E+01
Tin	3.0000E+01
Tin, filtered	3.0000E+01
Titanium	6.0000E+01
Titanium, filtered	6.0000E+01
Toluene	5.0000E+00
Toluenediamine	1.0000E+01

TABLE B.2. (contd)

Constituent Long Name	Detection Limit
Total Organic Halogen, Low Det. Level	1.0000E+01
Total carbon	1.0000E+03
Total organic carbon	2.0000E+03
Toxaphene	1.0000E+00
Trans-1,2-dichloroethene	5.0000E+00
Tributylphosphoric Acid	1.0000E+01
Trichloroethylene	5.0000E+00
Trichloromethanethiol	1.0000E+01
Trichloromonofluoromethane	1.0000E+01
Trichloropropane	1.0000E+01
Tris(2,3-dibromopropyl) phosphate	1.0000E+01
Tritium	5.0000E+02
Turbidity	1.0000E-01
Vanadium	5.0000E+00
Vanadium, filtered	5.0000E+00
Vinyl chloride	1.0000E+01
Warfarin	1.0000E+01
Xylene-m	5.0000E+00
Xylene-o,p	5.0000E+00
Zinc	5.0000E+00
Zinc, filtered	5.0000E+00
Zirconium	5.0000E+01
Zirconium, filtered	5.0000E+01
p-Dichlorobenzene	1.0000E+01
p-Nitrophenol	1.0000E+01
pH, Field Measurement	1.0000E-01
pH, Laboratory Measurement	1.0000E-02

TABLE B.3. Constituents That Were Detected at Least Once at the 2101-M Pond (data collected between August 1988 and August 1989)

Detected Constituents are reported below.
The constituents are presented in alphabetical order according to their short name
(with overriding rules of: unfiltered metals reported first, then filtered
field measurements reported first, then laboratory)

The following table lists the column headers, what time period they covered, and the purpose of the sampling

Header	Sample dates	Purpose
AUG88	16 Aug, 1988	First quarterly background sample
SEP88	22 Sep, 1988	Metals resample for Selenium
NOV88	9-10 Nov, 1988	Second quarterly background sample
NOV88x	22-Nov, 1988	B-3 Pond background sample (2-E18-2 only)
NOV88y	23-28 Nov, 1988	Volatiles resample for Acetone
FEB89	15-16 Feb, 1989	Third quarterly background sample
MAYJUN89	26 May-1 Jun, 1989	Fourth and final quarterly background sample
AUG89	8-11 Aug, 1989	First Contamination Indicator Parameter Evaluation sample

Data flags
. - Not sampled for
< - Less than Contractual Detection Limit, reported as Limit
- Less than Contractual Detection Limit, measured value reported
* - For radioactive constituents, reported value is less than 2-sigma error
M - Analysis performed by PNL.

TABLE B.3. (contd)

Constituent=I01 ACETONE ppb Long name=Acetone by VOA

WELLNAME	DUPNUM	AUG88	SEP88	NOV88	NOV88X	NOV88Y	FEB89	MAYJUN89	AUG89
2-E18-1		.	.	#2	.	<10	<10	<10	<10
2-E18-1	1	.	.	#2	.	.	.	.	.
2-E18-1	2	.	.	#3	.	.	.	.	.
2-E18-1	3	.	.	#1	.	.	.	.	.
2-E18-1	M	.	.	.	.	<5	.	.	.
2-E18-2		.	.	#2	.	11	.	.	.
2-E18-2	1	.	.	#2	.	.	.	.	.
2-E18-2	M	.	.	.	.	<5	.	.	.
2-E18-3		.	.	#4	.	<10	.	.	.
2-E18-3	1	.	.	<10	.	.	.	.	.
2-E18-3	M	.	.	.	.	<5	.	.	.
2-E18-4		.	.	#5	.	<10	.	.	.
2-E18-4	1	.	.	#3	.	.	.	.	.
2-E18-4	M	.	.	.	.	<5	.	.	.

Constituent=H58 ALKALIN ppb Long name=Total alkalinity, as CaCO3 (Method B)

WELLNAME	DUPNUM	AUG88	SEP88	NOV88	NOV88X	NOV88Y	FEB89	MAYJUN89	AUG89
2-E18-1		.	.	.	.	.	.	102000	108000
2-E18-2		.	.	.	.	.	.	90500	90000
2-E18-3		.	.	.	.	.	.	96600	98000
2-E18-4		.	.	.	.	.	.	105000	105000

Constituent=212 ALPHA pCi/L Long name=Gross alpha

WELLNAME	DUPNUM	AUG88	SEP88	NOV88	NOV88X	NOV88Y	FEB89	MAYJUN89	AUG89
2-E18-1		2.210	.	3.830	.	.	.	.	.
2-E18-1	1	.	.	3.900	.	.	.	.	.
2-E18-2		0.416	.	1.590	1.81	.	.	.	.
2-E18-3		*0.352	.	*0.292	.	.	.	.	.
2-E18-4		0.917	.	1.900	.	.	.	.	.

Constituent=112 ALPHAHI pCi/L Long name=Gross alpha, high DL

WELLNAME	DUPNUM	AUG88	SEP88	NOV88	NOV88X	NOV88Y	FEB89	MAYJUN89	AUG89
2-E18-1		.	.	.	.	.	4.870	5.530	5.530
2-E18-2		.	.	.	.	.	1.720	3.010	2.200
2-E18-2	1	.	.	.	.	.	*1.200	.	.
2-E18-3		.	.	.	.	.	2.420	0.931	*0.846
2-E18-3	1	.	.	.	.	.	.	1.100	.
2-E18-4		.	.	.	.	.	*0.879	2.330	1.880
2-E18-4	1	.	.	.	.	.	.	.	3.490

TABLE B.3. (contd)

Constituent=A16 ALUMNUM ppb Long name=Aluminum

WELLNAME	DUPNUM	AUG88	SEP88	NOV88	NOV88X	NOV88Y	FEB89	MAYJUN89	AUG89
2-E18-1		351	609	<150	.	.	<150	<150	<150
2-E18-1	1	.	.	<150	.	.	.	.	.
2-E18-2		<150	<150	<150	<150	.	<150	<150	<150
2-E18-2	1	.	.	.	.	.	<150	.	.
2-E18-3		<150	<150	<150	.	.	<150	<150	<150
2-E18-3	1	.	.	.	.	.	.	<150	.
2-E18-4		<150	173	<150	.	.	<150	<150	<150
2-E18-4	1	.	.	.	.	.	.	.	<150

Constituent=A20 ARSENIC ppb Long name=Arsenic

WELLNAME	DUPNUM	AUG88	SEP88	NOV88	NOV88X	NOV88Y	FEB89	MAYJUN89	AUG89
2-E18-1		<5	<5	<5	.	.	<5	<5	<5
2-E18-1	1	.	.	<5	.	.	.	.	.
2-E18-2		5	5	8	8	.	8	7	8
2-E18-2	1	.	.	.	.	.	8	.	.
2-E18-3		51	11	11	.	.	13	14	11
2-E18-3	1	.	.	.	.	.	.	13	.
2-E18-4		11	9	11	.	.	11	11	10
2-E18-4	1	.	.	.	.	.	.	.	10

Constituent=H37 FARSENI ppb Long name=Arsenic, filtered

WELLNAME	DUPNUM	AUG88	SEP88	NOV88	NOV88X	NOV88Y	FEB89	MAYJUN89	AUG89
2-E18-1		<5	<5	<5	.	.	<5	<5	<5
2-E18-1	1	.	.	<5	.	.	.	.	.
2-E18-2		5	5	5	8	.	8	5	8
2-E18-2	1	.	.	.	.	.	8	.	.
2-E18-3		12	12	14	.	.	12	14	11
2-E18-3	1	.	.	.	.	.	.	13	.
2-E18-4		9	8	9	.	.	10	12	10
2-E18-4	1	.	.	.	.	.	.	.	9

Constituent=A06 BARIUM ppb Long name=Barium

WELLNAME	DUPNUM	AUG88	SEP88	NOV88	NOV88X	NOV88Y	FEB89	MAYJUN89	AUG89
2-E18-1		41	54	42	.	.	29	28	25
2-E18-1	1	.	.	38	.	.	.	.	.
2-E18-2		49	54	51	52	.	60	61	58
2-E18-2	1	.	.	.	.	.	61	.	.
2-E18-3		50	61	52	.	.	62	53	54
2-E18-3	1	.	.	.	.	.	.	53	.
2-E18-4		49	58	51	.	.	51	57	59
2-E18-4	1	.	.	.	.	.	.	.	57

TABLE B.3. (contd)

Constituent=H20 FBARIUM ppb Long name=Barium, filtered

WELLNAME	DUPNUM	AUG88	SEP88	NOV88	NOV88X	NOV88Y	FEB89	MAYJUN89	AUG89
2-E18-1		41	48	43	.	.	31	25	34
2-E18-1	1	.	.	38	.	.	.	.	.
2-E18-2		53	52	61	53	.	59	58	73
2-E18-2	1	.	.	.	.	.	62	.	.
2-E18-3		52	59	56	.	.	63	55	61
2-E18-3	1	.	.	.	.	.	.	58	.
2-E18-4		52	55	52	.	.	52	57	64
2-E18-4	1	.	.	.	.	.	.	.	65

Constituent=H33 FBERYLL ppb Long name=Beryllium, filtered

WELLNAME	DUPNUM	AUG88	SEP88	NOV88	NOV88X	NOV88Y	FEB89	MAYJUN89	AUG89
2-E18-1		<5	.	<5	.	.	<5	<5	<5
2-E18-1	1	.	.	<5	.	.	.	.	.
2-E18-2		<5	.	<5	<5	.	<5	<5	<5
2-E18-2	1	.	.	.	.	.	<5	.	.
2-E18-3		<5	.	<5	.	.	<5	<5	<5
2-E18-3	1	.	.	.	.	.	.	<5	.
2-E18-4		<5	.	<5	.	.	<5	<5	5
2-E18-4	1	.	.	.	.	.	.	.	<5

Constituent=111 BETA pCi/L Long name=Gross beta

WELLNAME	DUPNUM	AUG88	SEP88	NOV88	NOV88X	NOV88Y	FEB89	MAYJUN89	AUG89
2-E18-1		3.89	.	8.45	.	.	6.85	6.58	7.46
2-E18-1	1	.	.	10.70	.	.	.	.	.
2-E18-2		*1.13	.	6.22	4.97	.	5.46	4.70	9.44
2-E18-2	1	.	.	.	.	.	*1.78	.	.
2-E18-3		1.87	.	5.68	.	.	5.12	6.81	10.60
2-E18-3	1	.	.	.	.	.	.	5.36	.
2-E18-4		2.05	.	7.60	.	.	5.85	6.08	3.37
2-E18-4	1	.	.	.	.	.	.	.	6.64

Constituent=P01 BORON ppb Long name=Boron

WELLNAME	DUPNUM	AUG88	SEP88	NOV88	NOV88X	NOV88Y	FEB89	MAYJUN89	AUG89
2-E18-1		.	.	.	.	.	33	37	38
2-E18-2		.	.	.	.	.	24	19	19
2-E18-2	1	.	.	.	.	.	13	.	.
2-E18-3		.	.	.	.	.	14	18	13
2-E18-3	1	.	.	.	.	.	.	13	.
2-E18-4		.	.	.	.	.	<10	17	15
2-E18-4	1	.	.	.	.	.	.	.	15

TABLE B.3. (contd)

Constituent=H86 FBORON ppb Long name=Boron, filtered

WELLNAME	DUPNUM	AUG88	SEP88	NOV88	NOV88X	NOV88Y	FEB89	MAYJUN89	AUG89
2-E18-1		.	.	.	.	.	38	34	42
2-E18-2		.	.	.	.	.	16	23	29
2-E18-2	1	.	.	.	.	.	34	.	.
2-E18-3		.	.	.	.	.	<10	<10	20
2-E18-3	1	.	.	.	.	.	.	11	.
2-E18-4		.	.	.	.	.	14	16	14
2-E18-4	1	.	.	.	.	.	.	.	19

Constituent=H21 FCADMIU ppb Long name=Cadmium, filtered

WELLNAME	DUPNUM	AUG88	SEP88	NOV88	NOV88X	NOV88Y	FEB89	MAYJUN89	AUG89
2-E18-1		<2	<2	<2	.	.	<2	<2	<2
2-E18-1	1	.	.	<2	.	.	.	.	.
2-E18-2		<2	<2	<2	<2	.	<2	<2	<2
2-E18-2	1	.	.	.	.	.	<2	.	.
2-E18-3		<2	<2	<2	.	.	2	<2	<2
2-E18-3	1	.	.	.	.	.	.	<2	.
2-E18-4		<2	<2	<2	.	.	<2	<2	<2
2-E18-4	1	.	.	.	.	.	.	.	<2

Constituent=A05 CALCIUM ppb Long name=Calcium

WELLNAME	DUPNUM	AUG88	SEP88	NOV88	NOV88X	NOV88Y	FEB89	MAYJUN89	AUG89
2-E18-1		57300	72800	67400	.	.	55700	58000	57000
2-E18-1	1	.	.	57700	.	.	.	.	.
2-E18-2		22900	25400	24300	24300	.	25700	27700	27100
2-E18-2	1	.	.	.	.	.	25400	.	.
2-E18-3		24800	29600	27000	.	.	29600	27800	27100
2-E18-3	1	.	.	.	.	.	.	27700	.
2-E18-4		27500	31000	29000	.	.	27800	31600	32300
2-E18-4	1	.	.	.	.	.	.	.	32000

Constituent=H19 FCALCIU ppb Long name=Calcium, filtered

WELLNAME	DUPNUM	AUG88	SEP88	NOV88	NOV88X	NOV88Y	FEB89	MAYJUN89	AUG89
2-E18-1		70800	73700	63200	.	.	57800	60400	69500
2-E18-1	1	.	.	58400	.	.	.	.	.
2-E18-2		25700	25600	25500	24600	.	25300	26300	32300
2-E18-2	1	.	.	.	.	.	26800	.	.
2-E18-3		26800	31000	28000	.	.	29800	28500	29900
2-E18-3	1	.	.	.	.	.	.	27900	.
2-E18-4		30700	31300	28700	.	.	27400	31700	35000
2-E18-4	1	.	.	.	.	.	.	.	34900

TABLE B.3. (contd)

Constituent=C75 CHLORID ppb Long name=Chloride

WELLNAME	DUPNUM	AUG88	SEP88	NOV88	NOV88X	NOV88Y	FEB89	MAYJUN89	AUG89
2-E18-1		6550	.	6800	.	.	6900	7100	6000
2-E18-1	1	.	.	6200	.	.	.	.	.
2-E18-2		2060	.	2800	2700	.	4900	8000	7000
2-E18-3		4470	.	4400	.	.	6500	7000	5800
2-E18-3	1	.	.	.	.	.	.	6900	.
2-E18-4		6260	.	6400	.	.	9500	14600	7000
2-E18-4	1	.	.	.	.	.	.	.	7000

Constituent=A08 CHROMUM ppb Long name=Chromium

WELLNAME	DUPNUM	AUG88	SEP88	NOV88	NOV88X	NOV88Y	FEB89	MAYJUN89	AUG89
2-E18-1		30	104	30	.	.	22	20	100
2-E18-1	1	.	.	20	.	.	.	.	.
2-E18-2		30	87	20	41	.	50	28	18
2-E18-2	1	.	.	.	.	.	79	.	.
2-E18-3		62	67	21	.	.	104	30	95
2-E18-3	1	.	.	.	.	.	.	36	.
2-E18-4		54	159	21	.	.	42	24	65
2-E18-4	1	.	.	.	.	.	.	.	80

Constituent=H22 FCHROMI ppb Long name=Chromium, filtered

WELLNAME	DUPNUM	AUG88	SEP88	NOV88	NOV88X	NOV88Y	FEB89	MAYJUN89	AUG89
2-E18-1		<10	<10	<10	.	.	<10	<10	<10
2-E18-1	1	.	.	<10	.	.	.	.	.
2-E18-2		<10	<10	<10	11	.	<10	<10	<10
2-E18-2	1	.	.	.	.	.	<10	.	.
2-E18-3		<10	<10	<10	.	.	<10	<10	<10
2-E18-3	1	.	.	.	.	.	.	12	.
2-E18-4		<10	<10	<10	.	.	<10	<10	<10
2-E18-4	1	.	.	.	.	.	.	.	<10

Constituent=P19 COLIMF 100mL Long name=Coliform (Membrane Filter)

WELLNAME	DUPNUM	AUG88	SEP88	NOV88	NOV88X	NOV88Y	FEB89	MAYJUN89	AUG89
2-E18-2		.	.	.	.	.	.	.	1

TABLE B.3. (contd)

Constituent=191 CONDFLD umho Long name=Specific conductance, field

WELLNAME	DUPNUM	AUG88	SEP88	NOV88	NOV88X	NOV88Y	FEB89	MAYJUN89	AUG89
2-E18-1		812	.	595	.	633	537	550	564
2-E18-1	1	812	.	594	.	.	534	549	567
2-E18-1	2	811	.	593	.	.	532	549	568
2-E18-1	3	809	.	594	.	.	531	549	567
2-E18-2		352	.	283	257	279	256	244	288
2-E18-2	1	354	.	282	260	.	256	244	285
2-E18-2	2	355	.	282	260	.	256	243	285
2-E18-2	3	355	.	282	260	.	256	244	286
2-E18-3		279	.	232	.	247	207	176	156
2-E18-3	1	279	.	232	.	.	206	176	156
2-E18-3	2	280	.	232	.	.	205	176	156
2-E18-3	3	280	.	232	.	.	205	176	157
2-E18-4		303	.	270	.	252	248	255	171
2-E18-4	1	303	.	271	.	.	248	255	171
2-E18-4	2	303	.	271	.	.	248	255	171
2-E18-4	3	303	.	270	.	.	248	255	171

Constituent=088 CONDLAB umho Long name=Specific conductance, laboratory

WELLNAME	DUPNUM	AUG88	SEP88	NOV88	NOV88X	NOV88Y	FEB89	MAYJUN89	AUG89
2-E18-1		534	.	571	.	.	514	503	533
2-E18-1	1	531	.	586	.	.	512	474	532
2-E18-1	2	529	.	588	.	.	510	484	534
2-E18-1	3	521	.	583	.	.	517	498	535
2-E18-2		251	.	269	.	.	252	247	285
2-E18-2	1	249	.	271	.	.	263	223	284
2-E18-2	2	249	.	270	.	.	256	249	288
2-E18-2	3	248	.	271	.	.	258	252	288
2-E18-3		200	.	229	.	.	235	183	232
2-E18-3	1	200	.	233	.	.	232	178	233
2-E18-3	2	204	.	233	.	.	224	178	232
2-E18-3	3	204	.	234	.	.	230	201	234
2-E18-4		219	.	242	.	.	228	296	253
2-E18-4	1	220	.	250	.	.	263	262	254
2-E18-4	2	219	.	251	.	.	261	294	254
2-E18-4	3	218	.	250	.	.	242	293	251

TABLE B.3. (contd)

Constituent=A13 COPPER ppb Long name=Copper

WELLNAME	DUPNUM	AUG88	SEP88	NOV88	NOV88X	NOV88Y	FEB89	MAYJUN89	AUG89
2-E18-1		<10	<10	<10	.	.	<10	<10	<10
2-E18-1	1	.	.	12	.	.	.	.	.
2-E18-2		<10	<10	<10	<10	.	12	15	<10
2-E18-2	1	.	.	.	.	.	<10	.	.
2-E18-3		<10	<10	<10	.	.	<10	<10	<10
2-E18-3	1	.	.	.	.	.	.	<10	.
2-E18-4		<10	<10	<10	.	.	13	18	<10
2-E18-4	1	.	.	.	.	.	.	.	<10

Constituent=H26 FCOPPER ppb Long name=Copper, filtered

WELLNAME	DUPNUM	AUG88	SEP88	NOV88	NOV88X	NOV88Y	FEB89	MAYJUN89	AUG89
2-E18-1		<10	<10	<10	.	.	<10	<10	<10
2-E18-1	1	.	.	<10	.	.	.	.	.
2-E18-2		<10	<10	12	<10	.	<10	<10	<10
2-E18-2	1	.	.	.	.	.	<10	.	.
2-E18-3		<10	<10	<10	.	.	<10	<10	<10
2-E18-3	1	.	.	.	.	.	.	<10	.
2-E18-4		<10	<10	<10	.	.	11	11	11
2-E18-4	1	.	.	.	.	.	.	.	<10

Constituent=C74 FLUORID ppb Long name=Fluoride

WELLNAME	DUPNUM	AUG88	SEP88	NOV88	NOV88X	NOV88Y	FEB89	MAYJUN89	AUG89
2-E18-1		<500	.	<500	.	.	<500	500	600
2-E18-1	1	.	.	<500	.	.	.	.	.
2-E18-2		575	.	600	600	.	700	700	700
2-E18-3		<500	.	<500	.	.	<500	<500	<500
2-E18-3	1	.	.	.	.	.	.	<500	.
2-E18-4		<500	.	<500	.	.	<500	<500	<500
2-E18-4	1	.	.	.	.	.	.	.	<500

Constituent=A19 IRON ppb Long name=Iron

WELLNAME	DUPNUM	AUG88	SEP88	NOV88	NOV88X	NOV88Y	FEB89	MAYJUN89	AUG89
2-E18-1		1250	1810	355	.	.	102	546	531
2-E18-1	1	.	.	265	.	.	.	.	.
2-E18-2		250	535	142	218	.	303	124	158
2-E18-2	1	.	.	.	.	.	423	.	.
2-E18-3		983	1440	325	.	.	858	284	574
2-E18-3	1	.	.	.	.	.	.	294	.
2-E18-4		493	1580	261	.	.	325	121	412
2-E18-4	1	.	.	.	.	.	.	.	465

TABLE B.3. (contd)

Constituent=H31 FIRON ppb Long name=Iron, filtered

WELLNAME	DUPNUM	AUG88	SEP88	NOV88	NOV88X	NOV88Y	FEB89	MAYJUN89	AUG89
2-E18-1		33	<30	<30	.	.	<30	<30	<30
2-E18-1	1	.	.	<30	.	.	.	.	.
2-E18-2		39	<30	<30	<30	.	39	<30	<30
2-E18-2	1	.	.	.	.	.	40	.	.
2-E18-3		40	32	53	.	.	41	39	<30
2-E18-3	1	.	.	.	.	.	.	31	.
2-E18-4		67	68	<30	.	.	<30	32	31
2-E18-4	1	.	.	.	.	.	.	.	32

Constituent=A51 LEADGF ppb Long name=Lead (graphite furnace)

WELLNAME	DUPNUM	AUG88	SEP88	NOV88	NOV88X	NOV88Y	FEB89	MAYJUN89	AUG89
2-E18-1		<5.0	.	<5	.	.	<5	<5	<5
2-E18-1	1	.	.	<5	.	.	.	.	.
2-E18-2		<5.0	.	<5	<5	.	<5	<5	<5
2-E18-2	1	.	.	.	.	.	<5	.	.
2-E18-3		<5.0	.	<5	.	.	<5	<5	<5
2-E18-3	1	.	.	.	.	.	.	<5	.
2-E18-4		9.5	.	6	.	.	<5	<5	<5
2-E18-4	1	.	.	.	.	.	.	.	<5

Constituent=A50 MAGNES ppb Long name=Magnesium

WELLNAME	DUPNUM	AUG88	SEP88	NOV88	NOV88X	NOV88Y	FEB89	MAYJUN89	AUG89
2-E18-1		15300	17000	15200	.	.	13900	14600	13700
2-E18-1	1	.	.	14700	.	.	.	.	.
2-E18-2		6750	6790	6460	6890	.	7190	7800	7330
2-E18-2	1	.	.	.	.	.	7220	.	.
2-E18-3		7170	7900	7180	.	.	8320	7720	7400
2-E18-3	1	.	.	.	.	.	.	7790	.
2-E18-4		7810	8070	7850	.	.	7930	8650	8580
2-E18-4	1	.	.	.	.	.	.	.	8470

Constituent=H32 FMAGNES ppb Long name=Magnesium, filtered

WELLNAME	DUPNUM	AUG88	SEP88	NOV88	NOV88X	NOV88Y	FEB89	MAYJUN89	AUG89
2-E18-1		17100	16500	15300	.	.	14400	15100	16200
2-E18-1	1	.	.	14700	.	.	.	.	.
2-E18-2		7340	6710	7170	6910	.	7150	7140	8670
2-E18-2	1	.	.	.	.	.	7510	.	.
2-E18-3		7550	8080	7850	.	.	8270	7740	8000
2-E18-3	1	.	.	.	.	.	.	7800	.
2-E18-4		8340	8060	7940	.	.	7850	9350	9060
2-E18-4	1	.	.	.	.	.	.	.	8970

TABLE B.3. (contd)

Constituent=A17 MANGESE ppb Long name=Manganese

WELLNAME	DUPNUM	AUG88	SEP88	NOV88	NOV88X	NOV88Y	FEB89	MAYJUN89	AUG89
2-E18-1		70	46	12	.	.	<5	12	12
2-E18-1	1	.	.	12	.	.	.	.	.
2-E18-2		6	13	<5	5	.	8	9	<5
2-E18-2	1	.	.	.	.	.	9	.	.
2-E18-3		15	22	<5	.	.	18	7	12
2-E18-3	1	.	.	.	.	.	.	7	.
2-E18-4		13	32	5	.	.	10	<5	10
2-E18-4	1	.	.	.	.	.	.	.	12

Constituent=H29 FMANGAN ppb Long name=Manganese, filtered

WELLNAME	DUPNUM	AUG88	SEP88	NOV88	NOV88X	NOV88Y	FEB89	MAYJUN89	AUG89
2-E18-1		51	19	<5	.	.	<5	<5	<5
2-E18-1	1	.	.	<5	.	.	.	.	.
2-E18-2		<5	<5	<5	<5	.	<5	<5	<5
2-E18-2	1	.	.	.	.	.	<5	.	.
2-E18-3		<5	<5	<5	.	.	<5	<5	<5
2-E18-3	1	.	.	.	.	.	.	<5	.
2-E18-4		8	11	<5	.	.	<5	8	<5
2-E18-4	1	.	.	.	.	.	.	.	5

Constituent=A12 NICKEL ppb Long name=Nickel

WELLNAME	DUPNUM	AUG88	SEP88	NOV88	NOV88X	NOV88Y	FEB89	MAYJUN89	AUG89
2-E18-1		15	48	25	.	.	<10	13	44
2-E18-1	1	.	.	19	.	.	.	.	.
2-E18-2		18	43	20	20	.	28	11	18
2-E18-2	1	.	.	.	.	.	40	.	.
2-E18-3		31	35	20	.	.	54	21	49
2-E18-3	1	.	.	.	.	.	.	22	.
2-E18-4		34	79	18	.	.	21	12	35
2-E18-4	1	.	.	.	.	.	.	.	41

Constituent=H25 FNICKEL ppb Long name=Nickel, filtered

WELLNAME	DUPNUM	AUG88	SEP88	NOV88	NOV88X	NOV88Y	FEB89	MAYJUN89	AUG89
2-E18-1		<10	<10	18	.	.	<10	<10	<10
2-E18-1	1	.	.	15	.	.	.	.	.
2-E18-2		<10	<10	17	10	.	<10	<10	<10
2-E18-2	1	.	.	.	.	.	<10	.	.
2-E18-3		<10	<10	12	.	.	13	12	<10
2-E18-3	1	.	.	.	.	.	.	<10	.
2-E18-4		13	18	11	.	.	<10	17	11
2-E18-4	1	.	.	.	.	.	.	.	<10

TABLE B.3. (contd)

Constituent=C72 NITRATE ppb Long name=Nitrate

WELLNAME	DUPNUM	AUG88	SEP88	NOV88	NOV88X	NOV88Y	FEB89	MAYJUN89	AUG89
2-E18-1		10100	.	8400	.	.	11400	12000	12500
2-E18-1	1	.	.	8400	.	.	.	.	.
2-E18-2		<500	.	<500	<500	.	<500	600	600
2-E18-3		<500	.	<500	.	.	<500	500	<500
2-E18-3	1	.	.	.	.	.	.	<500	.
2-E18-4		<500	.	<500	.	.	800	1000	<500
2-E18-4	1	.	.	.	.	.	.	.	570

Constituent=199 PHFIELD Long name=pH, field

WELLNAME	DUPNUM	AUG88	SEP88	NOV88	NOV88X	NOV88Y	FEB89	MAYJUN89	AUG89
2-E18-1		7.8	.	8.6	.	8.5	7.0	7.89	7.89
2-E18-1	1	7.8	.	8.6	.	.	7.0	7.89	7.89
2-E18-1	2	7.9	.	8.5	.	.	6.9	7.89	7.88
2-E18-1	3	7.8	.	8.5	.	.	6.9	7.89	7.88
2-E18-2		7.9	.	8.4	8.0	8.5	8.0	7.45	8.01
2-E18-2	1	7.9	.	8.4	8.1	.	8.0	7.46	8.00
2-E18-2	2	7.9	.	8.4	8.1	.	8.0	7.46	8.00
2-E18-2	3	7.9	.	8.4	8.1	.	8.0	7.46	8.00
2-E18-3		7.9	.	8.1	.	8.4	8.0	7.39	8.20
2-E18-3	1	7.9	.	8.1	.	.	8.0	7.40	8.20
2-E18-3	2	7.9	.	8.1	.	.	8.0	7.40	8.20
2-E18-3	3	7.9	.	8.1	.	.	8.0	7.41	8.20
2-E18-4		7.8	.	8.2	.	8.4	7.0	8.05	8.09
2-E18-4	1	7.9	.	8.2	.	.	7.0	8.05	8.08
2-E18-4	2	8.0	.	8.2	.	.	7.0	8.05	8.08
2-E18-4	3	8.0	.	8.2	.	.	7.0	8.05	8.09

TABLE B.3. (contd)

Constituent=207 PH-LAB Long name=pH, laboratory

WELLNAME	DUPNUM	AUG88	SEP88	NOV88	NOV88X	NOV88Y	FEB89	MAYJUN89	AUG89
2-E18-1		7.9	.	7.9	.	.	7.9	8.0	8.0
2-E18-1	1	7.9	.	7.9	.	.	7.8	8.0	8.0
2-E18-1	2	7.9	.	8.0	.	.	7.7	8.0	8.0
2-E18-1	3	7.9	.	7.9	.	.	7.8	8.0	8.0
2-E18-2		8.0	.	7.8	.	.	8.1	8.1	7.9
2-E18-2	1	8.0	.	7.8	.	.	8.1	8.1	8.0
2-E18-2	2	8.0	.	7.9	.	.	8.1	8.1	8.0
2-E18-2	3	8.0	.	7.9	.	.	8.1	8.1	8.0
2-E18-3		8.0	.	7.8	.	.	8.2	8.1	8.1
2-E18-3	1	8.0	.	7.8	.	.	8.2	8.2	8.1
2-E18-3	2	8.0	.	7.9	.	.	8.2	8.1	8.1
2-E18-3	3	8.0	.	7.9	.	.	8.1	8.2	8.2
2-E18-4		8.0	.	7.9	.	.	8.1	8.2	8.0
2-E18-4	1	8.0	.	7.9	.	.	8.1	8.1	8.1
2-E18-4	2	8.0	.	8.0	.	.	8.0	8.1	8.0
2-E18-4	3	8.0	.	8.0	.	.	8.0	8.1	8.1

Constituent=A18 POTASUM ppb Long name=Potassium

WELLNAME	DUPNUM	AUG88	SEP88	NOV88	NOV88X	NOV88Y	FEB89	MAYJUN89	AUG89
2-E18-1		6350	7200	6330	.	.	5570	5780	5340
2-E18-1	1	.	.	6410	.	.	.	.	.
2-E18-2		4920	5090	4560	4860	.	5210	5150	4920
2-E18-2	1	.	.	.	.	.	5220	.	.
2-E18-3		4860	5140	4620	.	.	5500	4980	5020
2-E18-3	1	.	.	.	.	.	.	5100	.
2-E18-4		5250	5640	5400	.	.	5370	5490	5650
2-E18-4	1	.	.	.	.	.	.	.	5460

Constituent=H30 FPOTASS ppb Long name=Potassium, filtered

WELLNAME	DUPNUM	AUG88	SEP88	NOV88	NOV88X	NOV88Y	FEB89	MAYJUN89	AUG89
2-E18-1		6980	6870	6540	.	.	5800	5810	6210
2-E18-1	1	.	.	6380	.	.	.	.	.
2-E18-2		5280	4930	5220	4850	.	5100	4790	5770
2-E18-2	1	.	.	.	.	.	5350	.	.
2-E18-3		5030	5220	5290	.	.	5310	5050	5100
2-E18-3	1	.	.	.	.	.	.	5010	.
2-E18-4		5580	5570	5450	.	.	5390	5980	5570
2-E18-4	1	.	.	.	.	.	.	.	5480

TABLE B.3. (contd)

Constituent=181 RADIUM pCi/L Long name=Radium, total

WELLNAME	DUPNUM	AUG88	SEP88	NOV88	NOV88X	NOV88Y	FEB89	MAYJUN89	AUG89
2-E18-1		2.160	.	0.272	.	.	0.247	0.471	0.312
2-E18-1	1	.	.	0.207	.	.	.	.	.
2-E18-2		1.240	.	0.174	0.14	.	0.222	*0.042	0.757
2-E18-2	1	.	.	.	.	.	0.343	.	.
2-E18-3		0.701	.	0.269	.	.	0.302	0.252	0.239
2-E18-3	1	.	.	.	.	.	.	0.138	.
2-E18-4		0.753	.	*0.031	.	.	0.275	*0.147	0.378
2-E18-4	1	.	.	.	.	.	.	.	*0.121

Constituent=A22 SELENUM ppb Long name=Selenium

WELLNAME	DUPNUM	AUG88	SEP88	NOV88	NOV88X	NOV88Y	FEB89	MAYJUN89	AUG89
2-E18-1		14.9	10	7	.	.	7	8	7
2-E18-1	1	.	.	7	.	.	.	.	.
2-E18-2		8.9	<5	<5	<5	.	<5	<5	<5
2-E18-2	1	.	.	.	.	.	<5	.	.
2-E18-3		48.6	<5	<5	.	.	<5	<5	<5
2-E18-3	1	.	.	.	.	.	.	<5	.
2-E18-4		<5.0	<5	<5	.	.	<5	<5	<5
2-E18-4	1	.	.	.	.	.	.	.	<5

Constituent=H39 FSELENI ppb Long name=Selenium, filtered

WELLNAME	DUPNUM	AUG88	SEP88	NOV88	NOV88X	NOV88Y	FEB89	MAYJUN89	AUG89
2-E18-1		10.7	8.8	7	.	.	7	7	7
2-E18-1	1	.	.	8	.	.	.	.	.
2-E18-2		7.0	<5.0	<5	<5	.	<5	<5	<5
2-E18-2	1	.	.	.	.	.	<5	.	.
2-E18-3		<5.0	<5.0	<5	.	.	<5	<5	<5
2-E18-3	1	.	.	.	.	.	.	<5	.
2-E18-4		<5.0	<5.0	<5	.	.	<5	<5	<5
2-E18-4	1	.	.	.	.	.	.	.	<5

Constituent=P05 SILICON ppb Long name=Silicon

WELLNAME	DUPNUM	AUG88	SEP88	NOV88	NOV88X	NOV88Y	FEB89	MAYJUN89	AUG89
2-E18-1		.	.	.	.	.	13800	15000	14900
2-E18-2		.	.	.	.	.	19800	19800	18900
2-E18-2	1	.	.	.	.	.	19800	.	.
2-E18-3		.	.	.	.	.	19600	17600	17500
2-E18-3	1	.	.	.	.	.	.	18100	.
2-E18-4		.	.	.	.	.	17100	18300	19100
2-E18-4	1	.	.	.	.	.	.	.	18800

TABLE B.3. (contd)

Constituent=H90 FSILICO ppb Long name=Silicon, filtered

WELLNAME	DUPNUM	AUG88	SEP88	NOV88	NOV88X	NOV88Y	FEB89	MAYJUN89	AUG89
2-E18-1		.	.	.	.	.	14000	15400	17300
2-E18-2		.	.	.	.	.	19600	18300	22600
2-E18-2	1	.	.	.	.	.	20700	.	.
2-E18-3		.	.	.	.	.	19000	18100	19300
2-E18-3	1	.	.	.	.	.	.	17600	.
2-E18-4		.	.	.	.	.	17200	17800	20200
2-E18-4	1	.	.	.	.	.	.	.	20300

Constituent=A11 SODIUM ppb Long name=Sodium

WELLNAME	DUPNUM	AUG88	SEP88	NOV88	NOV88X	NOV88Y	FEB89	MAYJUN89	AUG89
2-E18-1		28700	28800	25900	.	.	25800	27800	26100
2-E18-1	1	.	.	27000	.	.	.	.	.
2-E18-2		18000	17700	16600	17600	.	19200	18700	17500
2-E18-2	1	.	.	.	.	.	19000	.	.
2-E18-3		5570	5310	5280	.	.	6560	5710	5640
2-E18-3	1	.	.	.	.	.	.	5930	.
2-E18-4		6010	6760	6740	.	.	11400	6790	6130
2-E18-4	1	.	.	.	.	.	.	.	5900

Constituent=H24 FSODIUM ppb Long name=Sodium, filtered

WELLNAME	DUPNUM	AUG88	SEP88	NOV88	NOV88X	NOV88Y	FEB89	MAYJUN89	AUG89
2-E18-1		31500	27400	28100	.	.	27100	28500	30500
2-E18-1	1	.	.	26700	.	.	.	.	.
2-E18-2		19700	17300	19000	17600	.	18700	17400	20800
2-E18-2	1	.	.	.	.	.	19800	.	.
2-E18-3		5480	5360	6020	.	.	6460	5980	5800
2-E18-3	1	.	.	.	.	.	.	5890	.
2-E18-4		6310	6680	6620	.	.	9640	14400	6250
2-E18-4	1	.	.	.	.	.	.	.	6180

Constituent=A03 STRONUM ppb Long name=Strontium

WELLNAME	DUPNUM	AUG88	SEP88	NOV88	NOV88X	NOV88Y	FEB89	MAYJUN89	AUG89
2-E18-1		249	.	249	.	.	240	257	231
2-E18-1	1	.	.	241	.	.	.	.	.
2-E18-2		133	.	129	135	.	146	161	147
2-E18-2	1	.	.	.	.	.	147	.	.
2-E18-3		128	.	130	.	.	161	148	141
2-E18-3	1	.	.	.	.	.	.	149	.
2-E18-4		146	.	148	.	.	150	173	169
2-E18-4	1	.	.	.	.	.	.	.	165

TABLE B.3. (contd)

Constituent=H35 FSTRONT ppb Long name=Strontium, filtered

WELLNAME	DUPNUM	AUG88	SEP88	NOV88	NOV88X	NOV88Y	FEB89	MAYJUN89	AUG89
2-E18-1		277	.	255	.	.	241	259	283
2-E18-1	1	.	.	241	.	.	.	.	.
2-E18-2		145	.	144	136	.	146	147	184
2-E18-2	1	.	.	.	.	.	153	.	.
2-E18-3		138	.	145	.	.	156	148	156
2-E18-3	1	.	.	.	.	.	.	143	.
2-E18-4		163	.	151	.	.	145	171	183
2-E18-4	1	.	.	.	.	.	.	.	181

Constituent=C73 SULFATE ppb Long name=Sulfate

WELLNAME	DUPNUM	AUG88	SEP88	NOV88	NOV88X	NOV88Y	FEB89	MAYJUN89	AUG89
2-E18-1		168000	.	172000	.	.	149000	151000	153000
2-E18-1	1	.	.	169000	.	.	.	.	.
2-E18-2		23500	.	26600	28100	.	31600	44000	45000
2-E18-3		13000	.	14700	.	.	12500	12500	13900
2-E18-3	1	.	.	.	.	.	.	12600	.
2-E18-4		13500	.	17000	.	.	22100	35400	14900
2-E18-4	1	.	.	.	.	.	.	.	14800

Constituent=H16 TC ppb Long name=Total carbon

WELLNAME	DUPNUM	AUG88	SEP88	NOV88	NOV88X	NOV88Y	FEB89	MAYJUN89	AUG89
2-E18-1		.	.	21500	.	.	23800	.	24200
2-E18-2		.	.	22900	.	.	.	.	.
2-E18-3		.	.	21200	.	.	.	.	.
2-E18-4		.	.	22200	.	.	.	.	.

TABLE B.3. (contd)

Constituent=C69 TOC ppb Long name=Total organic carbon

WELLNAME	DUPNUM	AUG88	SEP88	NOV88	NOV88X	NOV88Y	FEB89	MAYJUN89	AUG89
2-E18-1		#532	.	#400	.	.	#200	#500	#300
2-E18-1	1	#890	.	#300	.	.	#200	#500	#400
2-E18-1	2	#382	.	#300	.	.	#200	#300	#300
2-E18-1	3	#397	.	#300	.	.	#200	#600	#300
2-E18-2		#341	.	#200	#200	.	#500	#400	#300
2-E18-2	1	#356	.	#300	#300	.	#700	#600	#700
2-E18-2	2	#717	.	#300	#300	.	#900	#500	#500
2-E18-2	3	#543	.	#500	#200	.	#1000	#400	#800
2-E18-3		#546	.	#400	.	.	#800	#500	#500
2-E18-3	1	#531	.	#500	.	.	#800	#500	#600
2-E18-3	2	#498	.	#500	.	.	#500	#400	#700
2-E18-3	3	#492	.	#500	.	.	#600	#400	#600
2-E18-4		#453	.	#500	.	.	#600	#900	#500
2-E18-4	1	#503	.	#600	.	.	#600	#900	#400
2-E18-4	2	#440	.	#500	.	.	#600	#1000	#500
2-E18-4	3	#642	.	#500	.	.	#600	#900	#400

Constituent=H42 TOXLDL ppb Long name=Total organic halogens, low DL

WELLNAME	DUPNUM	AUG88	SEP88	NOV88	NOV88X	NOV88Y	FEB89	MAYJUN89	AUG89
2-E18-1		#1.3	.	#4	.	.	#5	#4	#3
2-E18-1	1	#11.5	.	#0	.	.	#5	#3	#4
2-E18-1	2	#11.4	.	#3	.	.	#0	#3	#4
2-E18-1	3	#-4.8	.	#3	.	.	#5	#3	#2
2-E18-2		#-4.7	.	#7	#7	.	#4	15	#5
2-E18-2	1	#-0.9	.	#1	#7	.	#3	14	13
2-E18-2	2	#-1.8	.	#2	#2	.	#5	12	12
2-E18-2	3	#9.9	.	#7	#6	.	#3	13	13
2-E18-3		#2.9	.	#5	.	.	#8	11	#8
2-E18-3	1	#13.7	.	#7	.	.	#5	#9	#7
2-E18-3	2	37.2	.	#2	.	.	12	21	#3
2-E18-3	3	#5.1	.	#6	.	.	11	15	#8
2-E18-4		#0.9	.	#4	.	.	#8	#5	#6
2-E18-4	1	#7.7	.	#2	.	.	#9	#7	10
2-E18-4	2	#-3.2	.	#3	.	.	#9	12	#5
2-E18-4	3	#12.7	.	#2	.	.	#8	16	14

TABLE B.3. (contd)

Constituent=108 TRITIUM pCi/L Long name=Tritium (H-3)

WELLNAME	DUPNUM	AUG88	SEP88	NOV88	NOV88X	NOV88Y	FEB89	MAYJUN89	AUG89
2-E18-1		.	.	*-287	.	.	*-55.7	.	*-0.96
2-E18-2		.	.	*-216	*391	.	.	.	*35.40
2-E18-3		.	.	*-341	.	.	.	.	*-56.60
2-E18-4		.	.	847	.	.	.	.	*-48.00

Constituent=H60 TURBID ntu Long name=Turbidity, nephelometric

WELLNAME	DUPNUM	AUG88	SEP88	NOV88	NOV88X	NOV88Y	FEB89	MAYJUN89	AUG89
2-E18-1		.	.	.	.	.	1.4	19.5	3.0
2-E18-1	1	.	.	.	.	.	.	19.2	.
2-E18-2		.	.	.	1.5	.	.	0.9	2.7
2-E18-3		.	.	.	.	.	.	3.0	2.2
2-E18-4		.	.	.	.	.	.	1.4	2.1

Constituent=A14 VANADUM ppb Long name=Vanadium

WELLNAME	DUPNUM	AUG88	SEP88	NOV88	NOV88X	NOV88Y	FEB89	MAYJUN89	AUG89
2-E18-1		<5	5	6	.	.	<5	6	12
2-E18-1	1	.	.	<5	.	.	.	.	.
2-E18-2		15	19	12	20	.	29	27	24
2-E18-2	1	.	.	.	.	.	20	.	.
2-E18-3		23	28	22	.	.	32	31	30
2-E18-3	1	.	.	.	.	.	.	29	.
2-E18-4		20	22	25	.	.	22	27	29
2-E18-4	1	.	.	.	.	.	.	.	29

Constituent=H27 FVANADI ppb Long name=Vanadium, filtered

WELLNAME	DUPNUM	AUG88	SEP88	NOV88	NOV88X	NOV88Y	FEB89	MAYJUN89	AUG89
2-E18-1		<5	<5	<5	.	.	6	14	14
2-E18-1	1	.	.	<5	.	.	.	.	.
2-E18-2		13	18	16	17	.	24	25	26
2-E18-2	1	.	.	.	.	.	27	.	.
2-E18-3		21	27	24	.	.	31	35	34
2-E18-3	1	.	.	.	.	.	.	34	.
2-E18-4		19	19	25	.	.	22	25	32
2-E18-4	1	.	.	.	.	.	.	.	32

TABLE B.3. (contd)

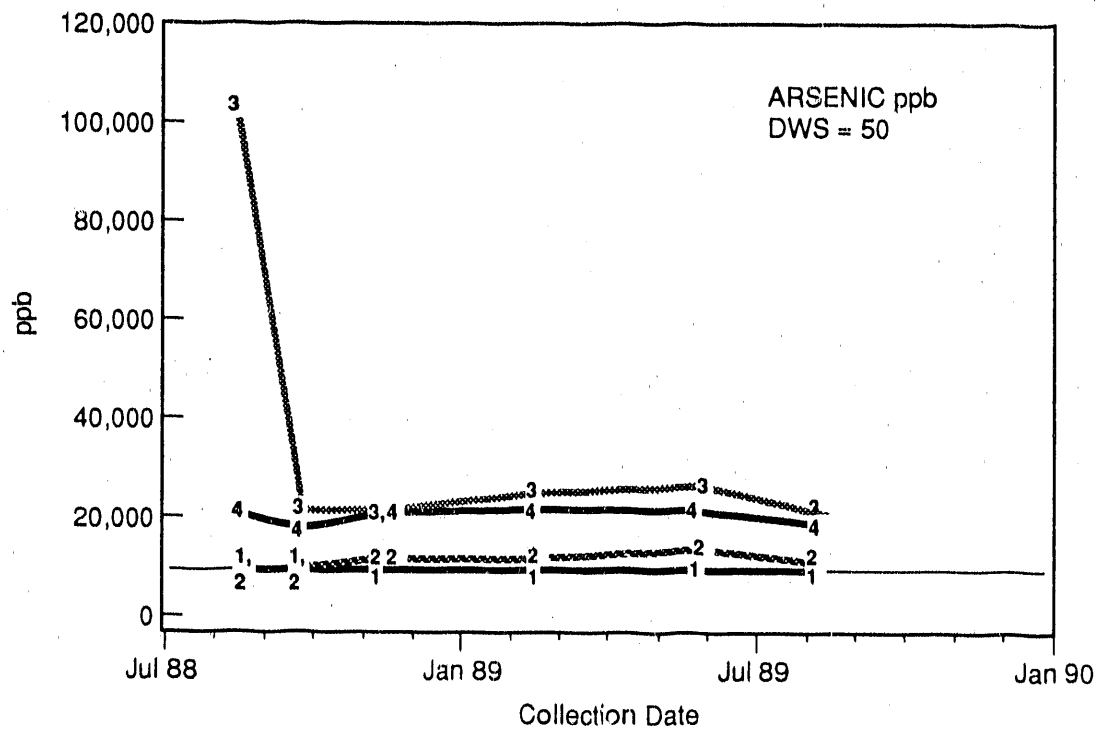
Constituent=A04 ZINC ppb Long name=Zinc

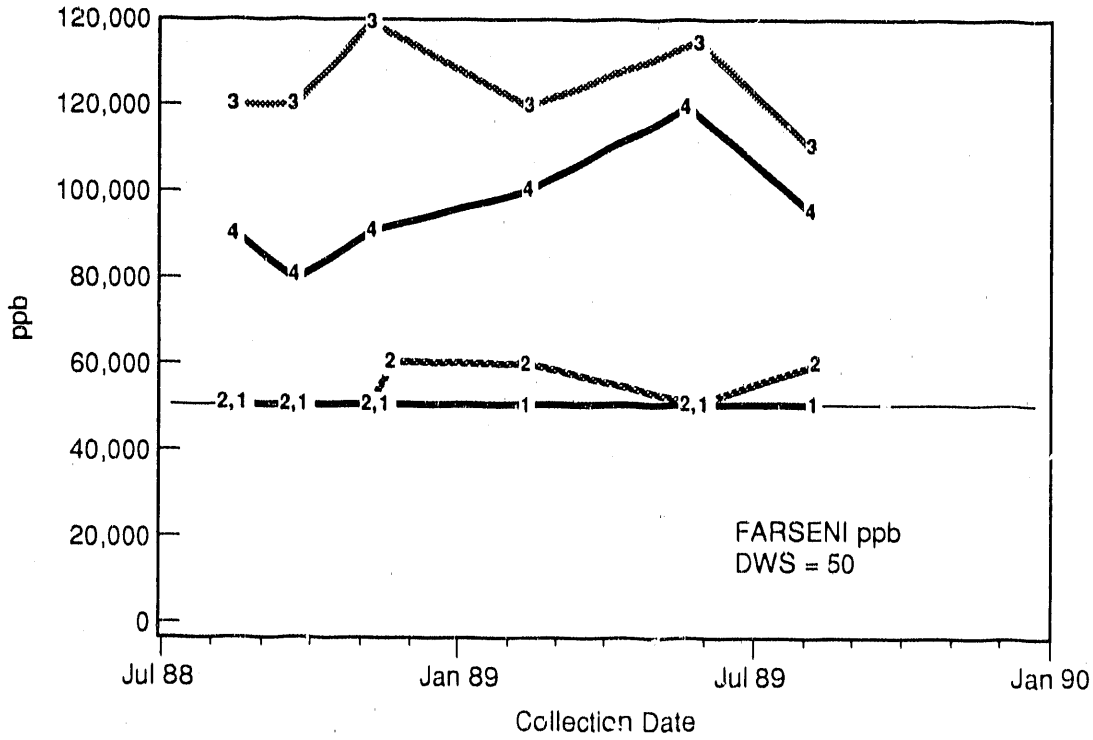
WELLNAME	DUPNUM	AUG88	SEP88	NOV88	NOV88X	NOV88Y	FEB89	MAYJUN89	AUG89
2-E18-1		181	73	79	.	.	23	30	22
2-E18-1	1	.	.	53	.	.	.	.	.
2-E18-2		<5	<5	332	96	.	27	10	16
2-E18-2	1	.	.	.	.	.	22	.	.
2-E18-3		64	34	33	.	.	22	22	24
2-E18-3	1	.	.	.	.	.	.	9	.
2-E18-4		21	10	32	.	.	9	8	12
2-E18-4	1	.	.	.	.	.	.	.	12

Constituent=H18 FZINC ppb Long name=Zinc, filtered

WELLNAME	DUPNUM	AUG88	SEP88	NOV88	NOV88X	NOV88Y	FEB89	MAYJUN89	AUG89
2-E18-1		145	46	28	.	.	30	12	19
2-E18-1	1	.	.	41	.	.	.	.	.
2-E18-2		<5	<5	235	67	.	11	<5	11
2-E18-2	1	.	.	.	.	.	20	.	.
2-E18-3		23	<5	5	.	.	5	<5	6
2-E18-3	1	.	.	.	.	.	.	<5	.
2-E18-4		<5	<5	15	.	.	6	<5	16
2-E18-4	1	.	.	.	.	.	.	.	14

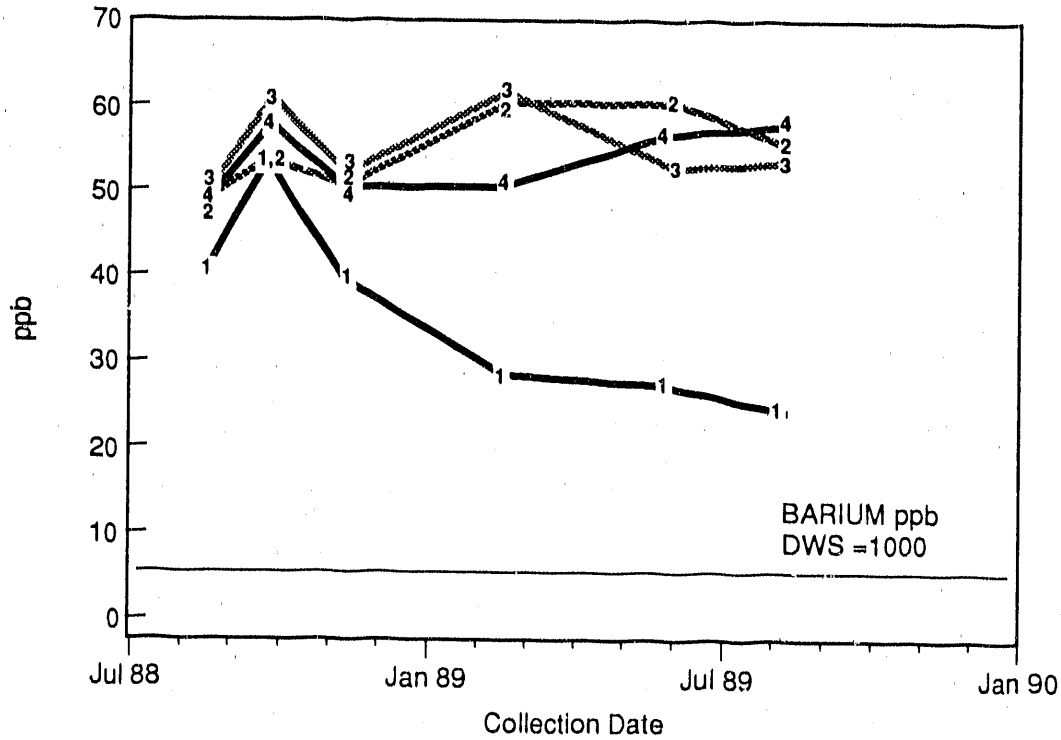
TREND PLOTS FOR SELECTED CONSTITUENTS

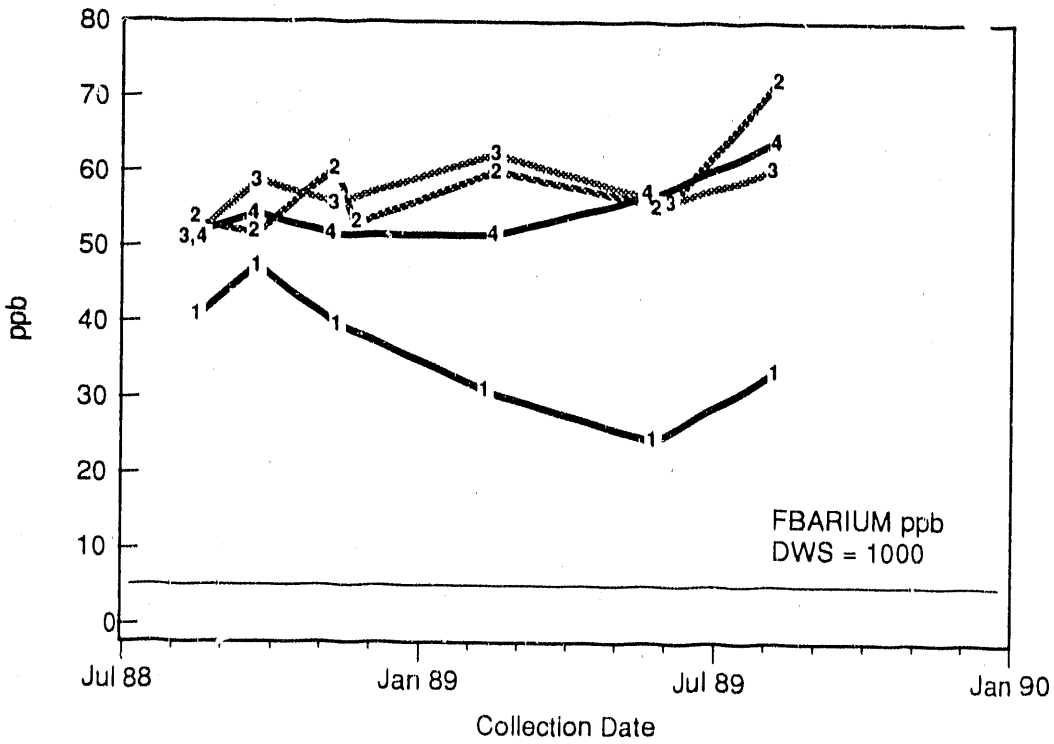




Plotting symbol is abbreviation of well name (299-E18-x)
Horizontal solid line is contractual detection limit

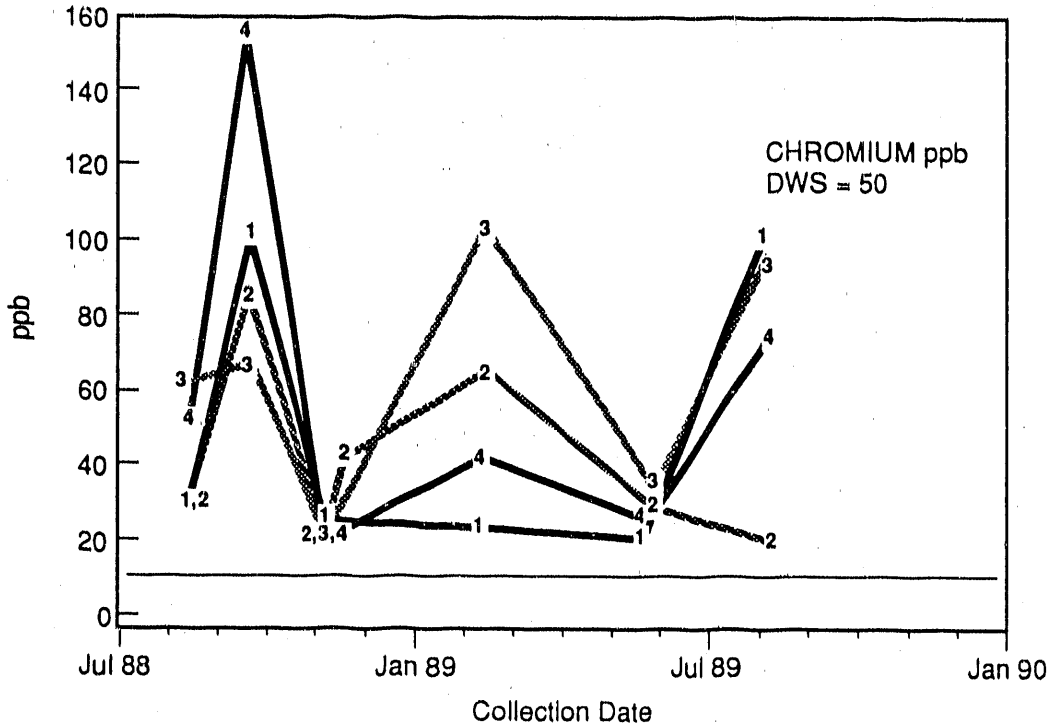
S9009007.3

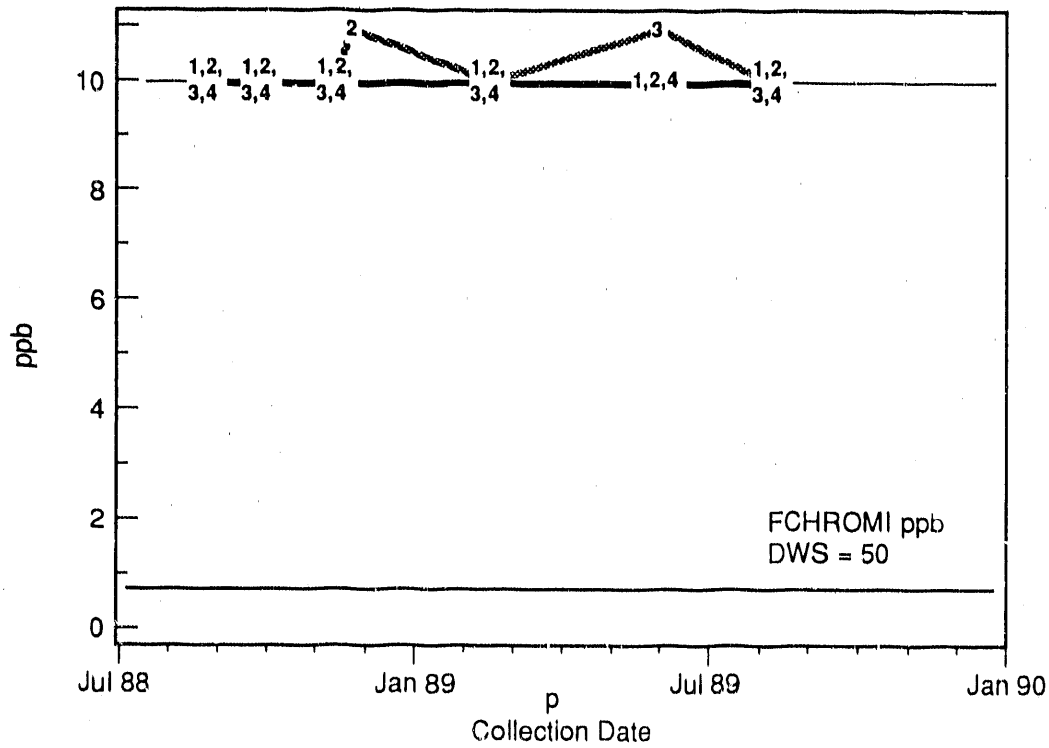




Plotting symbol is abbreviation of well name (299-E18-x)
Horizontal solid line is contractual detection limit

S9009007.4





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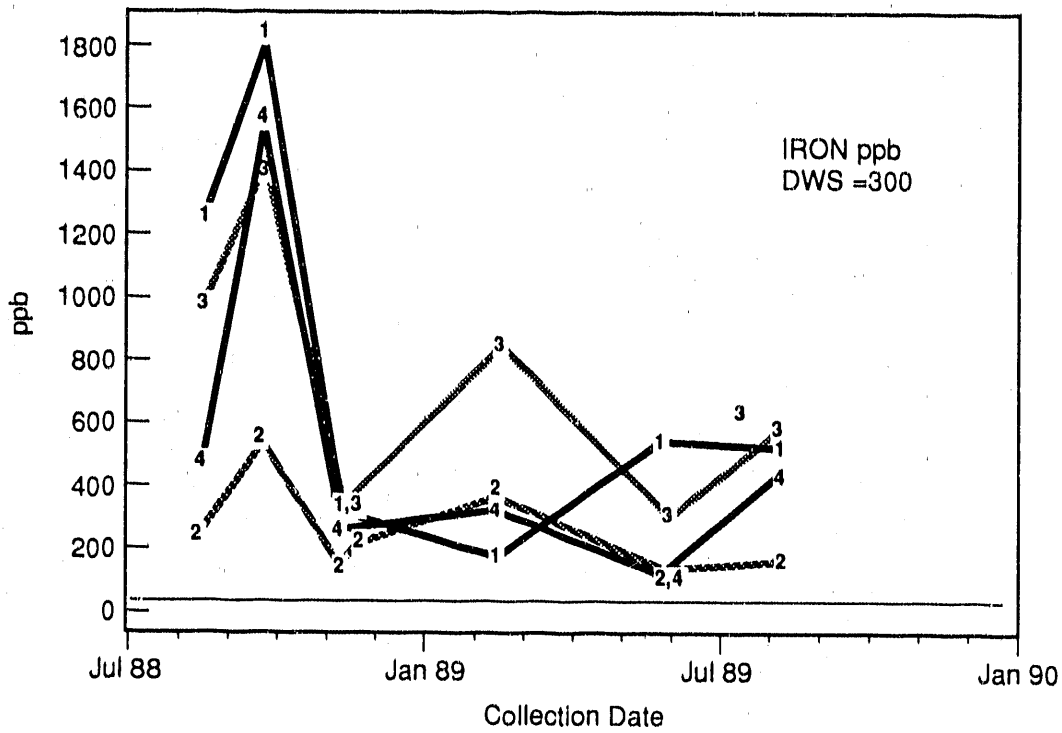
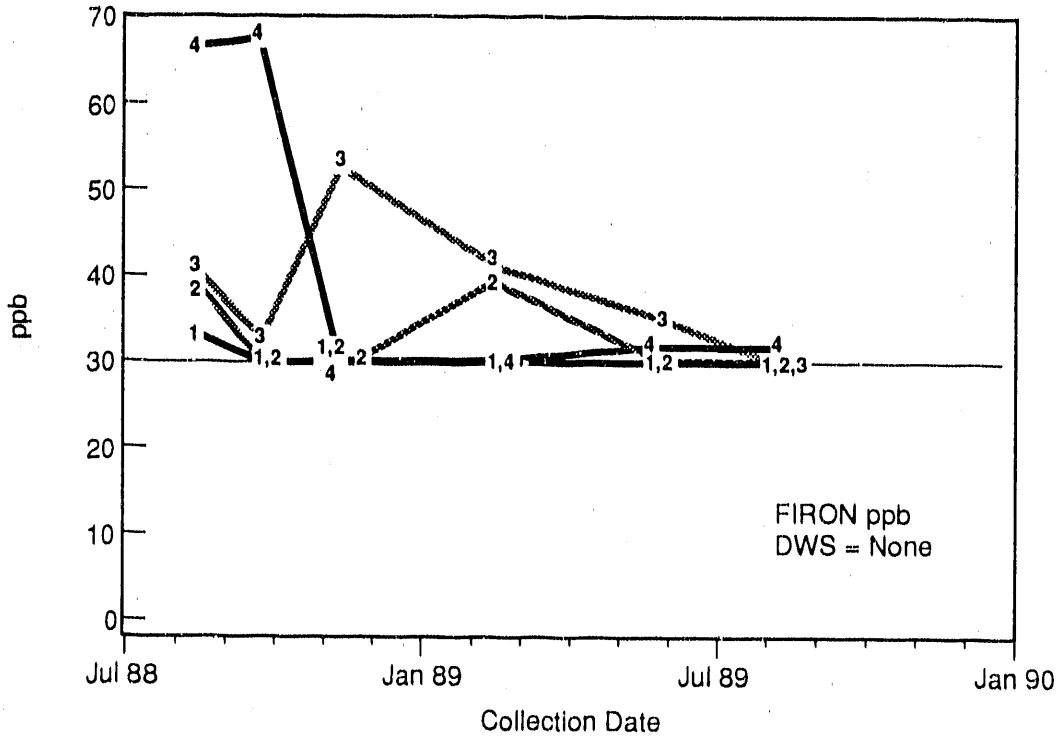
Horizontal solid line is contractual detection limit

S9009007.5





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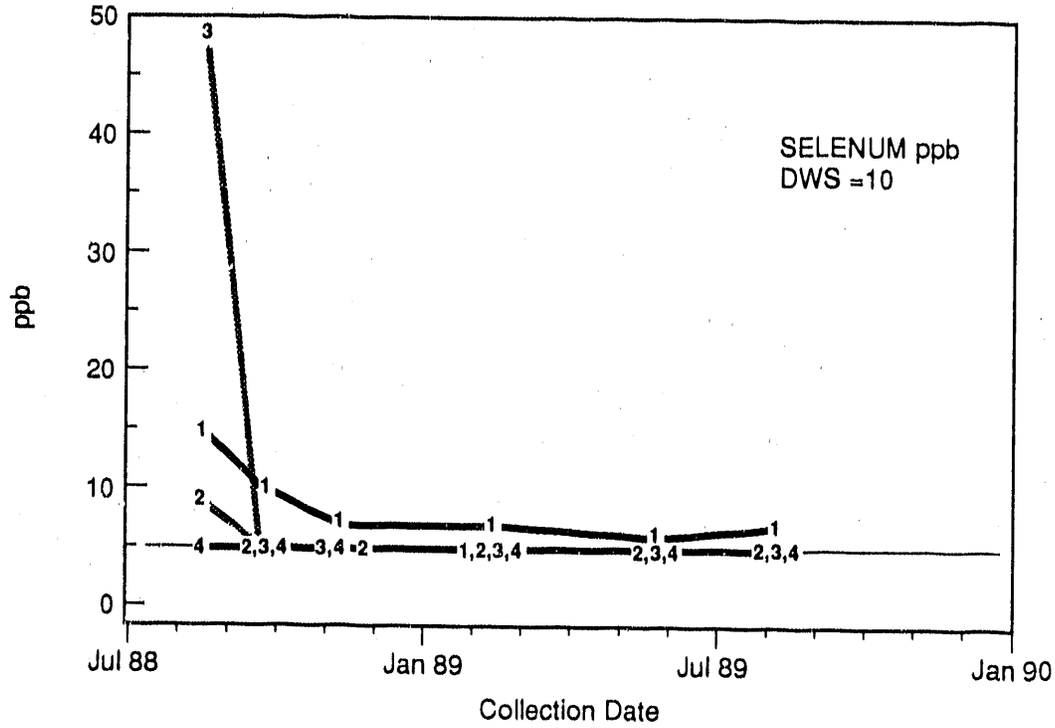
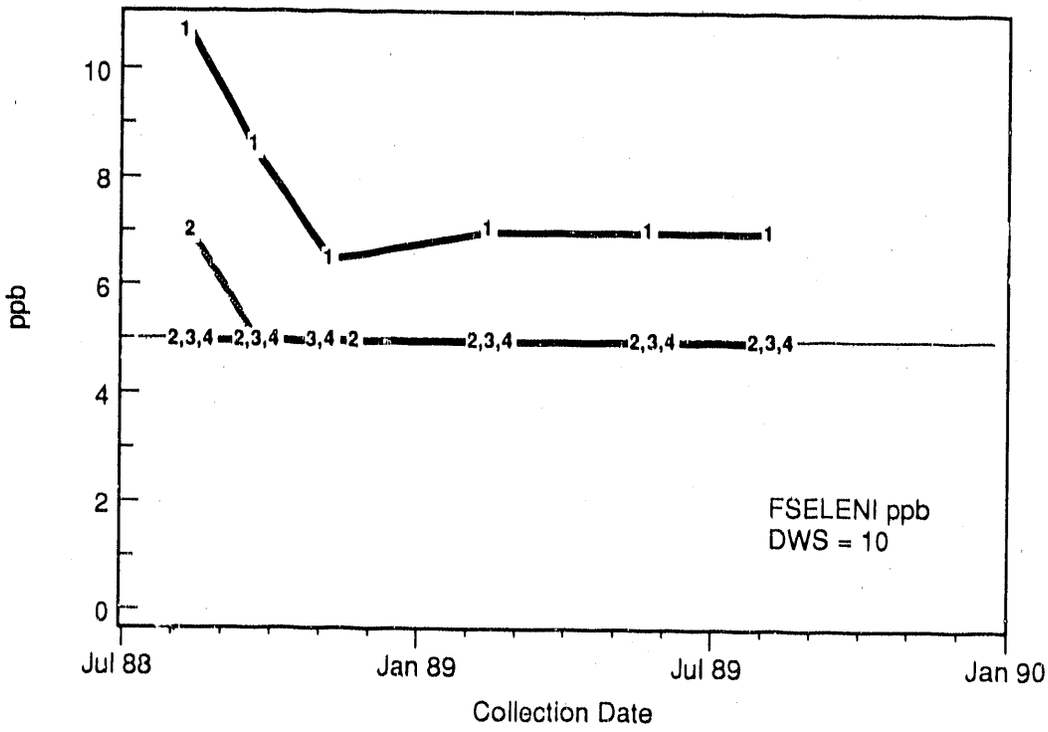
Horizontal solid line is contractual detection limit

S9009007.6





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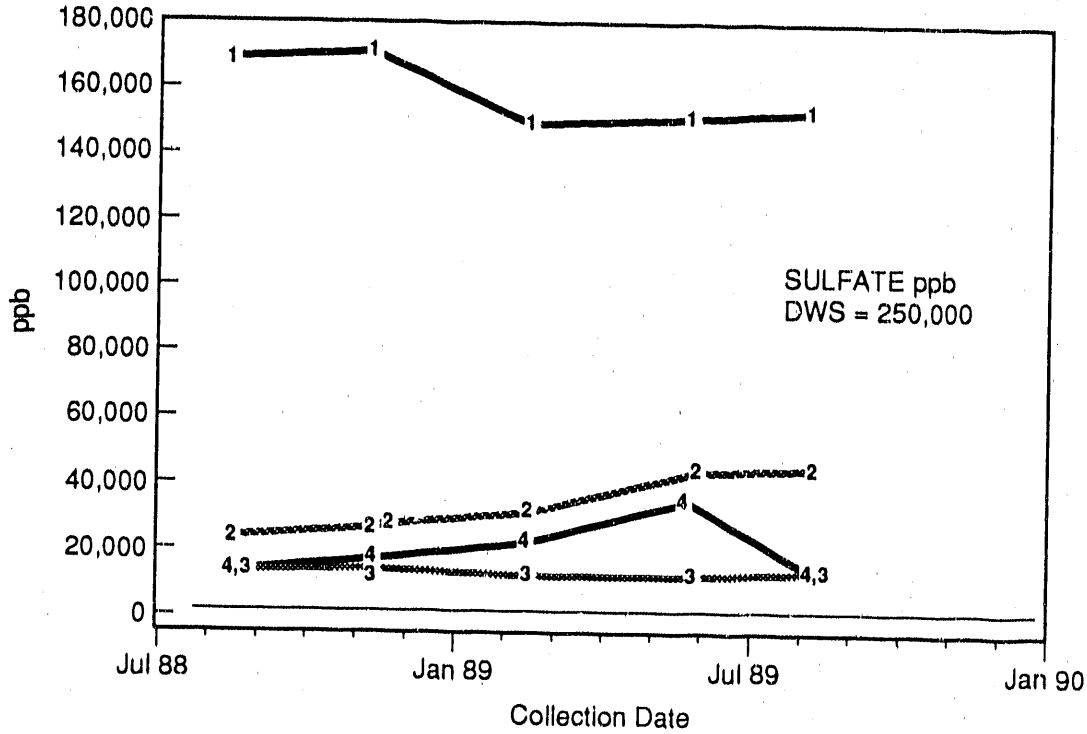
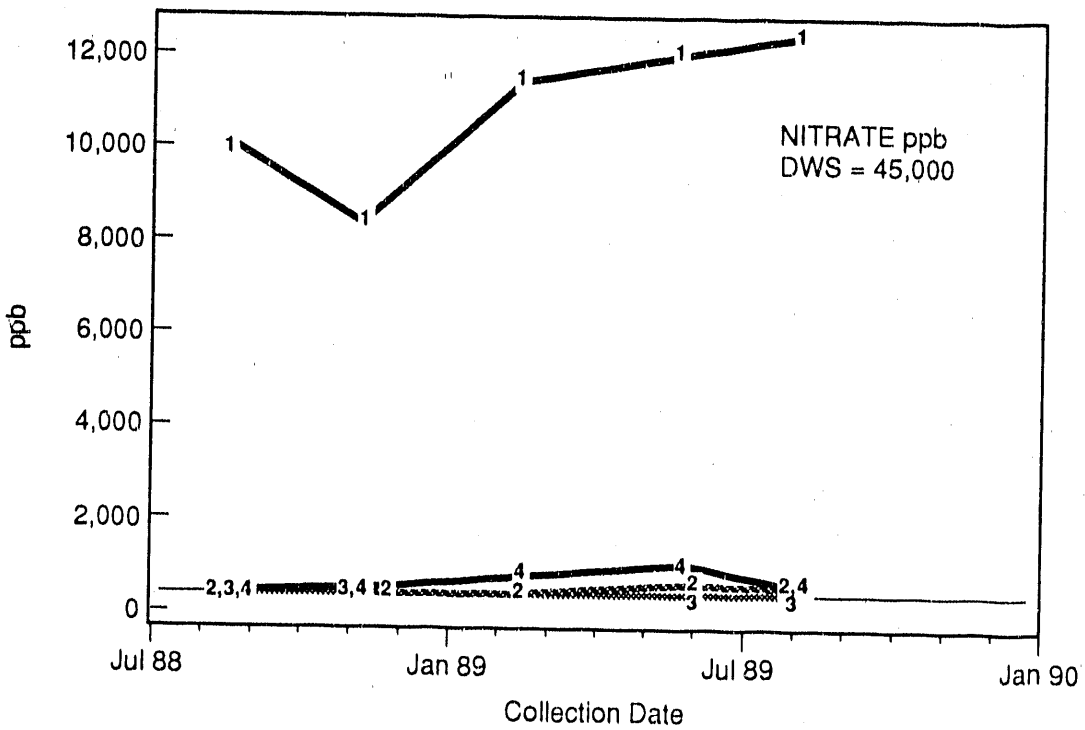
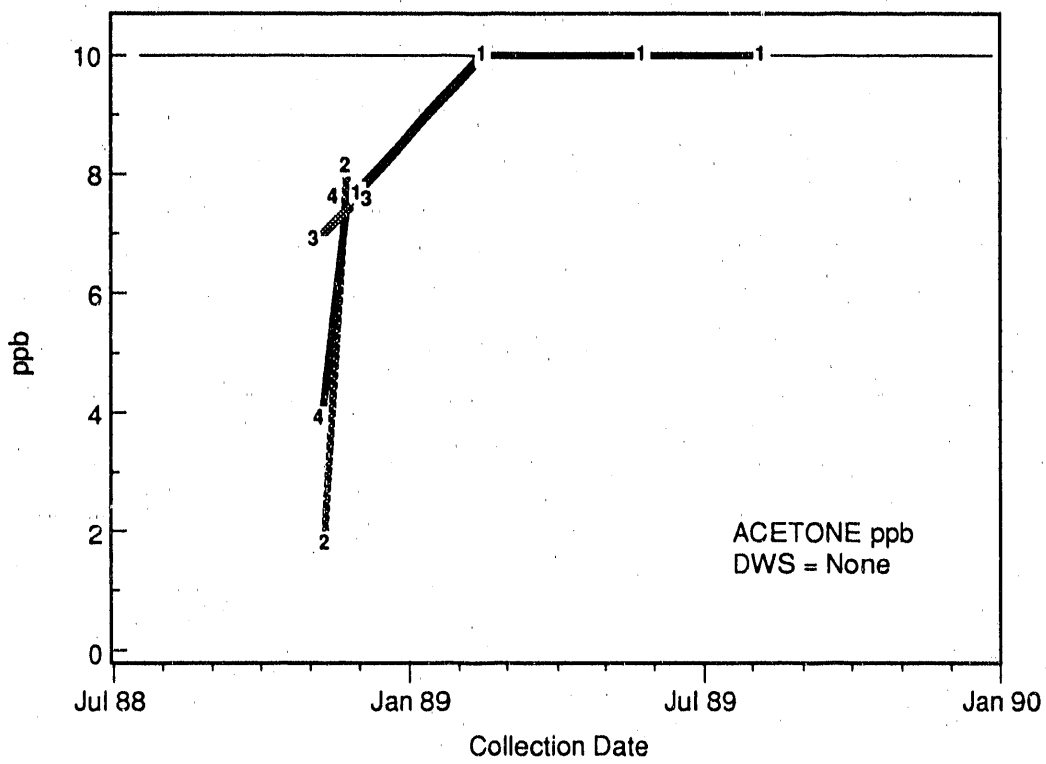
S9009007.7





Plotting symbol is abbreviation of well name (299-E18-x)
Horizontal solid line is contractual detection limit

S9009007.2



Plotting symbol is abbreviation of well name (299-E18-x)
Horizontal solid line is contractual detection limit

S9009007.1

APPENDIX C

AQUIFER TEST DATA

DISCHARGE, DRAWDOWN, AND RECOVERY DATA FOR THE TEST AT WELL 299-E18-1

TABLE C.1. Discharge Rate Data for the Constant Discharge Test at Well 299-E18-1

Aquifer Test Data

This sheet contains discharge rate information only.

page 1 of 2

Data for Well 2-E18-1
Pumping Well Same
Observation Wells ~~[illegible]~~ 2-E18-2

Location 2701 M Pond
Type of Aquifer Test Constant Discharge
How Q Measured Calibrated bucket/stopwatch (5.73 gal.)
How W.L.'s Measured — N/A
Rad./Dist. of/From Pumping Well — N/A
Meas. Point for W.L.'s — N/A
Elevation of Meas. Point N/A

Depth of Pump/Airpipe 327 ft
Pump On: date 8/3/88 time 9:20
Pump Off: date 8/3/88 time 1324
Duration of Aquifer Test 236 min

Time t = ____ at t' = 0					Water Level Data Static Water Level ____					Discharge		Recorded By	343.8 Comments 1 bucket = 5.73 gal.
Day	Clock Time (9:33 AM)	Δt	~~t'~~	~~log t'~~	~~Reading~~	~~Conversions or Corrections~~	~~Water Level~~	~~s or s'~~		Reading	Q (gpm)		
8/3	~~9:33~~	2			Had gas tank for generator engine					—	12.7	LPL	27.1 sec/bucket
	9:34	4			filled prior to start - Waited ~1 hr.						13.0	LPL	26.4 sec/bucket
	9:35	5			Generator is running very						13.4	LPL	25.7 sec/bucket
	9:38	8			smoothly and at ½						13.2	LPL	26.0 sec/bucket
	9:40	10			very constant rpm by the						13.3	LPL	25.9 sec/bucket
	9:44	14			sound of the engine.						13.5	LPL	25.5 sec/bucket
	9:47	17									13.5	LPL	25.4 sec/bucket
	9:50	20									13.4	LPL	25.6 sec/bucket
	9:54	24									13.7	LPL	25.1 sec/bucket
	9:56	26									13.5	LPL	25.5 sec/bucket
	10:00	30									13.5	LPL	25.5 sec/bucket
	10:05	35									13.3	LPL	25.8 sec/bucket
	10:09	39									13.4	LPL	25.5 sec/bucket
	10:15	45									13.4	LPL	25.6 sec/bucket
	10:20	50									13.6	LPL	25.3 sec/bucket
	10:21	51									13.4	LPL	25.6 sec/bucket
	10:26	56			At the 10:26 measurement, and on						13.1	LPL	26.3 sec/bucket
	10:28	58			on a railroad tie because wind had						12.9	LPL	26.7 sec/bucket
	10:29	59			picked up and had begun to splash						13.2	LPL	26.0 sec/bucket
	10:31	61			discharge water out of bucket. This got						13.5	LPL	25.5 sec/bucket
	10:35	65			the bucket down to the discharge point.						13.5	LPL	25.4 sec/bucket
	10:45	75			This did not affect the height of the						13.4	LPL	25.6 sec/bucket
	10:54	84			discharge line.						13.4	LPL	25.7 sec/bucket
	11:06	96									13.3	LPL	25.9 sec/bucket
	11:10	100									13.3	LPL	25.9 sec/bucket
	11:19	109									13.2	LPL	26.1 sec/bucket
	11:27	117									13.3	LPL	25.9 sec/bucket
	11:34	124									13.2	LPL	26.1 sec/bucket
	11:41	131									12.9	LPL	26.7 sec/bucket
	11:42	132									12.9	LPL	26.6 sec/bucket
	11:45	135									13.1	LPL	26.2 sec/bucket
	11:51	141									13.3	LPL	25.8 sec/bucket
	11:53	143									13.3	LPL	25.9 sec/bucket
	11:59	149									13.5	LPL	25.4 sec/bucket
	12:07	157									13.4	LPL	25.7 sec/bucket
	12:15	165									13.3	LPL	25.8 sec/bucket
	1225	175									13.5	SG	25.4 SEC/BUCKET
	1231	181									12.8	SG	26.91 SEC/BUCKET
	1243	193									12.8	SG	26.97 SEC/BUCKET

TABLE C.1. (contd)

Aquifer Test Data

DISCHARGE INFO. ONLY

page 2 of 2

Data for Well 299-E18-1
Pumping Well [illegible]
Observation Wells 299-E18-2

Location 2101 M POND
Type of Aquifer Test CONSTANT Q
How Q Measured CALIBRATED BUCKET / STOP WATCH (5.73 gal)
How W.L.'s Measured — N/A
Rad./Dist. of/From Pumping Well — N/A
Meas. Point for W.L.'s — N/A
Elevation of Meas. Point N/A

Depth of Pump/Airpipe 327'
Pump On: date 8/3/88 time 0930
Pump Off: date 8/3/88 time 1325
Duration of Aquifer Test 235 min

Time t = ____ at t' = 0					Water Level Data Static Water Level 314.92'					Discharge		Recorded By	Comments
Day	Clock Time	t	r	t/t'	Reading	Conversions or Corrections	Water Level	s or s'		Reading	Q (l/min)		1 BUCKET = 5.73 GAL
8/3	1255	205									13.1	SG	26.34 sec / BUCKET
1	1300	210									13.0	[illegible]	26.5 sec / bucket
1	1307	217									13.3	[illegible]	25.8 sec / bucket
1	1320	230										[illegible]	26.5 sec / bucket
1	1321											[illegible]	26.1 sec / bucket
1	1325	235										[illegible]	26.4 sec / bucket

TABLE C.2. Drawdown and Recovery Data for the Constant Discharge Test at Well 299-E18-1

Aquifer Test Data

page 1 of 2

Data for Well 2-E18-1
Pumping Well 2-E18-1
Observation Wells 2-E-18-2

Location 2101 M
Type of Aquifer Test Constant discharge
How Q Measured Calibrated bucket (5.73 gal)
How W.L.'s Measured E-tape (WHC Sheet 1) 1.D.
Rad./Dist. of/From Pumping Well — N/A
Meas. Point for W.L.'s Top of 6" pump casing - E. side
Elevation of Meas. Point — N/A

Depth of Pump/Airpipe 327 1 1/2 H.P. Grundfos stainless steel pump
Pump On: date 8/3/88 time 0930
Pump Off: date 8/3/88 time 1326
Duration of Aquifer Test 236 min.

Time: t = ~~8:30~~ at t' = 0					Water Level Data: Static Water Level 314.92					Recorded on Discharge Form: Discharge		Recorded By	Comments
Day	Clock Time	t	t'	t/t'	Reading	Conversions or Corrections	Water Level	s or s'		Read-ing	Q		
8/3	0930	0			314.92			0				SG	
	0930.30	:30			316.17			1.25				SG	
	0931	1			316.39			1.47				SG	
	0931.30	1:30			316.51			1.59				SG	
	0932	2			316.57			1.65				SG	
	0933	3			316.63			1.76				SG	
	0934	4			316.73			1.86				SG	
	0935	5			316.83			1.91				SG	
	0936	6			316.87			1.95				SG	
	0937	7			316.93			2.01				SG	
	0938	8			316.95			2.03				SG	
	0939	9			316.99			2.07				SG	
	0940	10			317.01			2.09				SG	
	0945	15			317.11			2.19				SG	
	0950	20			317.21			2.29				SG	
	0955	25			317.27			2.35				SG	
	1000	30			317.33			2.41				SG	
	1010	40			317.42			2.50				APK	
	1020	50			317.42			2.56				SG	
	1030	60			317.53			2.61				SG	
	1050	80			317.64			2.72				SG	
	1100	90			317.71			2.79				SG	
	1110	100			317.74			2.82				SG	
	1120	110			317.77			2.85				SG	
	1130	120			317.77			2.85				SG	
	1140	130			317.78			2.86				SG	
	1150	140			317.88			2.96				SG	
	1155	145			317.91			2.99				SG	
	12:00	150			~~318.92~~	317.92		~~2.99~~ 3.00				APK	
	12:10	160			~~318.93~~	317.93		~~3.01~~ 3.01				APK	
	1215	165			317.91			2.99				SG	
	1220	170			317.93			3.01				SG	
	1230	180			317.88			2.96				SG	
	1240	190			317.91			2.99				SG	
	1250	200			317.91			2.99				SG	
	1300	210			317.90			2.98				SG	
	1315	225			317.93			3.01				APK	
	1321	231			317.70			2.78				APK	1320 Stop pump!
	1326		10	23.6	316.22			1.70	5'			APK/SG	

Pump off 13:26:00

SG = Stanley Gardner

TABLE C.2. (contd)

Aquifer Test Data

page 2 of 2

Data for Well 299-E13-1
Pumping Well 299-E13-1
Observation Wells 299-E13-2

Location 2101 M POND
Type of Aquifer Test CONSTANT Q
How Q Measured CALIBRATED BUCKET (5.73 gpm)
How W.L.'s Measured E. TAPE (WHC SOUNDER) N.T.D.
Rad./Dist. of/From Pumping Well — N/A
Meas. Point for W.L.'s TOP OF 6" S.S. CASING
Elevation of Meas. Point — N/A

1 1/2 H.P. GRUNDFOS S.S. PUMP
Depth of Pump/Airpipe 327'
Pump On: date 8/3/89 time 0930
Pump Off: date 8/3/89 time 1324
Duration of Aquifer Test 235 min

Time t = ____ at t' = 0					Water Level Data Static Water Level 314.92'					Discharge		Recorded By	Comments
Day	Clock Time	t	t'	t/t'	Reading	Conversions or Corrections	Water Level	s or s'		Reading	Q		
8/3	1327	237	[illegible]	237	316.20			1.90				[illegible]	
1	[illegible]	237.5	[illegible]	172.7	315.91			1.93				[illegible]	
1	1333	238	200	119	315.85			2.05				[illegible]	
1	[illegible]	238.5	[illegible]	79.8	315.80			2.10				[illegible]	
1	[illegible]	[illegible]	[illegible]	79.7	315.77			2.13				[illegible]	
1	[illegible]	[illegible]	[illegible]	58.4	315.74			2.16				[illegible]	
1	1330	240	[illegible]	60	315.72			2.18				[illegible]	
1	1331	241	[illegible]	48.2	315.67			2.23				[illegible]	
1	1332	242	[illegible]	40.2	315.63			2.27				[illegible]	
1	1333	243	[illegible]	34.7	315.61			2.29				[illegible]	
1	1334	244	[illegible]	30.5	315.58			2.32				[illegible]	
1	1335	245	[illegible]	27.2	315.55			2.34				[illegible]	
1	1336	246	[illegible]	24.6	315.53			2.37				[illegible]	
1	1341	251	[illegible]	16.7	315.46			2.44				[illegible]	
1	1346	256	[illegible]	12.8	315.41			2.49				[illegible]	
1	1351	261	[illegible]	10.4	315.36			2.54				[illegible]	
	1356	266	30	8.87	315.33			2.57				SG	
	1406	276	40	6.9	315.27			2.63				SG	
	1416	286	50	5.72	315.22			2.68				SG	
	1426	296	60	4.93	315.18			2.72				SG	
	1446	316	80	3.95	315.12			2.80				SG	
	1456	326	90	3.62	315.09			2.83				SG	
	1506	336	100	3.36	315.07			2.85				SG	
	1516	346	110	3.15	315.04			2.88				SG	
	1526	356	120	2.97	315.03			2.89				SG	FINISHED RECOVERY READINGS

SG = SHANNON GOODWIN

TABLE C.3. Water-Level Data for Well 299-E18-2 During the Constant-Discharge Test at 299-E18-1

Aquifer Test Data

page 1 of 1

Data for Well 299-E18-2

Pumping Well 299-E18-1

Observation Wells 299-E18-2

Location 2101 M POND

Type of Aquifer Test CONSTANT Q

How Q Measured CALIBRATED BUCKET

How W.L.'s Measured E-TAPE (WHL SOUNDER)

Rad./Dist. of/From Pumping Well 434'

Meas. Point for W.L.'s TOP OF 6" C.S. CASING

Elevation of Meas. Point — N/A

Depth of Pump/Airpipe 327'

Pump On: date 8/3/93 time 0930

Pump Off: date 8/3/93 time 1324

Duration of Aquifer Test 23 Hrs

Time t = _____ at t' = 0					Water Level Data Static Water Level 314.96'					Discharge		Recorded By	Comments
Day	Clock Time	t	t'	t/t'	Reading	Conversions or Corrections	Water Level	s or s'		Read-ing	Q		
8/3	0915				314.36							SG	PUMP ON AT 0930
1	1008	38			314.84							SG	
1	1202	152			314.80							SG	
1	1225				314.80							DPL	

DISCHARGE AND DRAWDOWN DATA FOR THE TEST AT WELL 299-E18-2

TABLE C.4. Discharge and Drawdown Data for Well 299-E18-2 During the Constant-Discharge Test at Well 299-E18-2

Aquifer Test Data

page 1 of 2

Data for Well 2-E18-2
Pumping Well 2-E18-2
Observation Wells 2-E18-3

Location 2101-M Pond
Type of Aquifer Test Constant Discharge / Development
How Q Measured 5 gal bucket
How W.L.'s Measured J-tape
Rad./Dist. of/From Pumping Well N/A
Meas. Point for W.L.'s top of stilling pipe
Elevation of Meas. Point N/A

Depth of Pump/Airpipe 326.5
Pump On: date 11-4-88 time 0945
Pump Off: date 11-4-88 time 1325
Duration of Aquifer Test 3 hr 40 min
1 1/2 HP Submersible Pump

Time t = ____ at t' = 0					Water Level Data Static Water Level 315.27					Discharge		Recorded By	Comments
Day	Clock Time	t	t'	t/t'	Reading	Conversions or Corrections	Water Level	(s) or s'		Reading	Q		
	0945	0			315.27			0				SST	
	0946	1			317.10			1.83				SST	
		2			317.40			1.53				SST	
		3			317.44			1.57				SST	
	0950	5			317.42			1.61			5.8	SST	39 sec / 5.73 gal
		6			317.43			1.61				SST	
		7			317.41			1.64				SST	
		8			317.52			1.65				SST	
		9			317.53			1.66				SST	
		10			317.54			1.67				SST	
		14			317.56			1.69				SST	
		15			317.56			1.69				SST	
		19			317.57			1.70			5.8	SST	38 sec / 5.73 gal
		20			317.58			1.71				SST	
		26			317.61			1.74			9.3	SST	37 sec / 5.73 gal
		28			317.61			1.74				SST	
		32			317.62			1.75				SST	
		36			317.62			1.75				SST	
	1032	47			317.63			1.76				SST	
	1037	52			317.63			1.76			9.3	SST	37 sec / 5.73 gal
	1045	60			317.64			1.77				SST	
	1052	77			317.65			1.78				SST	
	1103	88			317.65			1.78			9.5	SST	36 sec / 5.73 gal
	1125	100			317.65			1.78				SST	
	1145	120			317.64			1.77				SST	
	1156	131			317.65			1.78				SST	
	1203	138			317.65			1.78			9.0	SST	38 sec / 5.73 gal
	1223	158			317.65			1.78			9.2	SST	38 sec / 5.73 gal
	1243	178			317.64			1.77			9.3	SST	37 sec / 5.73 gal
	1303	198			317.63			1.76			9.3	SST	37 sec / 5.73 gal
	1318	211			317.63			1.76				SST	
	1325	220			317.63			1.76				SST	

SST SST Inst

TABLE C.4. (contd)

Aquifer Test Data

page 2 of 2

Data for Well 2-F18-2
Pumping Well 2-F18-2
Observation Wells 2-F18-3

Location 216 N Pond
Type of Aquifer Test [illegible] / constant Q
How Q Measured [illegible]
How W.L.'s Measured 1 F tape
Rad./Dist. of/From Pumping Well [illegible]
Meas. Point for W.L.'s [illegible]
Elevation of Meas. Point N/A

Depth of Pump/Airpipe 326.5
Pump On: date 11-4-88 time 0914.5
Pump Off: date 11-4-88 time 1325
Duration of Aquifer Test 24 hr. [illegible]

Time t = _____ at t' = 0					Water Level Data Static Water Level _____					Discharge		Recorded By	Comments
Day	Clock Time	t	t'	t/t'	Reading	Conversions or Corrections	Water Level	s or s'		Reading	Q		
	1330		0										Pump OFF
			1:30		315.916						SST		Note: Check valve
			1:00		315.915						SST		was drilled out
			1:30		315.914						SST		
			2:00		315.94						SST		
			3		315.90						SST		
			4		315.94						SST		
			5		315.92						SST		
			6		315.93						SST		
			7		315.94						SST		
			8		315.93						SST		
			9		315.94						SST		
			10		315.92						SST		

TABLE C.5. Water-Level Data for Well 299-E18-3 During the Constant-Discharge Test at Well 299-E18-2

Aquifer Test Data

page 1 of 1

Data for Well 299-E18-3
Pumping Well 299-E18-2
Observation Wells 299-E18-3

Location 216-M Pond
Type of Aquifer Test [illegible]
How Q Measured [illegible]
How W.L.'s Measured E-tape
Rad./Dist. of/From Pumping Well 127.9'
Meas. Point for W.L.'s top of 6" [illegible]
Elevation of Meas. Point N/A

Depth of Pump/Airpipe 386.5
Pump On: date 11-4-88 time [illegible]
Pump Off: date 11-4-88 time 1325
Duration of Aquifer Test 2 hr 40 min

Time t = ____ at t' = 0					Water Level Data Static Water Level 316.41					Discharge			
Day	Clock Time	t	t'	t/t'	Reading	Conversions or Corrections	Water Level	s or s'		Read-ing	Q	Recorded By	Comments
	0945	0											
		12			316.41			0				SST	
		22			316.41			0				SST	
	1015	30			316.41			0				SST	
		40			316.41			0				SST	
		50			316.41			0				SST	
		57			316.41			0				SST	
		65			316.41			0				SST	
		76			316.41			0				SST	
		91			316.41			0				SST	
		99			316.41			0				SST	
		112			316.41			0				SST	
		128			316.41			0				SST	
		136			316.41			0				SST	
		160			316.41			0				SST	
		172			316.41			0				SST	
		200			316.41			0				SST	
		210			316.41			0				SST	
		217			316.41			0				SST	
		240			316.41			0				SST	

DRAWDOWN AND RECOVERY DATA FOR THE TEST AT WELL 299-E18-3, DATA FOR WELL 299-E18-2

TABLE C.6. Discharge, Drawdown and Recovery Data for Well 299-E18-3 During the Constant-Discharge Test at Well 299-E18-3

Aquifer Test Data

page 1 of 4

* Calculated using surveyed coordinates DRN 9-7-88

Data for Well 299-E18-3
Pumping Well 299-E18-3
Observation Wells 299-E18-2 and 299-E18-4

Location 2101 M
Type of Aquifer Test Constant discharge
How Q Measured In-line Rockwell Entronic Flowmeter (1½") Ser.# 40027314 - totalizer
How W.L.'s Measured E-tape No I.D. #
Rad./Dist. of/From Pumping Well # 127.94 ft to E18-2 # 61.21 ft to E18-4
Meas. Point for W.L.'s TOC
Elevation of Meas. Point N/A

Depth of Pump/Airpipe 327' from TOC
Pump On: date 8-12-88 time 10:20:00
Pump Off: date 8-12-88 time 15:20:00
Duration of Aquifer Test 5 hours

Time t = 300 min at t' = 0					Water Level Data Static Water Level 316.44					Discharge		Recorded By	Comments (at t=0 Totalizer = 134)
Day	Clock Time	t (min)	t'	t/t'	Reading	Conversions or Corrections	Water Level	s or s'		Reading	Q		
8/12	10:20:00	0			316.75			0.31		189 gal	30 min	DRN	35 gpm by flowmeter the totalizer
		1.5			317.00			0.56				DRN	
		1.5			317.35			0.91				DRN	
		2			317.60			1.16				DRN	30 gpm ??
		3			317.76			1.32				DRN	
		4			317.97			1.53				DRN	35 gpm @ 1024 hrs
		5			318.16			1.72				DRN	
		6			318.30			1.86				DRN	
		7			318.30			1.86				DRN	
		8			318.49			2.05				DRN	35 gpm @ 1028
		9 + 1/2			318.07			2.63				DRN	
		10			318.99			2.55		531		DRN	
		15			319.08			2.64				DRN	
		20			319.09			2.65				DRN	34 gpm
		25			319.17			2.73		1045		DRN	
		35			319.09			2.65				DRN	
		40			319.09			2.65		1563		DRN	
		50			319.22			2.78				DRN	35 gpm @ 1115 hrs
		60			319.38			2.94				DRN	34 gpm @ 1116 hrs
		70			319.22			2.32		2450 @		DRN	
		100			319.22			2.78		1140	30	DRN	35 gpm @ 1142 hrs
		120			319.22			2.78		4300		DRN	34 gpm @ 1150
		150			319.33			2.89		5325		DRN	
		180			319.29			2.85		6349		DRN	
		210			319.35			2.91		7450	@ 1452 hrs		34 gpm @ 1452 hrs
		240			319.32			2.88		8393		DRN	
		270			319.31			2.87		9150 @		DRN	34 gpm @ 1452 hrs
	15:20	300			317.34			2.90		145 hrs			Pump OFF @ 1520 hrs
													Root Engine malfunc.
		t'	t					s'		10435	@ 1530 hrs		@ 1505 hrs
		0	300	–	317.34		0.44	2.90					
Recovery	8/12	15:20 + .5	300.5	601	318.16			1.72				P.T. and DRN	
		1	301	301	317.95			1.51					
		1.5	301.5	201	317.60			1.24					
		2	302	151	317.57			1.13					
		2.5	302.5	121	317.50			1.06					
		3	303	101	317.22			0.78					
		4:20	304.33	76.3	317.19			0.75					
		5	305	61	317.08			0.64					

TABLE C.6. (contd)

Aquifer Test Data

page 2 of 4

Data for Well 299-E18-3

Pumping Well 299-E18-3

Observation Wells 299-E18-2 and 299-E18-4

Location 2101 M

Type of Aquifer Test Const. Discharge/Recovery

How Q Measured Flow Meter Ser # 40027614, Range 1/2 [illegible]

How W.L.'s Measured E-Tape - No ID #

Rad./Dist. of/From Pumping Well N/A

Meas. Point for W.L.'s TOC

Elevation of Meas. Point N/A

Depth of Pump/Airpipe 327' from TOC

Pump On: date 8/12/88 time 10:20:00

Pump Off: date 8/12/88 time 15:20:00

Duration of Aquifer Test 5 hours

Time t = 300 min at t' = 0					Water Level Data Static Water Level 316.44'					Discharge		Recorded By	Comments
Day	Clock Time	t' x	t x	t/t'	Reading	Conversions or Corrections	Water Level	s or s'		Reading	Q		
Recovery 8-12		6	306	51	316.49			0.55				I.T. and DRN	
		7	307	43.86	316.45			0.51					
		8.5	308.5	36.29	316.38			0.44					
		10	310	31	316.32			0.38					
		15	315	21	316.77			0.33					
		20	320	16	316.70			0.26					
		25	325	13	316.68			0.24					
		30	330	11	316.57	??		0.07					
		33.5	333.5	9.96	316.30	??		-0.14	?				
		40	340	8.5	316.60			0.16					

TABLE C.7. Drawdown Data for Well 299-E18-2 During the Constant-Discharge Test at Well 299-E18-3

Aquifer Test Data

page 4 of 4

Data for Well 299-E18-2
Pumping Well 299-E18-3
Observation Wells 299-E18-2 and 299-E18-4

Location 200 M
Type of Aquifer Test Constant discharge
How Q Measured In-Line Rockwell Internat'l Flowmeter (1½") - Ser # 40027614
How W.L.'s Measured 500' E-tape (Sdinst) No ID
Rad./Dist. of/From Pumping Well 127.9 ft
Meas. Point for W.L.'s TOC
Elevation of Meas. Point N/A

Depth of Pump/Airpipe 327 'from TOC
Pump On: date 8-12-88 time 10:20:00
Pump Off: date 8-12-88 time 15:20:00
Duration of Aquifer Test 5 hours

Time t = ____ at t' = 0					Water Level Data Static Water Level 316.09					Discharge		Recorded By	Comments
Day	Clock Time	t	t'	t/t'	Reading	Conversions or Corrections	Water Level	s or s'		Read-ing	Q		
8/16		27			316.12		0.03 →					DRN	
		32			316.13		0.04 →					DRN	
		34			316.13		0.04 →					DRN	
		103			316.13		0.04 →					HJC	
		123			316.13		0.04 →					HJC	
		152			316.13		0.04 →					HJC	
		182			316.13		0.04 →					HJC	
		242			316.12		0.03 →					DRN	
													No E-tape measurements for recovery, but have Terra measurements for 40 min.

DRAWDOWN AND RECOVERY DATA FOR THE TEST AT WELL 299-E18-3, DATA FOR WELL 299-E18-4

TABLE C.8. Drawdown Data, Measured by a Pressure Transducer, Well 299-E18-2 During the Constant-Discharge Test at Well 299-E18-3

Date	Time	t (min)	head(ft)	s (ft)	Comments
08/12	10:05:38.10		10.741		Baseline
08/12	10:06:51.10		10.741		Data
08/12	10:07:51.00		10.718		
08/12	10:08:50.90		10.718		
08/12	10:09:50.90		10.718		
08/12	10:10:50.90		10.718		
08/12	10:11:50.90		10.718		
08/12	10:12:50.90		10.718		
08/12	10:13:50.90		10.718		
08/12	10:14:50.90		10.695		
08/12	10:15:50.90		10.718		
08/12	10:16:50.90		10.695		
08/12	10:17:50.90		10.695		
08/12	10:18:50.90		10.695		
08/12	10:19:51.10		10.695		
08/12	10:20:00.30	0.000	10.695	0	Pump on
08/12	10:20:01.70	0.023	10.695	0	
08/12	10:20:03.00	0.045	10.695	0	
08/12	10:20:04.30	0.067	10.695	0	
08/12	10:20:05.70	0.090	10.695	0	
08/12	10:20:07.00	0.112	10.695	0	
08/12	10:20:08.40	0.135	10.695	0	
08/12	10:20:09.70	0.157	10.695	0	
08/12	10:20:11.00	0.178	10.695	0	
08/12	10:20:12.40	0.202	10.695	0	
08/12	10:20:18.90	0.310	10.695	0	
08/12	10:20:23.90	0.393	10.695	0	
08/12	10:20:28.90	0.477	10.695	0	
08/12	10:20:33.90	0.560	10.695	0	
08/12	10:20:38.90	0.643	10.695	0	
08/12	10:20:43.90	0.727	10.695	0	
08/12	10:20:48.90	0.810	10.695	0	
08/12	10:20:53.90	0.893	10.695	0	
08/12	10:20:58.90	0.977	10.695	0	
08/12	10:21:03.90	1.060	10.695	0	
08/12	10:21:13.90	1.227	10.695	0	
08/12	10:21:23.90	1.393	10.695	0	
08/12	10:21:33.90	1.560	10.695	0	
08/12	10:21:43.90	1.727	10.695	0	
08/12	10:21:53.90	1.893	10.695	0	
08/12	10:22:03.90	2.060	10.695	0	
08/12	10:22:13.90	2.227	10.695	0	
08/12	10:22:23.90	2.393	10.695	0	
08/12	10:22:33.90	2.560	10.695	0	

TABLE C.8. (contd)

08/12	10:25:33.90	5.560	10.672	0.023
08/12	10:26:03.90	6.060	10.672	0.023
08/12	10:26:33.90	6.560	10.672	0.023
08/12	10:27:03.90	7.060	10.672	0.023
08/12	10:28:03.90	8.060	10.672	0.023
08/12	10:29:03.90	9.060	10.672	0.023
08/12	10:30:03.90	10.060	10.672	0.023
08/12	10:31:03.90	11.060	10.649	0.046
08/12	10:32:03.90	12.060	10.672	0.023
08/12	10:33:03.90	13.060	10.649	0.046
08/12	10:34:03.90	14.060	10.649	0.046
08/12	10:35:03.90	15.060	10.649	0.046
08/12	10:36:03.90	16.060	10.649	0.046
08/12	10:38:03.90	18.060	10.649	0.046
08/12	10:40:03.90	20.060	10.649	0.046
08/12	10:42:03.90	22.060	10.649	0.046
08/12	10:44:03.90	24.060	10.626	0.069
08/12	10:46:03.90	26.060	10.626	0.069
08/12	10:48:03.90	28.060	10.626	0.069
08/12	10:50:03.90	30.060	10.626	0.069
08/12	10:52:03.90	32.060	10.626	0.069
08/12	10:54:03.90	34.060	10.626	0.069
08/12	10:59:03.90	39.060	10.626	0.069
08/12	11:04:03.90	44.060	10.603	0.092
08/12	11:09:03.90	49.060	10.603	0.092
08/12	11:14:03.90	54.060	10.603	0.092
08/12	11:19:03.90	59.060	10.58	0.115
08/12	11:24:03.90	64.060	10.58	0.115
08/12	11:29:03.90	69.060	10.58	0.115
08/12	11:34:03.90	74.060	10.58	0.115
08/12	11:39:03.90	79.060	10.58	0.115
08/12	11:49:03.90	89.060	10.58	0.115
08/12	11:59:03.90	99.060	10.557	0.138
08/12	12:09:03.90	109.060	10.557	0.138
08/12	12:19:03.90	119.060	10.557	0.138
08/12	12:29:03.90	129.060	10.534	0.161
08/12	12:39:03.90	139.060	10.534	0.161
08/12	12:49:03.90	149.060	10.534	0.161
08/12	12:59:03.90	159.060	10.534	0.161
08/12	13:09:03.90	169.060	10.534	0.161
08/12	13:29:03.90	189.060	10.534	0.161
08/12	13:49:03.90	209.060	10.51	0.185
08/12	14:09:03.90	229.060	10.51	0.185
08/12	14:29:03.90	249.060	10.534	0.161
08/12	14:49:03.90	269.060	10.51	0.185

TABLE C.9. Recovery Data, Measured by Pressure Transducer, for Well 299-E18-2 During the Constant-Discharge Test at Well 299-E18-3

Recovery Aquifer Test of Observation Well 299-E18-2

Date	Time	t (min)	t'(min)	t/t'	head(ft)	s'(ft)	Comments
08/12	15:04:45.20	284.748			10.534		Baseline
08/12	15:05:06.10	285.097			10.534		Data
08/12	15:06:06.00	286.095			10.51		
08/12	15:07:05.90	287.093			10.51		
08/12	15:08:05.90	288.093			10.51		
08/12	15:09:05.90	289.093			10.51		
08/12	15:10:05.90	290.093			10.534		
08/12	15:11:05.90	291.093			10.51		
08/12	15:12:05.90	292.093			10.534		
08/12	15:13:05.90	293.093			10.534		
08/12	15:14:05.90	294.093			10.534		
08/12	15:15:05.90	295.093			10.534		
08/12	15:16:05.90	296.093			10.534		
08/12	15:17:05.90	297.093			10.534		
08/12	15:18:05.90	298.093			10.534		
08/12	15:19:06.10	299.097			10.534		
08/12	15:20:00.40	300.002	0.000		10.534	0.161	Pump off
08/12	15:20:01.80	300.025	0.023	12858.21	10.534	0.161	
08/12	15:20:03.10	300.047	0.045	6667.70	10.51	0.185	
08/12	15:20:04.40	300.068	0.067	4501.03	10.534	0.161	
08/12	15:20:05.80	300.092	0.090	3334.35	10.534	0.161	
08/12	15:20:07.10	300.113	0.112	2687.58	10.534	0.161	
08/12	15:20:08.40	300.135	0.133	2251.01	10.534	0.161	
08/12	15:20:09.80	300.158	0.157	1915.90	10.534	0.161	
08/12	15:20:11.10	300.180	0.178	1683.25	10.534	0.161	
08/12	15:20:12.50	300.203	0.202	1488.61	10.534	0.161	
08/12	15:20:18.90	300.310	0.308	973.98	10.534	0.161	
08/12	15:20:23.90	300.393	0.392	766.96	10.534	0.161	
08/12	15:20:28.90	300.477	0.475	632.58	10.534	0.161	
08/12	15:20:33.90	300.560	0.558	538.32	10.534	0.161	
08/12	15:20:38.90	300.643	0.642	468.54	10.534	0.161	
08/12	15:20:43.90	300.727	0.725	414.80	10.534	0.161	
08/12	15:20:48.90	300.810	0.808	372.14	10.534	0.161	
08/12	15:20:53.90	300.893	0.892	337.45	10.534	0.161	
08/12	15:20:58.90	300.977	0.975	308.69	10.534	0.161	
08/12	15:21:03.90	301.060	1.058	284.47	10.534	0.161	
08/12	15:21:13.90	301.227	1.225	245.90	10.534	0.161	
08/12	15:21:23.90	301.393	1.392	216.57	10.534	0.161	
08/12	15:21:33.90	301.560	1.558	193.51	10.534	0.161	
08/12	15:21:43.90	301.727	1.725	174.91	10.534	0.161	
08/12	15:21:53.90	301.893	1.892	159.59	10.557	0.138	
08/12	15:22:03.90	302.060	2.058	146.75	10.557	0.138	
08/12	15:22:13.90	302.227	2.225	135.83	10.557	0.138	
08/12	15:22:23.90	302.393	2.392	126.44	10.557	0.138	
08/12	15:22:33.90	302.560	2.558	118.26	10.557	0.138	
08/12	15:23:03.90	303.060	3.058	99.09	10.557	0.138	
08/12	15:23:33.90	303.560	3.558	85.31	10.557	0.138	
08/12	15:24:03.90	304.060	4.058	74.92	10.557	0.138	
08/12	15:24:33.90	304.560	4.558	66.81	10.557	0.138	
08/12	15:25:03.90	305.060	5.058	60.31	10.557	0.138	

TABLE C.9. (contd)

08/12	15:25:33.90	305.560	5.558	54.97	10.557	0.138
08/12	15:26:03.90	306.060	6.058	50.52	10.534	0.161
08/12	15:26:33.90	306.560	6.558	46.74	10.557	0.138
08/12	15:27:03.90	307.060	7.058	43.50	10.557	0.138
08/12	15:28:03.90	308.060	8.058	38.23	10.557	0.138
08/12	15:29:03.90	309.060	9.058	34.12	10.557	0.138
08/12	15:30:03.90	310.060	10.058	30.83	10.557	0.138
08/12	15:31:03.90	311.060	11.058	28.13	10.557	0.138
08/12	15:32:03.90	312.060	12.058	25.88	10.557	0.138
08/12	15:33:03.90	313.060	13.058	23.97	10.557	0.138
08/12	15:34:03.90	314.060	14.058	22.34	10.557	0.138
08/12	15:35:03.90	315.060	15.058	20.92	10.557	0.138
08/12	15:36:03.90	316.060	16.058	19.68	10.557	0.138
08/12	15:38:03.90	318.060	18.058	17.61	10.557	0.138
08/12	15:40:03.90	320.060	20.058	15.96	10.557	0.138
08/12	15:42:03.90	322.060	22.058	14.60	10.557	0.138
08/12	15:44:03.90	324.060	24.058	13.47	10.557	0.138
08/12	15:46:03.90	326.060	26.058	12.51	10.557	0.138
08/12	15:48:03.90	328.060	28.058	11.69	10.557	0.138
08/12	15:50:03.90	330.060	30.058	10.98	10.58	0.115
08/12	15:52:03.90	332.060	32.058	10.36	10.557	0.138
08/12	15:54:03.90	334.060	34.058	9.81	10.58	0.115
08/12	15:59:03.90	339.060	39.058	8.68	10.58	0.115

TABLE C.10. Drawdown and Recovery Data for Well-299-E18-4 During the Constant-Discharge Test at Well 299-E18-3

Aquifer Test Data

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Data for Well 299-E18-4
Pumping Well 299-E18-3
Observation Wells 299-E18-2 and 299-E18-4

Location 2101-M / E18-4
Type of Aquifer Test Constant discharge
How Q Measured In-line Rockwell Intermat'l Flowmeter - 1½" - Ser # 20027614
How W.L.'s Measured E-tape No 10
Rad./Dist. of/From Pumping Well ~~[illegible]~~ 61.2 ft
Meas. Point for W.L.'s TOC
Elevation of Meas. Point N/A

Depth of Pump/Airpipe 327' from TOC
Pump On: date 8-12-88 time 10:20:00
Pump Off: date 8-12-88 time 15:20:00
Duration of Aquifer Test 5 hours

Time t = 15:20:00 at t' = 0					Water Level Data Static Water Level 314.90					Discharge		Recorded By	Comments
Day	Clock Time	t (min)	t'	t/t'	Reading	Conversions or Corrections	Water Level	s or s'		Reading	Q		
8/12	1020	1					314.91	0.01				HJC	Difference of 1.065'
		2					314.92	0.02				HJC	measured between 314'
		3					314.92	0.03				HJC	mark and 315' mark
		4					314.93	0.03				HJC	on E-tape, so 0.065'
		5					314.93	0.03				HJC	must be ~~[illegible]~~ readings
		6					314.93	0.03				HJC	> 315' between 330 min.
		7					314.93	0.03				HJC	and t = 60 min
		8					314.93	0.03				HJC	
		9					314.94	0.04				HJC	
		10					314.94	0.04				HJC	
		15				DRH 8-15-88	314.94	0.04				HJC	
		20				315.12	315.18	0.22				HJC	+.065
		25				~~315.13~~	315.19	0.23				HJC	+.065
		30				~~315.14~~	315.20	0.24				HJC	+.065
		40				~~315.15~~	315.21	0.25				HJC	+.065
		50				~~315.15~~	315.21	0.25				HJC	+.065
		60				~~315.15~~	315.21	0.25				HJC	+.065
		80					315.00	0.05				HJC	Correct / Measured from 314 mark
		100					315.00	0.05				HJC	Measured from 314 mark
		120					315.00	0.05				HJC	" " "
		150					315.01	0.06				HJC	" "
		180					315.00	0.05				HJC	
		210					315.01	0.06				HJC	
		240					315.01	0.06				HJC	
		270					315.00	0.05				HJC	
Recovery	1521	301	1	301			315.01	–				HJC	Shut off valve at 3:20
		302	2	151			315.00	–				HJC	
		303	3	101			315.00	–				HJC	
		304	4	76			314.99	0.01				HJC	
		305	5	61			315.00	–				HJC	
		306	6	51			314.99	0.01				HJC	
		307	7	43.8			314.99	0.01				HJC	
		308	8	38.5			314.99	0.01				HJC	
		309	9	34.33			314.99	0.01				HJC	
		310	10	31			314.99	0.01				HJC	
		315	15	21			315.01					HJC	
		320	20	16			314.98	0.02				HJC	
		325	25	13			314.96	0.04				HJC	
		330	30	11			314.96	0.04				HJC	
	1600	340	40	8.5			314.95	0.05				HJC	

TABLE C.11. Drawdown Data, Measured by a Pressure Transducer, for Well 2-99-E18-4 During the Constant-Discharge Test at Well 299-E18-3

Date	Time	t (min)	head(ft)	corr head(ft)	s (ft)	Comments
08/12	10:05:38.10		15.292	7.646		Baseline Data
08/12	10:06:51.10		15.315	7.6575		
08/12	10:07:51.00		15.292	7.646		
08/12	10:08:50.90		15.269	7.6345		
08/12	10:09:50.90		15.269	7.6345		
08/12	10:10:50.90		15.246	7.623		
08/12	10:11:50.90		15.246	7.623		
08/12	10:12:50.90		15.292	7.646		
08/12	10:13:50.90		15.246	7.623		
08/12	10:14:50.90		15.269	7.6345		
08/12	10:15:50.90		15.246	7.623		
08/12	10:16:50.90		15.269	7.6345		
08/12	10:17:50.90		15.269	7.6345		
08/12	10:18:50.90		15.246	7.623		
08/12	10:19:51.10		15.269	7.6345		
08/12	10:20:00.30	0.000	15.246	7.623	0.0115	Pump on
08/12	10:20:01.70	0.023	15.246	7.623	0.0115	
08/12	10:20:03.00	0.045	15.269	7.6345	0	
08/12	10:20:04.30	0.067	15.292	7.646	-0.0115	
08/12	10:20:05.70	0.090	15.223	7.6115	0.023	
08/12	10:20:07.00	0.112	15.338	7.669	-0.0345	
08/12	10:20:08.40	0.135	15.246	7.623	0.0115	
08/12	10:20:09.70	0.157	15.223	7.6115	0.023	
08/12	10:20:11.00	0.178	15.338	7.669	-0.0345	
08/12	10:20:12.40	0.202	15.292	7.646	-0.0115	
08/12	10:20:18.90	0.310	15.246	7.623	0.0115	
08/12	10:20:23.90	0.393	15.315	7.6575	-0.023	
08/12	10:20:28.90	0.477	15.269	7.6345	0	
08/12	10:20:33.90	0.560	15.292	7.646	-0.0115	
08/12	10:20:38.90	0.643	15.292	7.646	-0.0115	
08/12	10:20:43.90	0.727	15.292	7.646	-0.0115	
08/12	10:20:48.90	0.810	15.431	7.7155	-0.081	
08/12	10:20:53.90	0.893	15.269	7.6345	0	
08/12	10:20:58.90	0.977	15.315	7.6575	-0.023	
08/12	10:21:03.90	1.060	15.361	7.6805	-0.046	
08/12	10:21:13.90	1.227	15.408	7.704	-0.0695	
08/12	10:21:23.90	1.393	15.315	7.6575	-0.023	
08/12	10:21:33.90	1.560	15.246	7.623	0.0115	
08/12	10:21:43.90	1.727	15.246	7.623	0.0115	
08/12	10:21:53.90	1.893	15.223	7.6115	0.023	
08/12	10:22:03.90	2.060	15.292	7.646	-0.0115	
08/12	10:22:13.90	2.227	15.246	7.623	0.0115	
08/12	10:22:23.90	2.393	15.269	7.6345	0	
08/12	10:22:33.90	2.560	15.246	7.623	0.0115	
08/12	10:23:03.90	3.060	15.292	7.646	-0.0115	
08/12	10:23:33.90	3.560	15.315	7.6575	-0.023	
08/12	10:24:03.90	4.060	15.315	7.6575	-0.023	
08/12	10:24:33.90	4.560	15.269	7.6345	0	

TABLE C.11. (contd)

08/12	10:25:03.90	5.060	15.385	7.6925	-0.058
08/12	10:25:33.90	5.560	15.269	7.6345	0
08/12	10:26:03.90	6.060	15.315	7.6575	-0.023
08/12	10:26:33.90	6.560	15.292	7.646	-0.0115
08/12	10:27:03.90	7.060	15.246	7.623	0.0115
08/12	10:28:03.90	8.060	15.269	7.6345	0
08/12	10:29:03.90	9.060	15.292	7.646	-0.0115
08/12	10:30:03.90	10.060	15.385	7.6925	-0.058
08/12	10:31:03.90	11.060	15.223	7.6115	0.023
08/12	10:32:03.90	12.060	15.246	7.623	0.0115
08/12	10:33:03.90	13.060	15.246	7.623	0.0115
08/12	10:34:03.90	14.060	15.154	7.577	0.0575
08/12	10:35:03.90	15.060	15.2	7.6	0.0345
08/12	10:36:03.90	16.060	15.292	7.646	-0.0115
08/12	10:38:03.90	18.060	15.246	7.623	0.0115
08/12	10:40:03.90	20.060	15.223	7.6115	0.023
08/12	10:42:03.90	22.060	15.246	7.623	0.0115
08/12	10:44:03.90	24.060	15.269	7.6345	0
08/12	10:46:03.90	26.060	15.223	7.6115	0.023
08/12	10:48:03.90	28.060	15.246	7.623	0.0115
08/12	10:50:03.90	30.060	15.246	7.623	0.0115
08/12	10:52:03.90	32.060	15.269	7.6345	0
08/12	10:54:03.90	34.060	15.223	7.6115	0.023
08/12	10:59:03.90	39.060	15.246	7.623	0.0115
08/12	11:04:03.90	44.060	15.223	7.6115	0.023
08/12	11:09:03.90	49.060	15.223	7.6115	0.023
08/12	11:14:03.90	54.060	15.2	7.6	0.0345
08/12	11:19:03.90	59.060	15.223	7.6115	0.023
08/12	11:24:03.90	64.060	15.223	7.6115	0.023
08/12	11:29:03.90	69.060	15.177	7.5885	0.046
08/12	11:34:03.90	74.060	15.2	7.6	0.0345
08/12	11:39:03.90	79.060	15.246	7.623	0.0115
08/12	11:49:03.90	89.060	15.177	7.5885	0.046
08/12	11:59:03.90	99.060	15.154	7.577	0.0575
08/12	12:09:03.90	109.060	15.177	7.5885	0.046
08/12	12:19:03.90	119.060	15.154	7.577	0.0575
08/12	12:29:03.90	129.060	15.13	7.565	0.0695
08/12	12:39:03.90	139.060	15.13	7.565	0.0695
08/12	12:49:03.90	149.060	15.015	7.5075	0.127
08/12	12:59:03.90	159.060	15.13	7.565	0.0695
08/12	13:09:03.90	169.060	15.107	7.5535	0.081
08/12	13:29:03.90	189.060	15.154	7.577	0.0575
08/12	13:49:03.90	209.060	15.13	7.565	0.0695
08/12	14:09:03.90	229.060	14.899	7.4495	0.185
08/12	14:29:03.90	249.060	15.13	7.565	0.0695
08/12	14:49:03.90	269.060	15.13	7.565	0.0695

DISCHARGE AND DRAWDOWN DATA FOR THE TEST AT WELL 299-E18-4

TABLE C.12. Recovery Data, Measured by a Pressure Transducer, for Well 200-E-18-4 During the Constant-Discharge Test at Well 299-E18-3

Date	Time	t (min)	t'(min)	t/t'	head(ft)	s'(ft)	Comments
08/12	15:04:45.20	284.748			7.565		Baseline
08/12	15:05:06.10	285.097			7.577		Data
08/12	15:06:06.00	286.095			7.554		
08/12	15:07:05.90	287.093			7.542		
08/12	15:08:05.90	288.093			7.542		
08/12	15:09:05.90	289.093			7.565		
08/12	15:10:05.90	290.093			7.554		
08/12	15:11:05.90	291.093			7.542		
08/12	15:12:05.90	292.093			7.565		
08/12	15:13:05.90	293.093			7.542		
08/12	15:14:05.90	294.093			7.542		
08/12	15:15:05.90	295.093			7.554		
08/12	15:16:05.90	296.093			7.542		
08/12	15:17:05.90	297.093			7.542		
08/12	15:18:05.90	298.093			7.542		
08/12	15:19:06.10	299.097			7.542		
08/12	15:20:00.40	300.002	0.000		7.577	0.058	Pump off
08/12	15:20:01.80	300.025	0.023	12858.21	7.565	0.069	
08/12	15:20:03.10	300.047	0.045	6667.70	7.565	0.069	
08/12	15:20:04.40	300.068	0.067	4501.03	7.554	0.080	
08/12	15:20:05.80	300.092	0.090	3334.35	7.577	0.058	
08/12	15:20:07.10	300.113	0.112	2687.58	7.623	0.011	
08/12	15:20:08.40	300.135	0.133	2251.01	7.565	0.069	
08/12	15:20:09.80	300.158	0.157	1915.90	7.577	0.058	
08/12	15:20:11.10	300.180	0.178	1683.25	7.577	0.058	
08/12	15:20:12.50	300.203	0.202	1488.61	7.565	0.069	
08/12	15:20:18.90	300.310	0.308	973.98	7.588	0.046	
08/12	15:20:23.90	300.393	0.392	766.96	7.542	0.093	
08/12	15:20:28.90	300.477	0.475	632.58	7.554	0.080	
08/12	15:20:33.90	300.560	0.558	538.32	7.565	0.069	
08/12	15:20:38.90	300.643	0.642	468.54	7.565	0.069	
08/12	15:20:43.90	300.727	0.725	414.80	7.542	0.093	
08/12	15:20:48.90	300.810	0.808	372.14	7.6	0.035	
08/12	15:20:53.90	300.893	0.892	337.45	7.588	0.046	
08/12	15:20:58.90	300.977	0.975	308.69	7.554	0.080	
08/12	15:21:03.90	301.060	1.058	284.47	7.531	0.104	
08/12	15:21:13.90	301.227	1.225	245.90	7.554	0.080	
08/12	15:21:23.90	301.393	1.392	216.57	7.577	0.058	
08/12	15:21:33.90	301.560	1.558	193.51	7.531	0.104	
08/12	15:21:43.90	301.727	1.725	174.91	7.565	0.069	
08/12	15:21:53.90	301.893	1.892	159.59	7.577	0.058	
08/12	15:22:03.90	302.060	2.058	146.75	7.565	0.069	
08/12	15:22:13.90	302.227	2.225	135.83	7.611	0.024	
08/12	15:22:23.90	302.393	2.392	126.44	7.565	0.069	
08/12	15:22:33.90	302.560	2.558	118.26	7.542	0.093	
08/12	15:23:03.90	303.060	3.058	99.09	7.554	0.080	
08/12	15:23:33.90	303.560	3.558	85.31	7.565	0.069	
08/12	15:24:03.90	304.060	4.058	74.92	7.565	0.069	
08/12	15:24:33.90	304.560	4.558	66.81	7.554	0.080	

TABLE C.12. (contd)

08/12	15:25:03.90	305.060	5.058	60.31	7.565	0.069
08/12	15:25:33.90	305.560	5.558	54.97	7.6	0.035
08/12	15:26:03.90	306.060	6.058	50.52	7.565	0.069
08/12	15:26:33.90	306.560	6.558	46.74	7.519	0.115
08/12	15:27:03.90	307.060	7.058	43.50	7.577	0.058
08/12	15:28:03.90	308.060	8.058	38.23	7.542	0.093
08/12	15:29:03.90	309.060	9.058	34.12	7.565	0.069
08/12	15:30:03.90	310.060	10.058	30.83	7.565	0.069
08/12	15:31:03.90	311.060	11.058	28.13	7.554	0.080
08/12	15:32:03.90	312.060	12.058	25.88	7.577	0.058
08/12	15:33:03.90	313.060	13.058	23.97	7.588	0.046
08/12	15:34:03.90	314.060	14.058	22.34	7.565	0.069
08/12	15:35:03.90	315.060	15.058	20.92	7.577	0.058
08/12	15:36:03.90	316.060	16.058	19.68	7.588	0.046
08/12	15:38:03.90	318.060	18.058	17.61	7.577	0.058
08/12	15:40:03.90	320.060	20.058	15.96	7.565	0.069
08/12	15:42:03.90	322.060	22.058	14.60	7.577	0.058
08/12	15:44:03.90	324.060	24.058	13.47	7.611	0.024
08/12	15:46:03.90	326.060	26.058	12.51	7.588	0.046
08/12	15:48:03.90	328.060	28.058	11.69	7.6	0.035
08/12	15:50:03.90	330.060	30.058	10.98	7.554	0.080
08/12	15:52:03.90	332.060	32.058	10.36	7.588	0.046
08/12	15:54:03.90	334.060	34.058	9.81	7.6	0.035
08/12	15:59:03.90	339.060	39.058	8.68	7.6	0.035
08/12	16:04:03.90	344.060	44.058	7.81	7.623	0.011
08/12	16:09:03.90	349.060	49.058	7.12	7.635	-0.000
08/12	16:14:03.90	354.060	54.058	6.55	7.669	-0.034
08/12	16:19:03.90	359.060	59.058	6.08	7.669	-0.034
08/12	16:24:03.90	364.060	64.058	5.68	7.669	-0.034
08/12	16:29:03.90	369.060	69.058	5.34	7.692	-0.058
08/12	16:34:03.90	374.060	74.058	5.05	7.692	-0.058
08/12	16:39:03.90	379.060	79.058	4.79	7.692	-0.058
08/12	16:49:03.90	389.060	89.058	4.37	7.704	-0.069
08/12	16:59:03.90	399.060	99.058	4.03	7.715	-0.080
08/12	17:09:03.90	409.060	109.058	3.75	7.727	-0.093
08/12	17:19:03.90	419.060	119.058	3.52	7.727	-0.093
08/12	17:29:03.90	429.060	129.058	3.32	7.727	-0.093
08/12	17:39:03.90	439.060	139.058	3.16	7.738	-0.104
08/12	17:49:03.90	449.060	149.058	3.01	7.75	-0.115
08/12	17:59:03.90	459.060	159.058	2.89	7.75	-0.115
08/12	18:09:03.90	469.060	169.058	2.77	7.75	-0.115
08/12	18:29:03.90	489.060	189.058	2.59	7.762	-0.127
08/12	18:49:03.90	509.060	209.058	2.44	7.762	-0.127
08/12	19:09:03.90	529.060	229.058	2.31	7.773	-0.138
08/12	19:29:03.90	549.060	249.058	2.20	7.773	-0.138
08/12	19:49:03.90	569.060	269.058	2.12	7.773	-0.138
08/12	20:09:03.90	589.060	289.058	2.04	7.762	-0.127
08/12	20:29:03.90	609.060	309.058	1.97	7.773	-0.138
08/12	20:49:03.90	629.060	329.058	1.91	7.762	-0.127
08/12	21:09:03.90	649.060	349.058	1.86	7.75	-0.115
08/12	21:49:03.90	689.060	389.058	1.77	7.75	-0.115
08/12	22:29:03.90	729.060	429.058	1.70	7.796	-0.162
08/12	23:09:03.90	769.060	469.058	1.64	7.796	-0.162
08/12	23:49:03.90	809.060	509.058	1.59	7.796	-0.162

TABLE C.12. (contd)

08/13	00:29:03.90	849.060	549.058	1.55	7.796	-0.162
08/13	01:09:03.90	889.060	589.058	1.51	7.808	-0.173
08/13	01:49:03.90	929.060	629.058	1.48	7.819	-0.184
08/13	02:29:03.90	969.060	669.058	1.45	7.842	-0.207
08/13	03:09:03.90	1009.060	709.058	1.42	7.854	-0.220
08/13	03:49:03.90	1049.060	749.058	1.40	7.842	-0.207
08/13	04:29:03.90	1089.060	789.058	1.38	7.831	-0.197
08/13	05:09:03.90	1129.060	829.058	1.36	7.819	-0.184
08/13	05:49:03.90	1169.060	869.058	1.35	7.819	-0.184
08/13	06:29:03.90	1209.060	909.058	1.33	7.819	-0.184

Aquifer Test Data

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Data for Well: 2-E12-4
Pumping Well: 2-E12-4
Observation Wells: 2-E12-3

Location: 2101-M Pond
Type of Aquifer Test: Re-development, Constant Q
How Q Measured: 5-gal bucket
How W.L.'s Measured: E-tape
Rad./Dist. of/From Pumping Well: 2 N4
Meas. Point for W.L.'s: Top of casing pipe
Elevation of Meas. Point: 3.4' above [illegible]

Depth of Pump/Airpipe: 329' - 3.4' = 325.6
Pump On: date [illegible] time [illegible]
Pump Off: date 11-2-88 time 14:17
Duration of Aquifer Test: 3 hr 24 min (204 min)

Time: t = _____ at t' = 0
Water Level Data: 315.[illegible]
Static Water Level: ~~[illegible]~~

Day	Clock Time	t	t'	t/t'	Reading	Conversions or Corrections	Water Level	s or s'		Discharge Reading	Discharge Q	Recorded By	Comments
	1053	0											
		1			315.66			.06				SST	
		2			315.66			.06				SST	
		3			315.64			.04				SST	[illegible]
		4			315.66			.06				SST	= 9.05 g.
		5			—								
		6			315.65			.05				SST	
		10			315.66			.06				SST	
		14			315.65			.05				SST	
		17			315.65			.05				SST	
		21			[illegible]			.05				SST	
		24			315.66			.06				SST	
		[illegible]			~~[illegible]~~							SST	38 sec / 5.73 gal
		[illegible]			[illegible]			.05				SST	9.05 g
		[illegible]			[illegible] .06			.06				SST	
		[illegible]			[illegible]			.05				SST	
		[illegible]			[illegible]			.05				SST	
		58			[illegible]			.06				SST	
	[illegible]	63			315.65			.05				SST	36 sec / 5.[illegible] gal
		70			[illegible]			.08				SST	9.55 g.
		[illegible]										SST	37 sec / 5.73 gal
		[illegible]			[illegible]			.08				SST	9.3 g
		105			315.64			.06				SST	
		112										SST	38 sec / 5.73 gal
		118			315.68			.08				SST	9.05 g
		120			[illegible]			.05				SST	
		122			[illegible]			.05				SST	
		[illegible]			[illegible]			.07				SST	37 sec / 5.73 gal
		[illegible]			[illegible]			.06				SST	9.3 g
		[illegible]			[illegible]			.06				SST	
		125			[illegible]			.06				SST	
		126			[illegible]			.05				SST	
		[illegible]			[illegible]			.05				SST	
		[illegible]						s' ↓				SST	Pump OFF
			:30	408	315.51			~~.65~~ .14				SST	No check valve in
			1	204	[illegible]			.15				SST	pump; recovery data
			2	68	315.54			.09				SST	not useful!
			3	51	315.55			.10				SST	
			5	40.8	[illegible]			.11				SST	
12	315.55		6	34	315.[illegible]			.09				SST	SST: 38 sec /
			[illegible]	29.1	[illegible]			.11				SST	
			9	22.7	[illegible]			.10				SST	

Aquifer Test Data

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Data for Well 2-E18-3
Pumping Well 2-E18-4
Observation Wells 2-E15-3

Location 2101-M Pond
Type of Aquifer Test Re-development / Constant-[illegible]
How Q Measured 5 gal bucket
How W.L.'s Measured E-tape
Rad./Dist. of/From Pumping Well 61.5'
Meas. Point for W.L.'s top of 4" casing
Elevation of Meas. Point 3.54' above top of pad

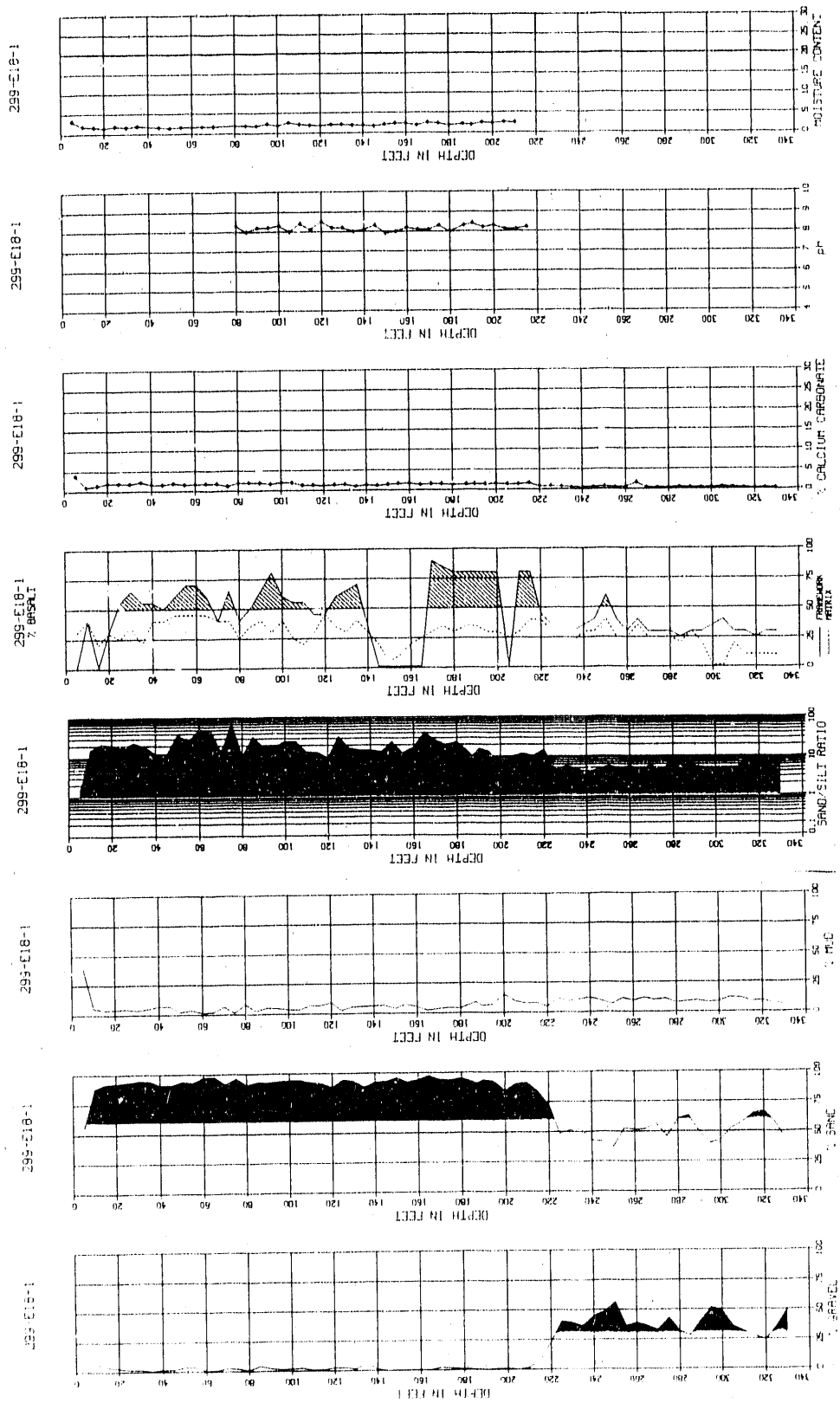
Depth of Pump/Airpipe
Pump On: date 11-2-88 time 10:53
Pump Off: date 11-2-88 time 14:17
Duration of Aquifer Test 3hr. 24min = 204 min

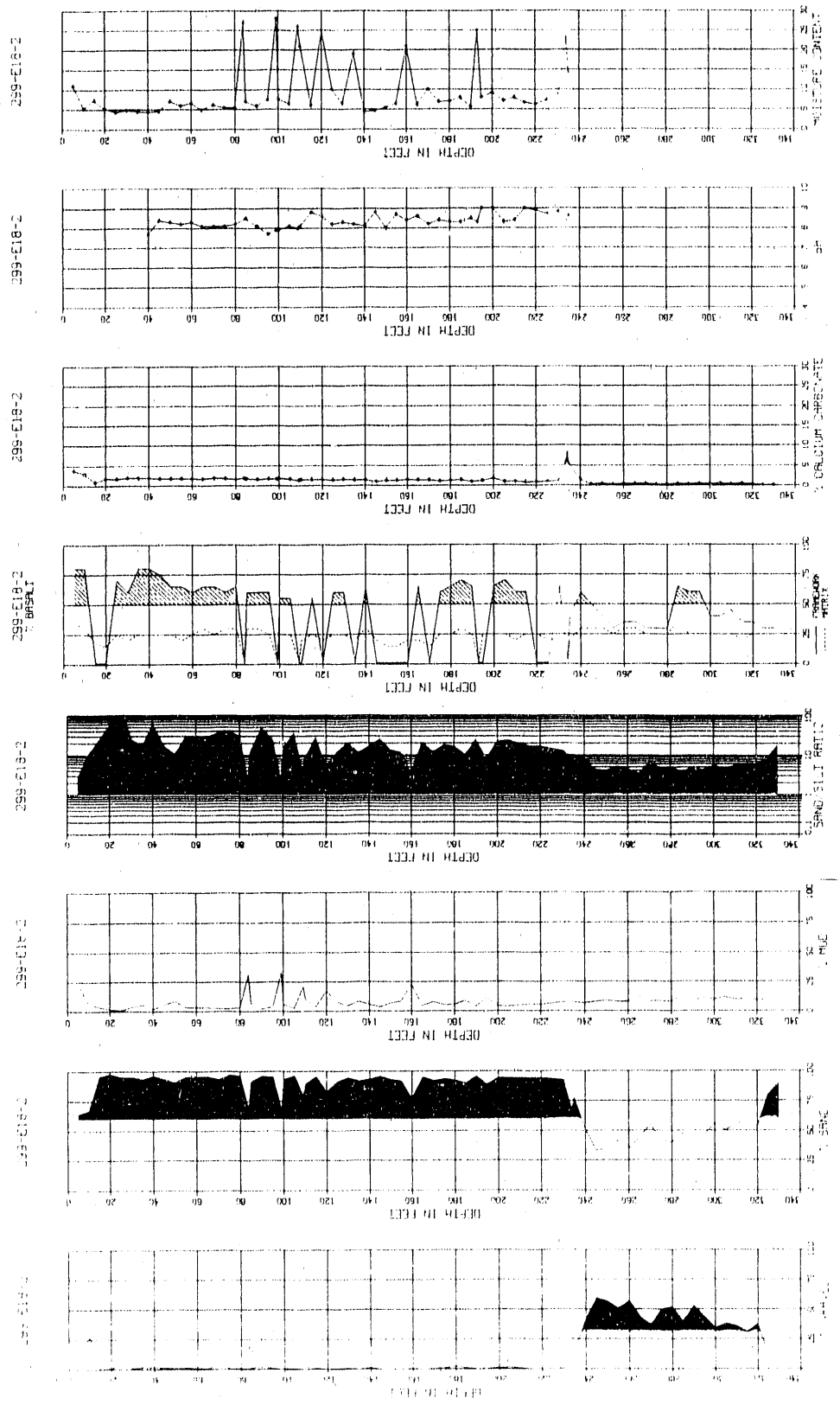
Time t = ____ at t' = 0					Water Level Data Static Water Level 316.34					Discharge		Recorded By	Comments
Day	Clock Time	t	t'	t/t'	Reading	Conversions or Corrections	Water Level	s or s'		Read-ing	Q		
	1053	0			~~316.34~~							SST	
	1102	9			316.34			0				SST	
	1105	12			316.34			0				SST	
	1112	19			316.34			0				SST	
	1119	[illegible]			316.34			0				SST	
	1126	[illegible]			316.34			0				SST	
	1131	[illegible]			316.34			0				SST	
	1143	50			316.34			0				SST	
	1153	60			316.34			0				SST	
	1222	89			316.35			.01				SST	
	1140	107			316.35			.01				SST	
	1148	115			316.35			.01				SST	
	1208	135			316.36			.02				SST	
	1218	145			316.36			.02				SST	
	1228	155			316.36			.02				SST	
	1243	170			316.37			.03				SST	
	1253	180			316.37			.03				SST	
	1302	190			316.37			.03				SST	
	1312	200			316.38			.04				SST	
			8	25.5	316.37			.01				SST	
			13	15.7	316.355			.025				SST	

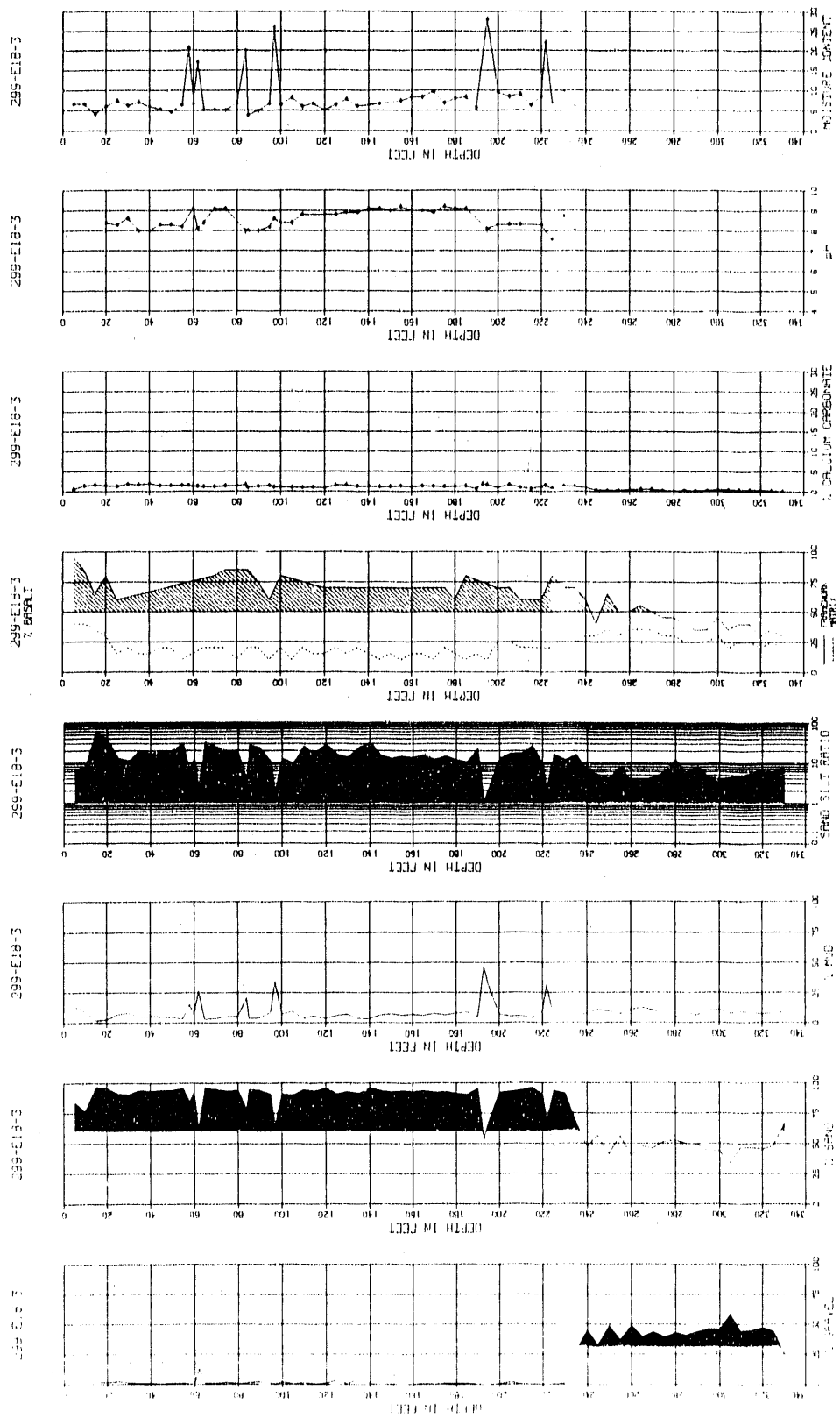
APPENDIX D

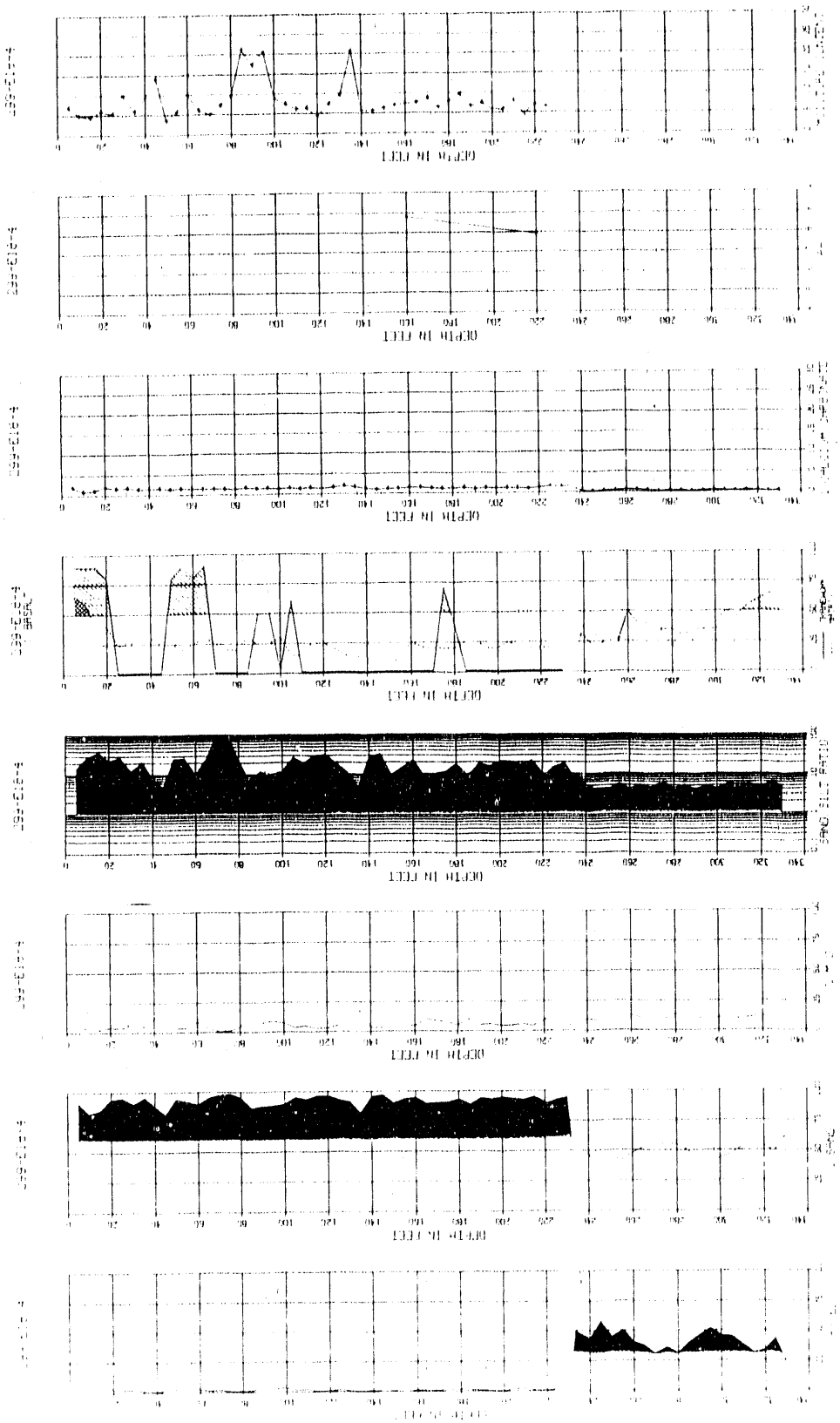
GEOLOGIC DATA

BOREHOLE CORRELATION CHARTS


299-E18-1
MOISTURE CONTENT
pH
% CALCIUM CARBONATE
% BASALT
FRAGMENTS
MATRIX
SAND/SILT RATIO
% MUD
% SAND
% GRAVEL
DEPTH IN FEET


299-E18-2
DEPTH IN FEET
299-E18-2
DEPTH IN FEET
299-E18-2
DEPTH IN FEET
299-E18-2
DEPTH IN FEET
299-E18-2
DEPTH IN FEET
299-E18-2
DEPTH IN FEET
299-E18-2
DEPTH IN FEET
299-E18-2
DEPTH IN FEET


299-E18-3
% BASALT
SAND SILT RATIO
% CALCIUM CARBONATE
DEPTH IN FEET


DEPTH IN FEET
DEPTH IN FEET
DEPTH IN FEET
DEPTH IN FEET
DEPTH IN FEET
DEPTH IN FEET
DEPTH IN FEET
DEPTH IN FEET

MOISTURE CONTENT

WELL NUMBER	DEPTH	MOISTURE %
299-E18-1	5'	3.28
	10'	1.81
	15'	1.79
	20'	1.48
	25'	1.93
	30'	1.66
	35'	1.91
	45'	1.67
	50'	1.48
	55'	1.61
	60'	1.69
	65'	1.72
	70'	1.76
	80'	1.98
	85'	1.92
	90'	1.81
	95'	2.34
	100'	1.81
	105'	2.61
	110'	2.22
	115'	1.92
	120'	1.86
	125'	2.11
	130'	2.12
	135'	1.94
	140'	1.87
	145'	1.67
	155'	2.06
	160'	2.35
	165'	2.36
	170'	1.85
	175'	2.38
	180'	1.84
	186.5'	2.12
	190'	1.91
	195'	2.50
	200'	2.30
	205'	2.53
	210'	2.46

WELL NUMBER	DEPTH	MOISTURE %
299-E18-2	5'	11.13
	10'	5.27
	15'	7.36
	20'	5.22
	25'	4.42
	30'	4.82
	35'	4.52
	40'	4.42
	45'	4.66
	50'	7.09
	55'	5.94
	60'	6.62
	65'	4.90
	70'	6.14
	75'	5.45
	80'	5.44
	84'	27.01
	85'	7.02
	90'	5.87
	95'	7.43
	99'	28.68
	100'	7.50
	105'	6.46
	109'	26.39
	110'	21.52
	115'	6.04
	120'	25.89
	125'	10.29
	130'	6.59
	135'	19.22
	140'	4.37
	145'	4.78
	150'	5.45
	155'	6.41
	160'	21.08
	165'	6.12
	170'	10.06
	175'	6.86
	180'	6.96
	185'	7.95
	190'	5.67
	193'	25.25
	195'	8.01
	200'	9.15
	205'	7.14
	210'	7.91
	215'	6.76
	220'	6.21
	225'	7.29
	230'	8.53
	234'	23.04
	235'	14.76

WELL NUMBER	DEPTH	MOISTURE %
299-E18-3	5'	6.62
	10'	6.66
	15'	4.05
	20'	6.08
	25'	7.42
	30'	6.21
	35'	7.05
	40'	6.05
	45'	5.36
	50'	4.78
	55'	6.45
	58'	20.73
	60'	6.77
	62'	17.25
	65'	5.25
	70'	5.22
	75'	5.17
	80'	6.75
	84'	20.44
	85'	3.84
	90'	4.93
	95'	6.73
	97'	26.77
	100'	6.44
	105'	8.16
	110'	6.03
	115'	6.76
	120'	5.14
	125'	6.43
	130'	7.89
	135'	6.13
	140'	6.42
	145'	6.79
	155'	7.47
	160'	8.38
	165'	8.37
	170'	9.67
	175'	6.89
	180'	8.06
	185'	8.31
	190'	5.72
	195'	28.42
	200'	9.44
	205'	8.49
	210'	9.06
	215'	6.34
	220'	8.59
	222'	22.14
	225'	6.74
	230'	9.87
	235'	5.98

WELL NUMBER	DEPTH	MOISTURE %
299-E18-4	5'	6.98
	10'	4.95
	15'	4.45
	20'	5.89
	25'	5.23
	30'	9.86
	35'	5.82
	40'	9.31
	45'	14.13
	50'	3.45
	55'	5.72
	60'	10.04
	65'	6.09
	70'	4.91
	75'	7.30
	80'	9.63
	85'	21.24
	90'	17.34
	95'	20.52
	100'	8.82
	105'	7.41
	110'	6.13
	115'	6.41
	120'	4.29
	125'	7.38
	130'	9.67
	135'	20.69
	140'	5.64
	145'	5.62
	150'	6.28
	155'	6.97
	160'	7.40
	165'	7.63
	170'	8.71
	175'	6.30
	180'	7.93
	185'	9.63
	190'	6.58
	195'	7.42
	200'	5.95
	205'	5.77
	210'	7.90
	215'	4.62
	221'	6.89
	225'	6.39
	230'	6.43
	233'	4.26

SIEVE DATA FOR WELL 299-E18-1

WESTINGHOUSE HANFORD OPERATIONS SIEVE ANALYSIS
ROCSAN REPORT

**** REPORT ON WELL 0299-E18-001 ****

12/11/89

DEPTH	%CACO3	DM	%MUD	%SAND	%GRAVEL	CLASS		FINE PEB (<=-2)	VFINE PEB (-1)	VERY COARS (0)	COARS (1)	MED (2)	FINE (3)	VERY FINE (4)	SILT (4.75)	PAN (>4.75)
5	3.9	C	40.2	55.8	3.9	mS	WT	9.2	14.0	21.4	34.0	39.1	110.0	125.9	63.4	174.7
SORT= 1.72 MEDIAN= 4.00 MODE= 5.00 MEAN= .27							WT %	1.6	2.4	3.6	5.8	6.6	18.6	21.3	10.7	29.5
SPLIT WT= 588.1							CUM WT %	1.6	3.9	7.5	13.3	19.9	38.5	59.8	70.5	100.0
10	1.0	C	5.6	88.1	6.3	(g)	WT	12.5	30.3	140.4	219.6	146.3	61.9	31.4	11.6	26.8
SORT= 1.45 MEDIAN= 1.00 MODE= 1.00 MEAN= .85							WT %	1.8	4.5	20.6	32.3	21.5	9.1	4.6	1.7	3.9
SPLIT WT= 680.7							CUM WT %	1.8	6.3	26.9	59.2	80.7	89.8	94.4	96.1	100.0
15	1.4	C	4.2	91.9	3.9	S	WT	1.5	22.7	127.2	268.4	119.6	40.7	19.8	6.3	20.3
SORT= 1.14 MEDIAN= 1.00 MODE= 1.00 MEAN= .70							WT %	0.2	3.6	20.3	42.8	19.1	6.5	3.2	1.0	3.2
SPLIT WT= 624.4							CUM WT %	0.2	3.[illegible]	24.2	67.0	86.1	92.6	95.8	96.8	100.0
20	1.9	C	4.5	92.6	2.9	S	WT	2.2	19.1	103.5	293.4	191.4	55.6	27.1	8.0	24.6
SORT= 1.04 MEDIAN= 1.00 MODE= 1.00 MEAN= .91							WT %	0.3	2.6	14.3	40.5	26.4	7.7	3.7	1.1	3.4
SPLIT WT= 725.1							CUM WT %	0.3	2.9	17.2	57.7	84.1	91.8	95.5	96.6	100.0
25	1.9	C	5.1	93.3	1.6	S	WT	0.4	7.6	38.8	132.6	198.1	63.6	20.2	7.1	17.6
SORT= 1.13 MEDIAN= 2.00 MODE= 2.00 MEAN= 1.34							WT %	0.1	1.6	8.0	27.3	40.8	13.1	4.2	1.5	3.6
SPLIT WT= 486.1							CUM WT %	0.1	1.6	9.6	36.9	77.7	90.8	94.9	96.4	100.0
30	1.8	C	4.1	94.5	1.4	S	WT	0.6	7.9	49.3	193.9	211.5	80.9	24.5	7.1	17.3
SORT= 1.12 MEDIAN= 2.00 MODE= 2.00 MEAN= 1.28							WT %	0.1	1.3	8.3	32.7	35.7	13.6	4.1	1.2	2.9
SPLIT WT= 590.6							CUM WT %	0.1	1.4	9.7	42.4	78.1	91.8	95.9	97.1	100.0
35	2.2	C	5.2	94.4	0.4	S	WT	0.1	1.8	9.9	70.4	189.8	164.7	45.1	9.3	17.0
SORT= 0.97 MEDIAN= 2.00 MODE= 2.00 MEAN= 1.95							WT %	0.0	0.4	2.0	13.9	37.4	32.4	8.9	1.8	3.4
SPLIT WT= 507.8							CUM WT %	0.0	0.4	2.3	16.2	53.5	85.9	94.8	96.7	100.0
40	1.6	C	7.3	91.1	1.6	S	WT	1.5	7.8	80.8	257.1	125.8	41.1	28.1	9.3	33.7
SORT= 1.22 MEDIAN= 1.00 MODE= 1.00 MEAN= 1.08							WT %	0.3	1.3	13.8	43.9	21.5	7.0	4.8	1.6	5.8
SPLIT WT= 582.7							CUM WT %	0.3	1.6	15.4	59.3	80.8	87.9	92.7	94.2	100.0
45	1.6	C	7.4	91.0	1.5	S	WT	5.9	2.5	30.9	277.8	123.3	39.5	24.8	8.8	31.7
SORT= 1.13 MEDIAN= 1.00 MODE= 1.00 MEAN= .15							WT %	1.1	0.5	5.7	51.0	22.6	7.3	4.6	1.6	5.8
SPLIT WT= 541.5							CUM WT %	1.1	1.5	7.2	58.2	80.8	88.0	92.6	94.2	100.0
50	1.9	C	2.5	93.9	3.6	S	WT	4.4	15.4	115.8	280.5	82.5	20.6	11.0	3.7	9.8
SORT= 0.95 MEDIAN= 1.00 MODE= 1.00 MEAN= .52							WT %	0.8	2.8	21.3	51.6	15.2	3.8	2.0	0.7	1.8
SPLIT WT= 540.9							CUM WT %	0.8	3.6	24.9	76.5	91.7	95.5	97.5	98.2	100.0
55	1.6	C	3.6	93.0	3.4	S	WT	3.8	18.1	117.6	319.4	120.1	30.8	14.5	6.0	17.6
SORT= 1.00 MEDIAN= 1.00 MODE= 1.00 MEAN= .66							WT %	0.6	2.8	18.2	49.3	18.5	4.8	2.2	0.9	2.7
SPLIT WT= 645.9							CUM WT %	0.6	3.4	21.5	70.8	89.4	94.1	96.4	97.3	100.0

WESTINGHOUSE HANFORD OPERATIONS SIEVE ANALYSIS
ROCKSAN REPORT

**** REPORT ON WELL 0299-E18-001 ****

09/20/89

DEPTH	%CACO3	DM	%MUD	%SAND	%GRAVEL	CLASS		FINE PEB (<=-2)	VFINE PEB (-1)	VERY COARS (0)	COARS (1)	MED (2)	FINE (3)	VERY FINE (4)	SILT (4.75)	PAN (>4.75)
60	1.7	C	1.9	97.5	0.6	S	WT	0.3	3.2	42.6	232.0	194.0	47.1	11.3	3.4	6.8
SORT= 0.87	MEDIAN=		1.00	MODE=	1.00	MEAN= 1.02	WT %	0.1	0.6	7.9	42.9	35.9	8.7	2.1	0.6	1.3
SPLIT WT= 537.6							CUM WT %	0.1	0.7	8.5	51.4	87.3	96.0	98.1	98.8	100.0
65	1.8	C	2.0	97.4	0.7	S	WT	0.1	3.6	43.9	247.8	204.1	35.6	11.0	3.5	7.5
SORT= 0.84	MEDIAN=		1.00	MODE=	1.00	MEAN= 0.98	WT %	0.0	0.7	7.9	44.5	36.6	6.4	2.0	0.6	1.4
SPLIT WT= 554.5							CUM WT %	0.0	0.7	8.6	53.0	89.7	96.1	98.0	98.7	100.0
70	1.8	C	6.5	91.2	2.4	S	WT	1.8	11.1	56.1	216.6	164.1	39.7	21.8	8.0	27.3
SORT= 1.07	MEDIAN=		1.00	MODE=	1.00	MEAN= 1.09	WT %	0.3	2.0	10.3	39.6	30.0	7.3	4.0	1.5	5.0
SPLIT WT= 542.5							CUM WT %	0.3	2.4	12.6	52.3	82.3	89.6	93.5	95.0	100.0
75	1.2	C	1.4	96.3	2.3	S	WT	1.7	9.8	58.8	248.5	144.3	22.2	8.1	2.6	4.3
SORT= 0.83	MEDIAN=		1.00	MODE=	1.00	MEAN= 0.82	WT %	0.3	2.0	11.8	49.7	28.8	4.4	1.6	0.5	0.9
SPLIT WT= 499.0							CUM WT %	0.3	2.3	14.1	63.7	92.6	97.0	98.6	99.1	100.0
80	1.9	C	8.6	90.8	0.6	S	WT	0.3	2.9	24.1	135.1	207.9	99.0	36.2	13.1	34.4
SORT= 1.25	MEDIAN=		2.00	MODE=	2.00	MEAN= 1.65	WT %	0.1	0.5	4.4	24.4	37.6	17.9	6.6	2.4	6.2
SPLIT WT= 549.4							CUM WT %	0.1	0.6	4.9	29.4	67.0	84.9	91.4	93.8	100.0
85	2.0	C	2.8	93.0	4.2	S	WT	0.6	10.9	44.1	113.6	77.0	14.0	6.6	2.1	5.7
SORT= 1.03	MEDIAN=		1.00	MODE=	1.00	MEAN= 0.75	WT %	0.2	4.0	16.1	41.4	28.0	5.1	2.4	0.8	2.1
SPLIT WT= 270.7							CUM WT %	0.2	4.2	20.3	61.6	89.7	94.8	97.2	97.9	100.0
90	1.9	C	5.3	92.6	2.1	S	WT	1.2	10.4	45.6	196.4	183.5	57.3	21.0	7.8	21.1
SORT= 1.10	MEDIAN=		2.00	MODE=	1.00	MEAN= 1.20	WT %	0.2	1.9	8.4	36.1	33.7	10.5	3.9	1.4	3.9
SPLIT WT= 541.0							CUM WT %	0.2	2.1	10.5	46.6	80.3	90.8	94.7	96.1	100.0
95	1.6	C	5.0	93.6	1.3	S	WT	0.3	3.5	17.1	49.7	98.7	78.2	20.8	4.9	9.2
SORT= 1.19	MEDIAN=		2.00	MODE=	2.00	MEAN= 1.69	WT %	0.1	1.2	6.1	17.6	34.9	27.7	7.4	1.7	3.3
SPLIT WT= 279.6							CUM WT %	0.1	1.4	7.4	25.0	59.9	87.6	95.0	96.7	100.0
100	1.9	C	3.8	94.2	2.0	S	WT	0.9	8.4	49.0	159.3	164.9	51.4	16.7	5.1	12.8
SORT= 1.06	MEDIAN=		2.00	MODE=	2.00	MEAN= 1.14	WT %	0.2	1.8	10.5	34.0	35.2	11.0	3.6	1.1	2.7
SPLIT WT= 464.4							CUM WT %	0.2	2.0	12.4	46.4	81.6	92.6	96.2	97.3	100.0
105	1.9	C	3.8	94.1	2.1	S	WT	0.2	5.0	10.9	35.1	82.5	84.8	16.4	3.4	5.9
SORT= 1.09	MEDIAN=		2.00	MODE=	3.00	MEAN= 1.78	WT %	0.1	2.1	4.5	14.4	33.8	34.7	6.7	1.4	2.4
SPLIT WT= 241.1							CUM WT %	0.1	2.1	6.6	21.0	54.7	89.5	96.2	97.6	100.0
110	1.3	C	7.0	92.3	0.7	S	WT	0.3	1.3	7.1	23.1	61.1	94.8	30.1	6.2	10.3
SORT= 1.10	MEDIAN=		3.00	MODE=	3.00	MEAN= 2.22	WT %	0.1	0.6	3.0	9.9	26.1	40.5	12.9	2.7	4.4
SPLIT WT= 231.1							CUM WT %	0.1	0.7	3.7	13.6	39.7	80.1	93.0	95.6	100.0

D.8

WESTINGHOUSE HANFORD OPERATIONS SIEVE ANALYSIS
ROCKSAN REPORT

**** REPORT ON WELL 0299-E18-001 ****

09/20/89

DEPTH	%CACO3	DM	%MUD	%SAND	%GRAVEL	CLASS		FINE PEB (<=-2)	VFINE PEB (-1)	VERY COARS (0)	COARS (1)	MED (2)	FINE (3)	VERY FINE (4)	SILT (4.75)	PAN (>4.75)
115	1.3	C	7.1	91.7	1.1	S	WT	0.4	2.4	15.9	67.6	90.8	34.6	18.4	5.3	12.4
SORT= 1.29	MEDIAN=		2.00	MODE=	2.00	MEAN= 1.54	WT %	0.2	1.0	6.4	27.3	36.6	14.0	7.4	2.1	5.0
SPLIT WT= 243.8							CUM WT %	0.2	1.1	7.6	34.8	71.5	85.4	92.9	95.0	100.0
120	1.2	C	9.4	88.2	2.4	S	WT	0.2	7.5	35.0	110.9	70.6	41.6	19.7	7.4	22.1
SORT= 1.45	MEDIAN=		2.00	MODE=	1.00	MEAN= 1.37	WT %	0.1	2.4	11.1	35.2	22.4	13.2	6.3	2.4	7.0
SPLIT WT= 312.1							CUM WT %	0.1	2.4	13.6	48.8	71.2	84.4	90.6	93.0	100.0
125	1.4	C	2.9	94.5	2.6	S	WT	1.0	6.5	29.2	95.6	103.8	31.4	10.7	3.1	5.1
SORT= 1.02	MEDIAN=		2.00	MODE=	2.00	MEAN= 1.11	WT %	0.4	2.3	10.2	33.4	36.2	11.0	3.7	1.1	1.8
SPLIT WT= 281.8							CUM WT %	0.4	2.6	12.8	46.2	82.4	93.4	97.1	98.2	100.0
130	1.5	C	5.6	93.2	1.2	S	WT	0.1	3.4	17.9	63.4	111.1	63.3	18.7	5.2	11.3
SORT= 1.20	MEDIAN=		2.00	MODE=	2.00	MEAN= 1.59	WT %	0.0	1.2	6.1	21.5	37.7	21.5	6.4	1.8	3.8
SPLIT WT= 291.5							CUM WT %	0.0	1.2	7.3	28.8	66.5	88.0	94.4	96.2	100.0
135	1.0	C	6.0	88.0	6.0	(g)S	WT	2.7	13.9	37.8	79.6	78.0	35.1	12.1	4.5	11.9
SORT= 1.41	MEDIAN=		2.00	MODE=	1.00	MEAN= 1.11	WT %	1.0	5.0	13.7	28.9	28.3	12.7	4.4	1.6	4.3
SPLIT WT= 272.7							CUM WT %	1.0	6.0	19.7	48.6	76.9	89.7	94.1	95.7	100.0
140	1.3	C	6.4	92.7	0.9	S	WT	0.1	2.4	12.2	69.4	123.6	38.2	14.0	4.6	13.3
SORT= 1.12	MEDIAN=		2.00	MODE=	2.00	MEAN= 1.51	WT %	0.0	0.9	4.4	25.0	44.5	13.8	5.0	1.7	4.8
SPLIT WT= 273.1							CUM WT %	0.0	0.9	5.3	30.3	74.8	88.5	93.6	95.2	100.0
145	1.1	C	7.0	92.8	0.1	S	WT	0.1	0.5	1.0	27.8	268.5	107.4	30.9	10.4	22.6
SORT= 0.86	MEDIAN=		2.00	MODE=	2.00	MEAN= 1.94	WT %	0.0	0.1	0.2	5.9	57.2	22.9	6.6	2.2	4.8
SPLIT WT= 467.1							CUM WT %	0.0	0.1	0.3	6.3	63.5	86.4	93.0	95.2	100.0
150	1.4	C	4.0	95.8	0.2	S	WT	0.0	1.1	1.7	2.3	139.7	407.5	50.1	9.0	16.0
SORT= 0.63	MEDIAN=		3.00	MODE=	3.00	MEAN= 2.34	WT %	0.0	0.2	0.3	0.4	22.3	65.0	8.0	1.4	2.6
SPLIT WT= 622.9							CUM WT %	0.0	0.2	0.5	0.8	23.1	88.0	96.0	97.5	100.0
155	1.6	C	7.6	92.1	0.3	S	WT	0.1	1.2	5.6	29.0	65.4	298.9	72.7	14.3	24.7
SORT= 0.85	MEDIAN=		3.00	MODE=	3.00	MEAN= 2.54	WT %	0.0	0.2	1.1	5.7	12.8	58.4	14.2	2.8	4.8
SPLIT WT= 508.6							CUM WT %	0.0	0.3	1.3	7.0	19.8	78.2	92.4	95.2	100.0
160	1.7	C	5.4	94.3	0.4	S	WT	0.3	1.8	20.6	119.4	241.0	134.0	36.6	10.2	21.1
SORT= 1.11	MEDIAN=		2.00	MODE=	2.00	MEAN= 1.67	WT %	0.1	0.3	3.5	20.4	41.2	22.9	6.3	1.7	3.6
SPLIT WT= 582.3							CUM WT %	0.1	0.4	3.9	24.3	65.5	88.4	94.7	96.4	100.0
165	1.3	C	2.4	97.3	0.3	S	WT	0.0	1.5	10.0	117.2	259.2	125.7	22.6	4.6	8.5
SORT= 0.96	MEDIAN=		2.00	MODE=	2.00	MEAN= 1.60	WT %	0.0	0.3	1.8	21.3	47.2	22.9	4.1	0.8	1.6
SPLIT WT= 545.6							CUM WT %	0.0	0.3	2.1	23.4	70.6	93.5	97.6	98.5	100.0

WESTINGHOUSE HANFORD OPERATIONS SIEVE ANALYSIS
ROCKSAN REPORT

**** REPORT ON WELL 0299-E18-001 ****

09/20/89

DEPTH	%CACO3	DM	%MUD	%SAND	%GRAVEL	CLASS		FINE PEB (<=-2)	VFINE PEB (-1)	VERY COARS (0)	COARS (1)	MED (2)	FINE (3)	VERY FINE (4)	SILT (4.75)	PAN (>4.75)
170	1.5	C	3.6	94.1	2.2	S	WT	0.3	11.6	49.1	140.8	226.6	63.0	18.6	5.4	13.7
SORT= 1.04	MEDIAN=		2.00	MODE=	2.00	MEAN= 1.23	WT %	0.1	2.2	9.3	26.6	42.8	11.9	3.5	1.0	2.6
SPLIT WT= 524.8							CUM WT %	0.1	2.3	11.5	38.1	81.0	92.9	96.4	97.4	100.0
175	1.5	C	4.7	93.9	1.4	S	WT	0.1	3.4	16.8	70.4	102.3	35.1	10.6	3.7	8.0
SORT= 1.10	MEDIAN=		2.00	MODE=	2.00	MEAN= 1.27	WT %	0.0	1.4	6.7	28.1	40.9	14.0	4.2	1.5	3.2
SPLIT WT= 247.4							CUM WT %	0.0	1.4	8.1	36.2	77.1	91.1	95.3	96.8	100.0
180	1.3	C	4.1	95.2	0.7	S	WT	0.5	1.7	7.8	54.7	146.1	62.7	14.3	3.8	8.5
SORT= 0.98	MEDIAN=		2.00	MODE=	2.00	MEAN= 1.64	WT %	0.2	0.6	2.6	18.2	48.7	20.9	4.8	1.3	2.8
SPLIT WT= 295.7							CUM WT %	0.2	0.7	3.3	21.6	70.3	91.1	95.9	97.2	100.0
187	1.3	C	9.1	90.6	0.4	S	WT	0.0	1.4	21.0	174.7	78.8	28.5	37.3	19.0	15.1
SORT= 1.54	MEDIAN=		1.00	MODE=	1.00	MEAN= 1.49	WT %	0.0	0.4	5.6	46.5	21.0	7.6	9.9	5.1	4.0
SPLIT WT= 371.1							CUM WT %	0.0	0.4	6.0	52.5	73.4	81.0	90.9	96.0	100.0
190	1.4	C	6.1	93.7	0.3	S	WT	0.1	0.8	13.9	120.5	113.3	33.6	16.8	7.7	11.6
SORT= 1.13	MEDIAN=		2.00	MODE=	1.00	MEAN= 1.36	WT %	0.0	0.3	4.4	37.9	35.6	10.6	5.3	2.4	3.6
SPLIT WT= 315.1							CUM WT %	0.0	0.3	4.7	42.5	78.1	88.7	94.0	96.4	100.0
195	1.4	C	7.1	92.2	0.8	S	WT	0.2	2.2	11.1	96.6	112.5	45.3	16.7	6.3	15.3
SORT= 1.19	MEDIAN=		2.00	MODE=	2.00	MEAN= 1.50	WT %	0.1	0.7	3.6	31.6	36.7	14.8	5.5	2.1	5.0
SPLIT WT= 302.6							CUM WT %	0.1	0.8	4.4	36.0	72.7	87.5	93.0	95.0	100.0
200	1.5	C	15.3	84.0	0.7	(m)S	WT	0.1	2.1	7.9	34.6	83.9	66.2	65.8	14.1	32.9
SORT= 1.46	MEDIAN=		3.00	MODE=	2.00	MEAN= 2.47	WT %	0.0	0.7	2.6	11.3	27.3	21.5	21.4	4.6	10.7
SPLIT WT= 302.6							CUM WT %	0.0	0.7	3.3	14.5	41.8	63.3	84.7	89.3	100.0
205	1.3	C	9.4	90.4	0.1	S	WT	0.1	0.7	4.5	77.5	290.2	87.2	39.2	16.5	35.6
SORT= 1.03	MEDIAN=		2.00	MODE=	2.00	MEAN= 1.92	WT %	0.0	0.1	0.8	14.1	52.6	15.8	7.1	3.0	6.5
SPLIT WT= 548.4							CUM WT %	0.0	0.2	1.0	15.0	67.6	83.5	90.6	93.6	100.0
210	1.3	C	7.9	90.9	1.2	S	WT	1.4	5.5	29.0	193.6	198.0	71.3	29.8	12.1	33.4
SORT= 1.24	MEDIAN=		2.00	MODE=	2.00	MEAN= 1.45	WT %	0.2	1.0	5.1	33.7	34.5	12.4	5.2	2.1	5.8
SPLIT WT= 570.3							CUM WT %	0.2	1.2	6.3	40.0	74.5	86.9	92.1	94.2	100.0
215	1.6	C	8.2	83.7	8.1	(g)S	WT	14.2	25.9	63.7	153.4	115.9	51.4	29.8	9.7	31.1
SORT= 1.61	MEDIAN=		1.00	MODE=	1.00	MEAN= 1.13	WT %	2.9	5.2	12.9	31.0	23.4	10.4	6.0	2.0	6.3
SPLIT WT= 495.7							CUM WT %	2.9	8.1	21.0	52.0	75.4	85.7	91.8	93.7	100.0
220	0.8	C	4.9	72.5	22.6	gS	WT	63.1	83.1	127.8	193.9	86.5	39.4	21.3	8.5	22.9
SORT= 1.69	MEDIAN=		1.00	MODE=	1.00	MEAN= 0.20	WT %	9.8	12.9	19.8	30.0	13.4	6.1	3.3	1.3	3.5
SPLIT WT= 646.5							CUM WT %	9.8	22.6	42.4	72.4	85.8	91.8	95.1	96.4	100.0

WESTINGHOUSE HANFORD OPERATIONS SIEVE ANALYSIS
ROCKSAN REPORT

**** REPORT ON WELL 0299-E18-001 ****

09/20/89

DEPTH	%CACO3	DM	%MUD	%SAND	%GRAVEL	CLASS		FINE PEB (<=-2)	VFINE PEB (-1)	VERY COARS (0)	COARS (1)	MED (2)	FINE (3)	VERY FINE (4)	SILT (4.75)	PAN (>4.75)
225	0.8	C	11.4	48.4	40.2	msG	WT	186.1	91.3	77.2	70.6	72.8	62.3	50.8	25.8	53.1
SORT=	N/A	MEDIAN=	0.00	MODE=	-2.00	MEAN= N/A	WT %	27.0	13.2	11.2	10.2	10.6	9.0	7.4	3.7	7.7
SPLIT WT= 690.1							CUM WT %	27.0	40.2	51.4	61.6	72.2	81.2	88.6	92.3	100.0
230	0.7	C	9.5	51.3	39.2	msG	WT	201.3	99.7	78.9	97.8	92.7	83.8	41.2	21.4	51.8
SORT=	N/A	MEDIAN=	1.00	MODE=	-2.00	MEAN= N/A	WT %	26.2	13.0	10.3	12.7	12.1	10.9	5.4	2.8	6.7
SPLIT WT= 767.8							CUM WT %	26.2	39.2	49.4	62.2	74.2	85.1	90.5	93.3	100.0
235	0.5	H	11.0	52.8	36.2	msG	WT	169.3	98.4	74.0	112.5	83.6	64.5	55.1	22.5	58.8
SORT=	N/A	MEDIAN=	1.00	MODE=	-2.00	MEAN= N/A	WT %	22.9	13.3	10.0	15.2	11.3	8.7	7.5	3.1	8.0
SPLIT WT= 737.5							CUM WT %	22.9	36.2	46.3	61.5	72.8	81.5	89.0	92.1	100.0
240	0.5	H	12.1	43.0	44.9	msG	WT	167.5	72.5	57.7	45.7	40.7	46.4	39.3	19.9	44.5
SORT=	N/A	MEDIAN=	0.00	MODE=	-2.00	MEAN= N/A	WT %	31.4	13.6	10.8	8.6	7.6	8.7	7.4	3.7	8.3
SPLIT WT= 534.0							CUM WT %	31.4	44.9	55.7	64.3	71.9	80.6	88.0	91.7	100.0
245	0.5	H	9.5	41.8	48.7	msG	WT	236.2	112.7	75.3	65.0	64.2	50.2	44.8	13.9	54.3
SORT=	N/A	MEDIAN=	0.00	MODE=	-2.00	MEAN= N/A	WT %	33.0	15.7	10.5	9.1	9.0	7.0	6.3	1.9	7.6
SPLIT WT= 714.7							CUM WT %	33.0	48.7	59.2	68.3	77.2	84.2	90.5	92.4	100.0
250	0.6	H	6.9	37.1	56.1	msG	WT	281.2	102.3	61.4	57.8	52.2	55.9	26.2	12.1	34.8
SORT=	N/A	MEDIAN=	-1.00	MODE=	-2.00	MEAN= N/A	WT %	41.1	15.0	9.0	8.5	7.6	8.2	3.8	1.8	5.1
SPLIT WT= 681.8							CUM WT %	41.1	56.1	65.1	73.5	81.1	89.3	93.1	94.9	100.0
255	0.4	H	11.4	52.6	36.1	msG	WT	167.8	103.8	91.7	76.0	88.1	79.5	60.6	29.5	56.1
SORT=	N/A	MEDIAN=	1.00	MODE=	-2.00	MEAN= N/A	WT %	22.3	13.8	12.2	10.1	11.7	10.6	8.1	3.9	7.5
SPLIT WT= 752.1							CUM WT %	22.3	36.1	48.2	58.3	70.0	80.6	88.6	92.6	100.0
260	0.5	H	9.5	51.6	38.9	msG	WT	150.2	104.0	83.0	68.3	78.7	71.0	36.3	15.0	47.2
SORT=	N/A	MEDIAN=	0.00	MODE=	-2.00	MEAN= N/A	WT %	23.0	15.9	12.7	10.5	12.0	10.9	5.6	2.3	7.2
SPLIT WT= 651.9							CUM WT %	23.0	38.9	51.6	62.0	74.1	84.9	90.5	92.8	100.0
265	1.6	H	11.8	52.1	36.1	msG	WT	152.4	116.3	87.5	88.5	86.4	68.3	57.5	27.7	60.4
SORT=	N/A	MEDIAN=	1.00	MODE=	-2.00	MEAN= N/A	WT %	20.5	15.6	11.7	11.9	11.6	9.2	7.7	3.7	8.1
SPLIT WT= 743.6							CUM WT %	20.5	36.1	47.8	59.7	71.3	80.5	88.2	91.9	100.0
270	0.3	H	10.3	57.1	32.6	msG	WT	110.1	88.9	78.1	71.3	88.7	75.9	34.8	25.0	37.7
SORT=	N/A	MEDIAN=	1.00	MODE=	-2.00	MEAN= N/A	WT %	18.0	14.6	12.8	11.7	14.5	12.4	5.7	4.1	6.2
SPLIT WT= 608.8							CUM WT %	18.0	32.6	45.4	57.1	71.6	84.0	89.7	93.8	100.0
275	0.3	H	11.2	45.8	43.0	msG	WT	210.4	106.1	79.8	64.1	76.2	62.2	55.2	21.0	61.2
SORT=	N/A	MEDIAN=	0.00	MODE=	-2.00	MEAN= N/A	WT %	28.6	14.4	10.8	8.7	10.4	8.5	7.5	2.9	8.3
SPLIT WT= 734.4							CUM WT %	28.6	43.0	53.8	62.5	72.9	81.3	88.8	91.7	100.0

WESTINGHOUSE HANFORD OPERATIONS SIEVE ANALYSIS
ROCKSAN REPORT

**** REPORT ON WELL 0299-E18-001 ****

09/20/89

DEPTH	%CACO3	DM	%MUD	%SAND	%GRAVEL	CLASS		FINE PEB (<=-2)	VFINE PEB (-1)	VERY COARS (0)	COARS (1)	MED (2)	FINE (3)	VERY FINE (4)	SILT (4.75)	PAN (>4.75)
280	0.3	H	7.8	60.5	31.6	msG	WT	122.0	108.7	84.5	141.8	101.5	78.7	34.7	15.4	41.7
SORT=	N/A	MEDIAN=	1.00	MODE=	1.00	MEAN= N/A	WT %	16.7	14.9	11.6	19.5	13.9	10.8	4.8	2.1	5.7
SPLIT WT= 726.1							CUM WT %	16.7	31.7	43.2	62.7	76.6	87.4	92.2	94.3	100.0
285	0.4	H	8.8	63.2	28.0	(m)gS	WT	114.8	79.5	76.8	147.6	106.1	62.0	45.9	21.8	39.2
SORT=	N/A	MEDIAN=	1.00	MODE=	1.00	MEAN= N/A	WT %	16.6	11.5	11.1	21.3	15.3	8.9	6.6	3.1	5.7
SPLIT WT= 691.6							CUM WT %	16.6	28.0	39.1	60.4	75.7	84.6	91.2	94.4	100.0
290	0.3	H	9.5	49.8	40.7	msG	WT	205.0	110.3	81.8	77.8	93.9	85.3	46.4	26.3	47.0
SORT=	N/A	MEDIAN=	0.00	MODE=	-2.00	MEAN= N/A	WT %	26.5	14.3	10.6	10.1	12.1	11.0	6.0	3.4	6.1
SPLIT WT= 772.3							CUM WT %	26.5	40.7	51.3	61.4	73.5	84.5	90.5	93.9	100.0
295	0.3	H	8.2	40.1	51.7	msG	WT	204.5	168.6	102.1	69.1	42.2	42.4	33.2	14.1	44.8
SORT=	N/A	MEDIAN=	-1.00	MODE=	-2.00	MEAN= N/A	WT %	28.4	23.4	14.2	9.6	5.9	5.9	4.6	2.0	6.2
SPLIT WT= 718.2							CUM WT %	28.4	51.7	65.9	75.5	81.3	87.2	91.8	93.8	100.0
300	0.4	H	8.8	42.8	46.4	msG	WT	226.6	101.3	69.4	49.7	53.9	82.9	34.5	21.8	37.8
SORT=	N/A	MEDIAN=	0.00	MODE=	-2.00	MEAN= N/A	WT %	33.4	14.9	10.2	7.3	8.0	12.2	5.1	3.2	5.6
SPLIT WT= 675.9							CUM WT %	33.4	48.4	58.6	65.9	73.9	86.1	91.2	94.4	100.0
305	0.5	H	11.9	52.7	35.4	msG	WT	147.4	108.8	80.2	58.3	65.2	114.2	64.2	19.4	66.7
SORT=	N/A	MEDIAN=	1.00	MODE=	-2.00	MEAN= N/A	WT %	20.4	15.0	11.1	8.1	9.0	15.8	8.9	2.7	9.2
SPLIT WT= 722.4							CUM WT %	20.4	35.4	46.4	54.5	63.5	79.3	88.1	90.8	100.0
310	0.4	H	11.6	57.3	31.1	msG	WT	117.8	113.5	79.0	81.7	113.1	80.7	72.3	38.1	48.4
SORT=	2.77	MEDIAN=	1.00	MODE=	-2.00	MEAN= 0.77	WT %	15.8	15.2	10.6	11.0	15.2	10.8	9.7	5.1	6.5
SPLIT WT= 743.1							CUM WT %	15.8	31.1	41.7	52.6	67.8	78.7	88.4	93.5	100.0
315	0.2	H	8.4	64.4	27.2	(m)gS	WT	100.3	76.0	52.9	61.2	178.7	88.0	37.1	15.4	39.4
SORT=	2.41	MEDIAN=	2.00	MODE=	2.00	MEAN= 0.70	WT %	15.5	11.7	8.2	9.4	27.5	13.6	5.7	2.4	6.1
SPLIT WT= 645.4							CUM WT %	15.5	27.2	35.3	44.7	72.3	85.8	91.6	93.9	100.0
320	0.1	H	9.7	66.4	23.9	(m)gS	WT	106.5	64.6	38.5	33.2	119.6	227.5	55.8	24.6	44.6
SORT=	2.53	MEDIAN=	2.00	MODE=	3.00	MEAN= 1.09	WT %	14.9	9.0	5.4	4.6	16.7	31.8	7.8	3.4	6.2
SPLIT WT= 713.0							CUM WT %	14.9	23.9	29.3	34.0	50.7	82.5	90.3	93.8	100.0
325	0.2	H	7.2	58.5	34.3	msG	WT	164.9	75.6	51.3	36.7	164.8	106.4	49.4	12.2	38.3
SORT=	N/A	MEDIAN=	2.00	MODE=	-2.00	MEAN= N/A	WT %	23.5	10.8	7.3	5.5	23.5	15.2	7.0	1.7	5.5
SPLIT WT= 699.0							CUM WT %	23.5	34.3	41.6	47.1	70.6	85.8	92.8	94.6	100.0
330	0.2	H	6.3	44.5	49.2	msG	WT	230.7	117.5	59.9	36.8	73.5	103.5	41.5	13.0	31.4
SORT=	N/A	MEDIAN=	0.00	MODE=	-2.00	MEAN= N/A	WT %	32.6	16.6	8.5	5.2	10.4	14.6	5.9	1.8	4.4
SPLIT WT= 705.0							CUM WT %	32.6	49.2	57.7	62.9	73.2	87.9	93.7	95.6	100.0

SIEVE DATA FOR WELL 299-E18-2

WESTINGHOUSE HANFORD OPERATIONS SIEVE ANALYSIS
ROCKSAN REPORT

**** REPORT ON WELL 0299-E18-002 ****

09/21/89

DEPTH	%CAC03	DM	%MUD	%SAND	%GRAVEL	CLASS		FINE PEB (<=-2)	VFINE PEB (-1)	VERY COARS (0)	COARS (1)	MED (2)	FINE (3)	VERY FINE (4)	SILT (4.75)	PAN (>4.75)
5	3.8	C	23.5	64.1	12.4	gmS	WT	36.6	22.5	41.5	44.2	63.6	77.0	79.9	41.7	70.4
SORT= 2.61 MEDIAN= 3.00 MODE= 4.00 MEAN= 2.15							WT %	7.7	4.7	8.7	9.3	13.3	16.1	16.7	8.7	14.8
SPLIT WT= 477.6							CUM WT %	7.7	12.4	21.1	30.3	43.7	59.8	76.5	85.3	100.0
10	3.0	C	6.3	66.8	26.9	gS	WT	84.5	63.7	118.7	126.4	65.2	34.0	23.7	9.6	25.0
SORT= 2.03 MEDIAN= 1.00 MODE= 1.00 MEAN= 0.08							WT %	15.3	11.6	21.6	23.0	11.8	6.2	4.3	1.7	4.5
SPLIT WT= 549.7							CUM WT %	15.3	26.9	48.5	71.4	83.1	89.4	93.7	95.5	100.0
15	0.9	C	4.0	95.9	0.1	S	WT	0.0	0.4	7.2	63.1	219.5	125.8	25.3	6.2	12.4
SORT= 0.88 MEDIAN= 2.00 MODE= 2.00 MEAN= 1.83							WT %	0.0	0.1	1.6	13.7	47.7	27.4	5.5	1.4	2.7
SPLIT WT= 459.1							CUM WT %	0.0	0.1	1.7	15.4	63.1	90.5	96.0	97.3	100.0
20	1.8	C	1.8	97.7	0.5	S	WT	0.1	2.2	24.7	178.8	190.1	43.6	8.5	2.6	5.4
SORT= 0.83 MEDIAN= 2.00 MODE= 2.00 MEAN= 1.10							WT %	0.0	0.5	5.4	39.2	41.7	9.6	1.9	0.6	1.2
SPLIT WT= 454.4							CUM WT %	0.0	0.5	5.9	45.1	86.8	96.4	98.2	98.8	100.0
25	1.7	C	0.7	95.2	4.1	S	WT	3.4	16.4	69.6	209.6	152.5	18.6	4.0	0.8	2.4
SORT= 0.93 MEDIAN= 1.00 MODE= 1.00 MEAN= 0.73							WT %	0.7	3.4	14.6	43.9	32.0	3.9	0.8	0.2	0.5
SPLIT WT= 473.7							CUM WT %	0.7	4.2	18.7	62.6	94.6	98.5	99.3	99.5	100.0
30	2.0	C	3.9	95.2	0.9	S	WT	0.4	4.5	35.2	215.6	177.8	45.6	17.1	6.3	13.7
SORT= 0.90 MEDIAN= 2.00 MODE= 1.00 MEAN= 1.07							WT %	0.1	0.9	6.8	41.8	34.4	8.8	3.3	1.2	2.7
SPLIT WT= 515.3							CUM WT %	0.1	1.0	7.8	49.5	84.0	92.8	96.1	97.3	100.0
35	1.9	C	5.5	93.1	1.4	S	WT	3.1	4.5	48.0	291.1	100.8	34.2	18.9	7.4	21.7
SORT= 0.93 MEDIAN= 1.00 MODE= 1.00 MEAN= 0.93							WT %	0.6	0.9	9.1	55.0	19.0	6.5	3.6	1.4	4.1
SPLIT WT= 528.1							CUM WT %	0.6	1.4	10.5	65.5	84.5	91.0	94.5	95.9	100.0
40	1.9	C	1.7	96.6	1.7	S	WT	2.3	5.4	66.4	279.0	69.8	13.2	6.1	1.9	5.8
SORT= 0.69 MEDIAN= 1.00 MODE= 1.00 MEAN= 0.62							WT %	0.5	1.2	14.8	62.0	15.5	2.9	1.4	0.4	1.3
SPLIT WT= 448.5							CUM WT %	0.5	1.7	16.5	78.5	94.0	96.9	98.3	98.7	100.0
45	1.8	C	5.5	93.2	1.2	S	WT	0.6	5.5	64.1	247.9	99.7	32.8	18.1	7.1	20.4
SORT= 0.97 MEDIAN= 1.00 MODE= 1.00 MEAN= 0.92							WT %	0.1	1.1	12.9	50.0	20.1	6.6	3.7	1.4	4.1
SPLIT WT= 494.5							CUM WT %	0.1	1.2	14.2	64.1	84.2	90.8	94.5	95.9	100.0
50	1.8	C	8.7	90.7	0.7	S	WT	0.2	3.2	85.7	264.9	68.4	26.2	28.5	20.4	25.0
SORT= 1.34 MEDIAN= 1.00 MODE= 1.00 MEAN= 1.07							WT %	0.0	0.6	16.4	50.7	13.1	5.0	5.5	3.9	4.8
SPLIT WT= 521.0							CUM WT %	0.0	0.7	17.1	67.8	80.8	85.9	91.3	95.2	100.0
55	1.8	C	3.4	95.5	1.2	S	WT	0.6	4.8	23.7	111.6	218.2	67.9	15.9	4.0	11.4
SORT= 0.99 MEDIAN= 2.00 MODE= 2.00 MEAN= 1.39							WT %	0.1	1.1	5.2	24.4	47.6	14.8	3.5	0.9	2.5
SPLIT WT= 454.8							CUM WT %	0.1	1.2	6.4	30.7	78.3	93.2	96.6	97.5	100.0

WESTINGHOUSE HANFORD OPERATIONS SIEVE ANALYSIS
ROCKSAN REPORT

**** REPORT ON WELL 0299-E18-002 ****

09/21/89

DEPTH	%CACO3	DM	%MUD	%SAND	%GRAVEL	CLASS		FINE PEB (<=-2)	VFINE PEB (-1)	VERY COARS (0)	COARS (1)	MED (2)	FINE (3)	VERY FINE (4)	SILT (4.75)	PAN (>4.75)
60	1.8	C	3.3	95.8	0.9	S	WT	0.2	4.2	53.3	220.7	143.9	32.5	14.0	4.9	11.2
SORT= 0.90	MEDIAN=		1.00	MODE=	1.00	MEAN= 0.94	WT %	0.0	0.9	11.0	45.5	29.7	6.7	2.9	1.0	2.3
SPLIT WT= 482.9							CUM WT %	0.0	0.9	11.9	57.4	87.1	93.8	96.7	97.7	100.0
65	1.7	C	3.4	95.8	0.8	S	WT	0.6	3.2	82.9	252.0	107.6	24.2	11.8	4.6	12.6
SORT= 0.91	MEDIAN=		1.00	MODE=	1.00	MEAN= 0.77	WT %	0.1	0.6	16.6	50.5	21.5	4.8	2.4	0.9	2.5
SPLIT WT= 498.4							CUM WT %	0.1	0.8	17.4	67.8	89.4	94.2	96.6	97.5	100.0
70	1.9	C	2.6	93.4	4.0	S	WT	3.4	14.6	64.3	231.3	96.1	19.4	8.6	3.3	8.5
SORT= 0.91	MEDIAN=		1.00	MODE=	1.00	MEAN= 0.71	WT %	0.8	3.3	14.3	51.5	21.4	4.3	1.9	0.7	1.9
SPLIT WT= 445.9							CUM WT %	0.8	4.0	18.3	69.8	91.2	95.5	97.4	98.1	100.0
75	1.8	C	2.5	97.3	0.2	S	WT	0.0	1.2	42.5	280.5	135.7	23.3	9.5	2.9	9.5
SORT= 0.80	MEDIAN=		1.00	MODE=	1.00	MEAN= 0.87	WT %	0.0	0.2	8.4	55.5	26.9	4.6	1.9	0.6	1.9
SPLIT WT= 503.2							CUM WT %	0.0	0.2	8.7	64.2	91.1	95.7	97.5	98.1	100.0
80	1.6	C	3.3	96.2	0.5	S	WT	0.0	2.2	40.6	193.6	142.1	32.5	11.6	3.6	10.7
SORT= 0.89	MEDIAN=		1.00	MODE=	1.00	MEAN= 0.99	WT %	0.0	0.5	9.3	44.3	32.5	7.4	2.7	0.8	2.5
SPLIT WT= 435.5							CUM WT %	0.0	0.5	9.8	54.1	86.6	94.1	96.7	97.5	100.0
84	1.9	C	31.1	68.2	0.7	mS	WT	0.1	3.2	15.2	22.0	48.3	94.5	142.8	64.4	82.7
SORT= 1.52	MEDIAN=		4.00	MODE=	4.00	MEAN= 3.29	WT %	0.0	0.7	3.2	4.7	10.2	20.0	30.2	13.6	17.5
SPLIT WT= 471.0							CUM WT %	0.0	0.7	3.9	8.6	18.8	38.7	68.9	82.5	100.0
85	1.8	C	7.4	91.4	1.2	S	WT	0.0	5.6	107.6	181.8	78.2	27.7	29.2	15.8	18.4
SORT= 1.48	MEDIAN=		1.00	MODE=	1.00	MEAN= 0.97	WT %	0.0	1.2	23.2	39.2	16.8	6.0	6.3	3.4	4.0
SPLIT WT= 464.8							CUM WT %	0.0	1.2	24.4	63.5	80.4	86.4	92.6	96.0	100.0
90	1.6	C	2.1	96.1	1.8	S	WT	0.1	7.8	45.4	176.1	155.6	30.0	9.0	2.5	6.7
SORT= 0.88	MEDIAN=		1.00	MODE=	1.00	MEAN= 0.96	WT %	0.0	1.8	10.5	40.7	35.9	6.9	2.1	0.6	1.6
SPLIT WT= 432.1							CUM WT %	0.0	1.8	12.3	53.0	88.9	95.8	97.9	98.5	100.0
95	1.7	C	4.0	95.4	0.6	S	WT	0.1	2.7	16.3	70.4	175.3	125.8	24.1	5.4	11.8
SORT= 1.03	MEDIAN=		2.00	MODE=	2.00	MEAN= 1.74	WT %	0.0	0.6	3.8	16.3	40.6	29.1	5.6	1.3	2.7
SPLIT WT= 431.9							CUM WT %	0.0	0.7	4.4	20.7	61.3	90.4	96.0	97.3	100.0
99	1.7	C	32.8	67.2	0.0	mS	WT	0.0	0.1	0.7	1.0	3.2	16.1	383.3	106.8	90.4
SORT= 0.75	MEDIAN=		4.00	MODE=	4.00	MEAN= 3.88	WT %	0.0	0.0	0.1	0.2	0.5	2.7	63.7	17.8	15.0
SPLIT WT= 601.2							CUM WT %	0.0	0.0	0.1	0.3	0.8	3.5	67.2	85.0	100.0
100	1.8	C	6.3	93.2	0.5	S	WT	0.0	2.3	25.5	121.8	162.6	64.7	25.6	8.8	18.2
SORT= 1.20	MEDIAN=		2.00	MODE=	2.00	MEAN= 1.50	WT %	0.0	0.5	5.9	28.4	37.9	15.1	6.0	2.1	4.2
SPLIT WT= 428.2							CUM WT %	0.0	0.5	6.5	34.8	72.7	87.8	93.7	95.8	100.0

WESTINGHOUSE HANFORD OPERATIONS SIEVE ANALYSIS
ROCKSAN REPORT

**** REPORT ON WELL 0299-E18-002 ****

09/21/89

DEPTH	%CACO3	DM	%MUD	%SAND	%GRAVEL	CLASS		FINE PEB (<=-2)	VFINE PEB (-1)	VERY COARS (0)	COARS (1)	MED (2)	FINE (3)	VERY FINE (4)	SILT (4.75)	PAN (>4.75)
105	1.7	C	2.8	96.5	0.6	S	WT	0.0	3.0	27.5	136.0	198.2	77.6	15.5	4.1	9.3
SORT= 1.03	MEDIAN=		2.00	MODE=	2.00	MEAN= 1.36	WT %	0.0	0.6	5.8	28.9	42.1	16.5	3.3	0.9	2.0
SPLIT WT= 469.7							CUM WT %	0.0	0.6	6.5	35.3	77.4	93.9	97.2	98.0	100.0
109	1.3	C	20.9	79.1	0.0	mS	WT	0.0	0.0	0.7	1.8	8.5	74.1	328.2	57.1	52.4
SORT= 0.68	MEDIAN=		4.00	MODE=	4.00	MEAN= 3.62	WT %	0.0	0.0	0.1	0.3	1.6	14.2	62.8	10.9	10.0
SPLIT WT= 524.5							CUM WT %	0.0	0.0	0.1	0.5	2.1	16.3	79.1	90.0	100.0
110	1.5	C	10.5	89.4	0.1	(m)S	WT	0.0	0.3	1.8	12.9	43.3	223.7	172.6	20.0	33.3
SORT= 0.87	MEDIAN=		3.00	MODE=	3.00	MEAN= 2.94	WT %	0.0	0.1	0.4	2.5	8.5	44.0	34.0	3.9	6.6
SPLIT WT= 509.6							CUM WT %	0.0	0.1	0.4	3.0	11.5	55.5	89.5	93.4	100.0
115	1.5	C	3.6	95.5	0.8	S	WT	0.2	3.3	22.3	147.8	172.5	48.4	13.6	4.2	11.2
SORT= 0.96	MEDIAN=		2.00	MODE=	2.00	MEAN= 1.23	WT %	0.1	0.8	5.3	34.9	40.7	11.4	3.2	1.0	2.6
SPLIT WT= 421.5							CUM WT %	0.1	0.8	6.1	41.0	81.7	93.2	96.4	97.4	100.0
120	1.5	C	17.4	82.5	0.1	(m)S	WT	0.0	0.6	2.0	17.4	45.1	113.6	196.9	39.5	39.4
SORT= 1.02	MEDIAN=		4.00	MODE=	4.00	MEAN= 3.15	WT %	0.0	0.1	0.4	3.6	9.9	25.0	43.3	8.7	8.7
SPLIT WT= 454.1							CUM WT %	0.0	0.1	0.6	4.4	14.3	39.3	82.6	91.3	100.0
125	1.4	C	8.0	91.2	0.8	S	WT	0.2	2.3	22.4	61.5	70.1	87.8	35.9	8.5	15.9
SORT= 1.46	MEDIAN=		2.00	MODE=	3.00	MEAN= 1.88	WT %	0.1	0.8	7.4	20.2	23.0	28.8	11.8	2.8	5.2
SPLIT WT= 304.8							CUM WT %	0.1	0.8	8.2	28.4	51.4	80.2	92.0	94.8	100.0
130	1.6	C	4.7	94.5	0.8	S	WT	0.0	3.4	17.7	94.0	166.3	99.2	20.9	5.8	13.9
SORT= 1.12	MEDIAN=		2.00	MODE=	2.00	MEAN= 1.60	WT %	0.0	0.8	4.2	22.3	39.5	23.6	5.0	1.4	3.3
SPLIT WT= 420.4							CUM WT %	0.0	0.8	5.0	27.3	66.8	90.4	95.3	96.7	100.0
135	1.4	C	8.2	91.7	0.1	S	WT	0.0	0.5	2.0	12.3	124.7	154.4	35.8	8.6	20.7
SORT= 0.93	MEDIAN=		3.00	MODE=	3.00	MEAN= 2.27	WT %	0.0	0.1	0.6	3.4	34.7	43.0	10.0	2.4	5.8
SPLIT WT= 358.1							CUM WT %	0.0	0.1	0.7	4.1	38.9	81.9	91.9	94.3	100.0
140	1.4	C	5.6	93.4	1.0	S	WT	0.1	4.4	45.6	182.1	140.9	41.7	19.3	7.0	18.7
SORT= 1.09	MEDIAN=		1.00	MODE=	1.00	MEAN= 1.15	WT %	0.0	1.0	9.9	39.6	30.6	9.1	4.2	1.5	4.1
SPLIT WT= 458.9							CUM WT %	0.0	1.0	10.9	50.5	81.1	90.2	94.4	95.9	100.0
145	1.0	C	3.9	96.0	0.1	S	WT	0.0	0.4	1.3	72.8	237.0	76.8	17.1	5.0	11.6
SORT= 0.83	MEDIAN=		2.00	MODE=	2.00	MEAN= 1.68	WT %	0.0	0.1	0.3	17.3	56.2	18.2	4.1	1.2	2.8
SPLIT WT= 421.0							CUM WT %	0.0	0.1	0.4	17.7	73.8	92.0	96.1	97.2	100.0
150	1.3	C	7.0	93.0	0.0	S	WT	0.0	0.1	0.5	1.9	125.6	180.7	30.9	8.0	17.5
SORT= 0.77	MEDIAN=		3.00	MODE=	3.00	MEAN= 2.25	WT %	0.0	0.0	0.1	0.5	34.4	49.5	8.5	2.2	4.8
SPLIT WT= 363.9							CUM WT %	0.0	0.0	0.2	0.7	35.1	84.6	93.0	95.2	100.0

WESTINGHOUSE HANFORD OPERATIONS SIEVE ANALYSIS
ROCKSAN REPORT

**** REPORT ON WELL 0299-E18-002 ****

09/21/89

DEPTH	%CACO3	DM	%MUD	%SAND	%GRAVEL	CLASS		FINE PEB (<=-2)	VFINE PEB (-1)	VERY COARS (0)	COARS (1)	MED (2)	FINE (3)	VERY FINE (4)	SILT (4.75)	PAN (>4.75)
155	1.3	C	8.1	91.8	0.1	S	WT	0.0	0.4	0.7	4.1	101.7	227.3	39.0	10.5	22.3
SORT= 0.79	MEDIAN=		3.00	MODE=	3.00	MEAN= 2.39	WT %	0.0	0.1	0.2	1.0	25.1	56.0	9.6	2.6	5.5
SPLIT WT= 404.6							CUM WT %	0.0	0.1	0.3	1.3	26.3	82.3	91.9	94.5	100.0
160	1.5	C	22.7	77.0	0.3	mS	WT	0.0	1.7	10.9	23.5	23.6	173.7	181.2	31.8	89.7
SORT= 1.30	MEDIAN=		4.00	MODE=	4.00	MEAN= 3.37	WT %	0.0	0.3	2.0	4.4	4.4	32.4	33.8	5.9	16.7
SPLIT WT= 537.7							CUM WT %	0.0	0.3	2.4	6.7	11.1	43.5	77.3	83.3	100.0
165	1.4	C	4.6	95.3	0.1	S	WT	0.0	0.2	4.5	35.9	77.2	41.7	9.7	2.6	5.5
SORT= 1.04	MEDIAN=		2.00	MODE=	2.00	MEAN= 1.68	WT %	0.0	0.1	2.5	20.3	43.5	23.5	5.5	1.5	3.1
SPLIT WT= 176.8							CUM WT %	0.0	0.1	2.7	22.9	66.4	90.0	95.4	96.9	100.0
170	1.4	C	7.8	91.9	0.2	S	WT	0.0	0.4	1.1	4.9	46.1	100.2	23.6	4.6	10.4
SORT= 0.91	MEDIAN=		3.00	MODE=	3.00	MEAN= 2.43	WT %	0.0	0.2	0.6	2.6	24.1	52.4	12.3	2.4	5.4
SPLIT WT= 191.0							CUM WT %	0.0	0.2	0.8	3.4	27.5	79.8	92.2	94.6	100.0
175	1.1	C	5.3	93.7	1.0	S	WT	0.0	3.8	41.9	128.2	133.2	44.8	16.3	5.7	14.9
SORT= 1.15	MEDIAN=		2.00	MODE=	2.00	MEAN= 1.24	WT %	0.0	1.0	10.8	33.0	34.3	11.5	4.2	1.5	3.8
SPLIT WT= 389.3							CUM WT %	0.0	1.0	11.8	44.7	79.0	90.5	94.7	96.2	100.0
180	1.3	C	5.7	92.3	2.1	S	WT	0.5	7.1	22.7	111.7	136.4	51.3	17.6	6.0	14.9
SORT= 1.17	MEDIAN=		2.00	MODE=	2.00	MEAN= 1.39	WT %	0.1	1.9	6.2	30.3	37.1	13.9	4.8	1.6	4.1
SPLIT WT= 368.7							CUM WT %	0.1	2.1	8.2	38.6	75.6	89.6	94.3	96.0	100.0
185	1.4	C	9.0	90.1	0.9	S	WT	0.0	3.2	19.9	111.9	118.7	43.9	26.3	9.9	22.2
SORT= 1.38	MEDIAN=		2.00	MODE=	2.00	MEAN= 1.57	WT %	0.0	0.9	5.6	31.4	33.3	12.3	7.4	2.8	6.2
SPLIT WT= 356.9							CUM WT %	0.0	0.9	6.5	37.9	71.3	83.6	91.0	93.8	100.0
190	1.0	C	4.0	96.0	0.1	S	WT	0.0	0.3	15.8	175.5	147.6	39.1	13.9	4.7	11.5
SORT= 0.91	MEDIAN=		2.00	MODE=	1.00	MEAN= 1.16	WT %	0.0	0.1	3.9	43.0	36.1	9.6	3.4	1.2	2.8
SPLIT WT= 408.8							CUM WT %	0.0	0.1	3.9	46.9	83.1	92.6	96.0	97.2	100.0
195	1.2	C	11.2	88.6	0.2	(m)S	WT	0.0	0.9	15.4	174.3	113.1	50.1	40.7	20.0	29.8
SORT= 1.56	MEDIAN=		2.00	MODE=	1.00	MEAN= 1.69	WT %	0.0	0.2	3.5	39.2	25.5	11.3	9.2	4.5	6.7
SPLIT WT= 447.1							CUM WT %	0.0	0.2	3.7	42.9	68.4	79.6	88.8	93.3	100.0
200	1.8	C	4.2	94.7	1.1	S	WT	0.7	4.3	33.3	143.9	166.0	63.5	19.3	5.1	13.6
SORT= 1.12	MEDIAN=		2.00	MODE=	2.00	MEAN= 1.32	WT %	0.2	1.0	7.4	32.0	36.9	14.1	4.3	1.1	3.0
SPLIT WT= 450.6							CUM WT %	0.2	1.1	8.5	40.5	77.4	91.6	95.8	97.0	100.0
205	0.9	C	4.1	94.2	1.7	S	WT	0.5	6.5	29.1	146.3	157.6	40.8	14.6	4.7	12.3
SORT= 0.98	MEDIAN=		2.00	MODE=	2.00	MEAN= 1.17	WT %	0.1	1.6	7.1	35.5	38.2	9.9	3.5	1.1	3.0
SPLIT WT= 412.2							CUM WT %	0.1	1.7	8.8	44.2	82.5	92.4	95.9	97.0	100.0

WESTINGHOUSE HANFORD OPERATIONS SIEVE ANALYSIS
ROCKSAN REPORT

**** REPORT ON WELL 0299-E16-002 ****

09/21/89

DEPTH	%CACO3	DM	%MUD	%SAND	%GRAVEL	CLASS		FINE PEB (<=-2)	VFINE PEB (-1)	VERY COARS (0)	COARS (1)	MED (2)	FINE (3)	VERY FINE (4)	SILT (4.75)	PAN (>4.75)
210	1.0	C	5.0	94.4	0.6	S	WT	0.6	2.1	11.9	86.7	197.5	60.3	20.6	6.2	14.7
SORT= 1.03	MEDIAN=		2.00	MODE=	2.00	MEAN= 1.61	WT %	0.1	0.5	2.8	20.6	47.0	19.1	4.9	1.5	3.5
SPLIT WT= 421.2							CUM WT %	0.1	0.6	3.5	24.1	71.0	90.1	95.0	96.5	100.0
215	0.8	C	5.6	94.3	0.0	S	WT	0.0	0.2	8.0	78.9	251.9	83.3	24.5	6.7	20.0
SORT= 0.92	MEDIAN=		2.00	MODE=	2.00	MEAN= 1.72	WT %	0.0	0.0	1.7	16.7	53.2	17.6	5.2	1.4	4.2
SPLIT WT= 474.1							CUM WT %	0.0	0.0	1.7	18.4	71.6	89.2	94.4	95.8	100.0
220	0.9	C	5.7	94.3	0.0	S	WT	0.0	0.0	9.1	69.6	210.0	76.7	21.6	7.0	16.5
SORT= 0.96	MEDIAN=		2.00	MODE=	2.00	MEAN= 1.71	WT %	0.0	0.0	2.2	17.0	51.2	18.7	5.3	1.7	4.0
SPLIT WT= 410.7							CUM WT %	0.0	0.0	2.2	19.2	70.3	89.0	94.3	96.0	100.0
225	1.0	C	6.6	93.4	0.0	S	WT	0.0	0.0	0.5	22.6	245.2	98.5	23.5	7.8	19.6
SORT= 0.83	MEDIAN=		2.00	MODE=	2.00	MEAN= 1.93	WT %	0.0	0.0	0.1	5.4	58.7	23.6	5.6	1.9	4.7
SPLIT WT= 418.8							CUM WT %	0.0	0.0	0.1	5.5	64.2	87.8	93.4	95.3	100.0
230	1.1	C	7.3	92.4	0.4	S	WT	0.4	1.4	18.1	146.0	175.9	102.5	32.3	10.9	26.5
SORT= 1.22	MEDIAN=		2.00	MODE=	2.00	MEAN= 1.61	WT %	0.1	0.3	3.5	28.4	34.2	19.9	6.3	2.1	5.2
SPLIT WT= 515.8							CUM WT %	0.1	0.4	3.9	32.3	66.5	86.4	92.7	94.8	100.0
234	7.8	C	7.9	66.9	25.2	(m)gS	WT	24.4	35.3	36.9	36.2	43.6	26.7	15.2	5.2	13.4
SORT= 2.23	MEDIAN=		1.00	MODE=	2.00	MEAN= 0.61	WT %	10.3	14.9	15.6	15.3	18.4	11.3	6.4	2.2	5.7
SPLIT WT= 237.1							CUM WT %	10.3	25.2	40.8	56.1	74.5	85.7	92.2	94.4	100.0
235	5.0	C	7.4	77.4	15.2	gS	WT	27.0	40.2	47.6	89.5	120.9	59.7	25.4	9.7	23.2
SORT= 1.85	MEDIAN=		2.00	MODE=	2.00	MEAN= 1.00	WT %	6.1	9.1	10.7	20.2	27.3	13.5	5.7	2.2	5.2
SPLIT WT= 442.7							CUM WT %	6.1	15.2	25.9	46.1	73.4	86.8	92.6	94.8	100.0
240	1.5	H	6.9	51.5	41.6	msG	WT	163.7	114.3	79.6	99.9	79.1	53.0	33.0	10.7	35.6
SORT= N/A	MEDIAN=		0.00	MODE=	-2.00	MEAN= N/A	WT %	24.5	17.1	11.9	14.9	11.8	7.9	4.9	1.6	5.3
SPLIT WT= 668.9							CUM WT %	24.5	41.6	53.5	68.4	80.2	88.1	93.1	94.7	100.0
245	0.3	H	7.8	33.1	59.1	msG	WT	247.7	211.8	91.0	49.5	38.8	48.3	29.8	19.4	41.4
SORT= N/A	MEDIAN=		-1.00	MODE=	-2.00	MEAN= N/A	WT %	31.9	27.2	11.7	6.4	5.0	6.2	3.8	2.5	5.3
SPLIT WT= 775.8							CUM WT %	31.9	59.1	70.8	77.1	82.1	88.3	92.2	94.7	100.0
250	0.4	H	8.8	34.8	56.4	msG	WT	247.5	206.4	94.9	55.9	43.7	43.9	41.9	13.6	56.9
SORT= N/A	MEDIAN=		-1.00	MODE=	-2.00	MEAN= N/A	WT %	30.8	25.7	11.8	7.0	5.4	5.5	5.2	1.7	7.1
SPLIT WT= 803.0							CUM WT %	30.8	56.4	68.2	75.2	80.6	86.0	91.3	92.9	100.0
255	0.2	H	8.0	41.5	50.5	msG	WT	178.1	215.2	127.1	73.9	44.9	39.2	38.6	12.0	50.2
SORT= N/A	MEDIAN=		-1.00	MODE=	-1.00	MEAN= N/A	WT %	22.9	27.6	16.3	9.5	5.8	5.0	5.0	1.5	6.4
SPLIT WT= 777.2							CUM WT %	22.9	50.5	66.8	76.3	82.0	87.1	92.0	93.6	100.0

WESTINGHOUSE HANFORD OPERATIONS SIEVE ANALYSIS
ROCKSAN REPORT

**** REPORT ON WELL 0299-E18-002 ****

09/21/89

DEPTH	%CACO3	DM	%MUD	%SAND	%GRAVEL	CLASS		FINE PEB (<=-2)	VFINE PEB (-1)	VERY COARS (0)	COARS (1)	MED (2)	FINE (3)	VERY FINE (4)	SILT (4.75)	PAN (>4.75)
260	0.4	H	8.0	34.9	57.1	msG	WT	274.9	165.1	79.3	50.1	51.1	56.8	31.4	21.7	39.8
SORT=	N/A	MEDIAN=	-1.00	MODE=	-2.00	MEAN= N/A	WT %	35.7	21.4	10.3	6.5	6.6	7.4	4.1	2.8	5.2
SPLIT WT= 766.1							CUM WT %	35.7	57.1	67.4	73.9	80.6	87.9	92.0	94.8	100.0
265	0.4	H	13.1	44.0	43.0	msG	WT	191.7	128.0	77.8	65.5	68.5	60.3	55.0	25.9	71.5
SORT=	N/A	MEDIAN=	0.00	MODE=	-2.00	MEAN= N/A	WT %	25.8	17.2	10.5	8.8	9.2	8.1	7.4	3.5	9.6
SPLIT WT= 742.1							CUM WT %	25.8	43.0	53.4	62.2	71.4	79.5	86.9	90.4	100.0
270	0.4	H	8.3	55.1	36.6	msG	WT	132.1	129.0	88.8	107.8	86.8	71.3	38.0	15.6	43.8
SORT=	N/A	MEDIAN=	1.00	MODE=	-2.00	MEAN= N/A	WT %	18.5	18.1	12.5	15.1	12.2	10.0	5.3	2.2	6.1
SPLIT WT= 711.5							CUM WT %	18.5	36.6	49.1	64.2	76.3	86.3	91.7	93.9	100.0
275	0.2	H	8.7	41.2	50.1	msG	WT	212.2	157.6	110.7	62.2	51.4	41.9	37.9	19.6	44.5
SORT=	N/A	MEDIAN=	-1.00	MODE=	-2.00	MEAN= N/A	WT %	28.8	21.4	15.0	8.4	7.0	5.7	5.1	2.7	6.0
SPLIT WT= 733.7							CUM WT %	28.8	50.1	65.1	73.5	80.5	86.2	91.3	94.0	100.0
280	0.3	H	7.8	40.3	51.9	msG	WT	217.3	139.8	77.3	59.7	54.0	55.8	30.5	13.3	40.1
SORT=	N/A	MEDIAN=	-1.00	MODE=	-2.00	MEAN= N/A	WT %	31.6	20.3	11.2	8.7	7.9	8.1	4.4	1.9	5.8
SPLIT WT= 685.2							CUM WT %	31.6	51.9	63.2	71.8	79.7	87.8	92.2	94.2	100.0
285	0.4	H	13.0	47.5	39.5	msG	WT	155.6	93.9	65.8	54.3	69.5	57.5	53.2	30.4	52.0
SORT=	N/A	MEDIAN=	1.00	MODE=	-2.00	MEAN= N/A	WT %	24.6	14.9	10.4	8.6	11.0	9.1	8.4	4.8	8.2
SPLIT WT= 631.2							CUM WT %	24.6	39.5	49.9	58.5	69.5	78.6	87.0	91.8	100.0
290	0.3	H	8.1	39.4	52.5	msG	WT	216.3	162.8	86.2	54.2	53.7	58.2	32.6	13.0	45.2
SORT=	N/A	MEDIAN=	-1.00	MODE=	-2.00	MEAN= N/A	WT %	30.0	22.5	11.9	7.5	7.4	8.1	4.5	1.8	6.3
SPLIT WT= 718.3							CUM WT %	30.0	52.5	64.4	71.9	79.4	87.4	91.9	93.7	100.0
295	0.4	H	11.1	45.8	43.1	msG	WT	150.2	95.1	56.3	53.0	63.2	51.4	36.7	16.0	47.2
SORT=	N/A	MEDIAN=	0.00	MODE=	-2.00	MEAN= N/A	WT %	26.4	16.7	9.9	9.3	11.1	9.0	6.5	2.8	8.3
SPLIT WT= 567.3							CUM WT %	26.4	43.1	53.0	62.3	73.4	82.4	88.9	91.7	100.0
300	0.4	H	9.9	56.1	34.0	msG	WT	136.5	114.6	76.7	69.4	122.2	103.1	43.9	40.6	32.7
SORT=	N/A	MEDIAN=	1.00	MODE=	-2.00	MEAN= N/A	WT %	18.5	15.5	10.4	9.4	16.5	13.9	5.9	5.5	4.4
SPLIT WT= 737.7							CUM WT %	18.5	34.0	44.3	53.7	70.2	84.2	90.1	95.6	100.0
305	0.5	H	11.8	50.6	37.6	msG	WT	160.0	130.5	89.9	76.0	81.2	76.5	66.6	30.2	61.0
SORT=	N/A	MEDIAN=	1.00	MODE=	-2.00	MEAN= N/A	WT %	20.7	16.9	11.7	9.9	10.5	9.9	8.6	3.9	7.9
SPLIT WT= 767.3							CUM WT %	20.7	37.6	49.3	59.1	69.7	79.6	88.2	92.1	100.0
310	0.3	H	9.9	54.5	35.5	msG	WT	156.2	103.5	69.3	95.9	99.8	94.4	38.9	28.6	44.1
SORT=	N/A	MEDIAN=	1.00	MODE=	-2.00	MEAN= N/A	WT %	21.4	14.2	9.5	13.1	13.7	12.9	5.3	3.9	6.0
SPLIT WT= 728.3							CUM WT %	21.4	35.5	45.0	58.1	71.8	84.7	90.0	94.0	100.0

WESTINGHOUSE HANFORD OPERATIONS SIEVE ANALYSIS
ROCKSAN REPORT

**** REPORT ON WELL 0299-E18-002 ****

09/21/89

DEPTH	%CACO3	DM	%MUD	%SAND	%GRAVEL	CLASS		FINE PEB (<=-2)	VFINE PEB (-1)	VERY COARS (0)	COARS (1)	MED (2)	FINE (3)	VERY FINE (4)	SILT (4.75)	PAN (>4.75)
315	0.5	H	10.1	59.2	30.8	msG	WT	136.0	103.3	60.5	60.0	176.9	104.9	58.0	29.8	48.5
SORT=	N/A	MEDIAN=	2.00	MODE=	2.00	MEAN= N/A	WT %	17.5	13.3	7.8	7.7	22.7	13.5	7.5	3.8	6.2
SPLIT WT= 774.6							CUM WT %	17.5	30.8	38.5	46.3	69.0	82.5	89.9	93.8	100.0
320	0.3	H	9.5	53.2	37.3	msG	WT	132.0	137.7	84.0	65.8	89.5	96.3	49.0	19.1	49.2
SORT=	N/A	MEDIAN=	1.00	MODE=	-1.00	MEAN= N/A	WT %	18.3	19.1	11.6	9.1	12.4	13.3	6.8	2.6	6.8
SPLIT WT= 719.3							CUM WT %	18.3	37.3	49.0	58.1	70.5	83.8	90.6	93.1	100.0
325	0.1	H	9.4	79.5	11.2	(m)gS	WT	34.5	43.0	38.4	88.8	176.4	178.6	68.9	20.6	44.4
SORT=	1.73	MEDIAN=	2.00	MODE=	3.00	MEAN= 1.67	WT %	5.0	6.2	5.5	12.8	25.4	25.8	9.9	3.0	6.4
SPLIT WT= 692.0							CUM WT %	5.0	11.2	16.7	29.5	54.9	80.7	90.6	93.6	100.0
330	0.1	H	5.3	89.4	5.3	(g)S	WT	5.5	29.4	110.1	187.0	188.4	78.3	28.9	10.1	25.0
SORT=	1.40	MEDIAN=	1.00	MODE=	2.00	MEAN= 1.04	WT %	0.8	4.4	16.6	28.2	28.4	11.8	4.4	1.5	3.8
SPLIT WT= 660.4							CUM WT %	0.8	5.3	21.9	50.1	78.5	90.4	94.7	96.2	100.0

SIEVE DATA FOR WELL 299-E18-3

WESTINGHOUSE HANFORD OPERATIONS SIEVE ANALYSIS
ROCKSAN REPORT

**** REPORT ON WELL 0299-E18-003 ****

09/21/89

DEPTH	%CACO3	DM	%MUD	%SAND	%GRAVEL	CLASS		FINE PEB (<=-2)	VFINE PEB (-1)	VERY COARS (0)	COARS (1)	MED (2)	FINE (3)	VERY FINE (4)	SILT (4.75)	PAN (>4.75)
5	0.6	C	13.9	84.0	2.0	(m)S	WT	2.9	7.1	16.4	37.7	53.6	153.3	149.6	34.0	34.0
SORT= 1.33 MEDIAN= 3.00 MODE= 3.00 MEAN= 2.67							WT %	0.6	1.5	3.4	7.7	11.0	31.4	30.6	7.0	7.0
SPLIT WT= 484.4							CUM WT %	0.6	2.0	5.4	13.1	24.1	55.5	86.1	93.1	100.0
10	1.4	C	9.2	76.3	14.6	(m)gS	WT	35.5	34.4	68.7	111.5	88.7	51.8	44.7	18.5	25.4
SORT= 2.08 MEDIAN= 1.00 MODE= 1.00 MEAN= 1.09							WT %	7.4	7.2	14.3	23.3	18.5	10.8	9.3	3.9	5.3
SPLIT WT= 474.6							CUM WT %	7.4	14.6	28.9	52.2	70.7	81.5	90.9	94.7	100.0
15	1.6	C	1.7	96.4	1.9	S	WT	2.1	7.0	63.5	278.1	90.4	14.0	6.2	2.2	5.8
SORT= 0.73 MEDIAN= 1.00 MODE= 1.00 MEAN= 0.69							WT %	0.5	1.5	13.5	59.3	19.3	3.0	1.3	0.5	1.2
SPLIT WT= 464.4							CUM WT %	0.5	1.9	15.5	74.7	94.0	97.0	98.3	98.8	100.0
20	1.5	C	2.6	95.9	1.5	S	WT	1.6	6.0	67.4	232.5	147.6	31.7	11.3	3.8	9.4
SORT= 0.90 MEDIAN= 1.00 MODE= 1.00 MEAN= 0.88							WT %	0.3	1.2	13.2	45.5	28.9	6.2	2.2	0.7	1.8
SPLIT WT= 511.8							CUM WT %	0.3	1.5	14.7	60.1	89.0	95.2	97.4	98.2	100.0
25	1.3	C	7.1	90.9	2.1	S	WT	3.5	7.0	55.0	181.5	93.6	70.9	56.0	13.3	22.2
SORT= 1.56 MEDIAN= 2.00 MODE= 1.00 MEAN= 1.44							WT %	0.7	1.4	10.9	36.1	18.6	14.1	11.1	2.6	4.4
SPLIT WT= 503.7							CUM WT %	0.7	2.1	13.0	49.1	67.7	81.8	92.9	95.6	100.0
30	1.8	C	8.3	90.5	1.3	S	WT	1.7	6.3	33.4	263.0	157.8	68.4	47.3	17.4	34.5
SORT= 1.38 MEDIAN= 2.00 MODE= 1.00 MEAN= 1.43							WT %	0.3	1.0	5.3	41.8	25.1	10.9	7.5	2.8	5.5
SPLIT WT= 631.2							CUM WT %	0.3	1.3	6.6	48.3	73.4	84.2	91.7	94.5	100.0
35	1.7	C	4.7	94.3	1.1	S	WT	0.0	4.5	23.3	89.3	162.8	100.7	24.9	6.0	13.9
SORT= 1.16 MEDIAN= 2.00 MODE= 2.00 MEAN= 1.60							WT %	0.0	1.1	5.5	21.0	38.3	23.7	5.9	1.4	3.3
SPLIT WT= 423.9							CUM WT %	0.0	1.1	6.5	27.5	65.8	89.5	95.3	96.7	100.0
40	1.9	C	5.8	93.3	1.0	S	WT	1.0	3.7	45.0	231.6	106.6	50.5	21.2	8.7	19.4
SORT= 1.15 MEDIAN= 1.00 MODE= 1.00 MEAN= 1.13							WT %	0.2	0.8	9.2	47.5	21.9	10.4	4.4	1.8	4.0
SPLIT WT= 487.4							CUM WT %	0.2	1.0	10.2	57.7	79.6	89.9	94.3	96.0	100.0
45	1.5	C	5.0	94.4	0.6	S	WT	0.6	2.7	24.9	223.0	135.8	38.9	20.2	8.1	18.6
SORT= 0.90 MEDIAN= 1.00 MODE= 1.00 MEAN= 1.02							WT %	0.1	0.5	4.7	53.1	25.5	7.3	3.8	1.5	3.5
SPLIT WT= 531.5							CUM WT %	0.1	0.6	5.3	58.4	83.9	91.2	95.0	96.5	100.0
50	1.5	C	4.7	94.3	1.0	S	WT	1.0	3.4	32.4	233.3	108.5	24.8	13.6	5.0	15.4
SORT= 0.88 MEDIAN= 1.00 MODE= 1.00 MEAN= 0.94							WT %	0.2	0.8	7.4	53.3	24.8	5.7	3.1	1.1	3.5
SPLIT WT= 437.4							CUM WT %	0.2	1.0	8.4	61.8	86.6	92.2	95.4	96.5	100.0
55	1.5	C	3.3	95.6	1.1	S	WT	0.6	1.8	10.5	65.8	90.4	37.2	7.7	2.4	5.0
SORT= 1.05 MEDIAN= 2.00 MODE= 2.00 MEAN= 1.32							WT %	0.3	0.8	4.7	29.7	40.8	16.8	3.5	1.1	2.3
SPLIT WT= 220.8							CUM WT %	0.3	1.1	5.8	35.5	76.4	93.2	96.7	97.7	100.3

WESTINGHOUSE HANFORD OPERATIONS SIEVE ANALYSIS
ROCKSAN REPORT

**** REPORT ON WELL 0299-E18-003 ****

09/21/89

DEPTH	%CACO3	DM	%MUD	%SAND	%GRAVEL	CLASS		FINE PEB (<=-2)	VFINE PEB (-1)	VERY COARS (0)	COARS (1)	MED (2)	FINE (3)	VERY FINE (4)	SILT (4.75)	PAN (>4.75)
58	1.5	C	15.5	84.3	0.2	(m)S	WT	0.0	0.6	1.3	10.8	38.6	98.6	109.9	22.4	25.1
SORT= 1.01 MEDIAN= 4.00 MODE= 4.00 MEAN= 2.99							WT %	0.0	0.2	0.4	3.5	12.6	32.1	35.8	7.3	8.2
SPLIT WT= 307.3							CUM WT %	0.0	0.2	0.6	4.1	16.7	48.8	84.5	91.8	100.0
60	1.3	C	6.5	92.8	0.7	S	WT	0.1	1.5	18.9	86.8	77.3	24.6	12.2	4.1	11.4
SORT= 1.19 MEDIAN= 2.00 MODE= 1.00 MEAN= 1.31							WT %	0.0	0.6	8.0	36.6	32.6	10.4	5.2	1.7	4.8
SPLIT WT= 236.5							CUM WT %	0.0	0.7	8.7	45.3	77.9	88.3	93.5	95.2	100.0
62	1.3	C	26.2	60.9	12.9	gmS	WT	1.9	32.7	24.9	49.6	24.4	7.6	57.0	33.9	36.5
SORT= 2.63 MEDIAN= 3.00 MODE= 4.00 MEAN= 2.02							WT %	0.7	12.2	9.3	18.5	9.1	2.8	21.2	12.6	13.6
SPLIT WT= 268.4							CUM WT %	0.7	12.9	22.2	40.6	49.7	52.6	73.8	86.4	100.0
65	1.2	C	3.0	96.1	0.9	S	WT	0.3	1.9	25.7	135.2	57.5	11.4	5.5	2.2	5.2
SORT= 0.83 MEDIAN= 1.00 MODE= 1.00 MEAN= 0.84							WT %	0.1	0.8	10.5	55.2	23.5	4.7	2.3	0.9	2.1
SPLIT WT= 244.5							CUM WT %	0.1	0.9	11.4	66.6	90.1	94.7	97.0	97.9	100.0
70	1.2	C	3.8	95.0	1.1	S	WT	0.3	1.9	19.3	88.4	57.8	12.3	5.4	1.8	5.6
SORT= 0.89 MEDIAN= 1.00 MODE= 1.00 MEAN= 0.95							WT %	0.2	1.0	10.0	45.9	30.0	6.4	2.8	0.9	2.9
SPLIT WT= 192.8							CUM WT %	0.2	1.2	11.2	57.0	87.0	93.4	96.2	97.1	100.0
75	1.4	C	4.9	93.6	1.5	S	WT	1.3	1.8	21.2	106.2	43.1	12.8	6.8	2.8	7.2
SORT= 0.92 MEDIAN= 1.00 MODE= 1.00 MEAN= 0.91							WT %	0.6	0.9	10.4	52.3	21.2	6.3	3.4	1.4	3.5
SPLIT WT= 203.2							CUM WT %	0.6	1.5	12.0	64.2	85.4	91.7	95.1	96.5	100.0
80	1.4	C	5.4	93.8	0.7	S	WT	0.5	1.2	10.8	61.4	90.8	39.7	10.9	3.6	8.7
SORT= 1.14 MEDIAN= 2.00 MODE= 2.00 MEAN= 1.50							WT %	0.2	0.5	4.8	27.0	39.9	17.4	4.8	1.6	3.8
SPLIT WT= 227.3							CUM WT %	0.2	0.8	5.5	32.5	72.4	89.8	94.6	96.2	100.0
84	1.7	C	20.7	78.3	1.0	mS	WT	0.1	2.9	20.0	21.8	52.1	75.6	71.3	29.5	34.2
SORT= 1.64 MEDIAN= 3.00 MODE= 3.00 MEAN= 2.74							WT %	0.0	0.9	6.5	7.1	16.9	24.6	23.2	9.6	11.1
SPLIT WT= 306.7							CUM WT %	0.0	1.0	7.5	14.6	31.5	56.1	79.3	88.9	100.0
85	1.0	C	3.6	94.7	1.7	S	WT	0.3	4.4	35.4	119.8	79.8	15.7	7.0	2.6	7.2
SORT= 0.91 MEDIAN= 1.00 MODE= 1.00 MEAN= 0.90							WT %	0.1	1.6	13.0	44.0	29.3	5.8	2.6	1.0	2.7
SPLIT WT= 272.3							CUM WT %	0.1	1.7	14.7	58.8	88.1	93.8	96.4	97.4	100.0
90	1.3	C	4.0	94.1	1.8	S	WT	0.9	3.9	20.6	81.9	102.4	32.5	9.9	3.4	7.2
SORT= 1.07 MEDIAN= 2.00 MODE= 2.00 MEAN= 1.26							WT %	0.3	1.5	7.8	31.2	39.0	12.4	3.8	1.3	2.7
SPLIT WT= 264.6							CUM WT %	0.3	1.8	9.7	40.8	79.8	92.2	96.0	97.3	100.0
95	1.5	C	8.5	90.6	0.9	S	WT	0.2	1.5	9.2	36.1	63.6	47.3	17.8	5.0	11.4
SORT= 1.32 MEDIAN= 2.00 MODE= 2.00 MEAN= 1.84							WT %	0.1	0.8	4.8	18.8	33.1	24.6	9.3	2.6	5.9
SPLIT WT= 192.1							CUM WT %	0.1	0.9	5.7	24.5	57.6	82.2	91.5	94.1	100.0

WESTINGHOUSE HANFORD OPERATIONS SIEVE ANALYSIS
ROCKSAN REPORT

**** REPORT ON WELL 0299-E18-003 ****

09/21/89

DEPTH	%CACO3	DM	%MUD	%SAND	%GRAVEL	CLASS		FINE PEB (<=-2)	VFINE PEB (-1)	VERY COARS (0)	COARS (1)	MED (2)	FINE (3)	VERY FINE (4)	SILT (4.75)	PAN (>4.75)
97	1.1	C	34.4	65.3	0.2	mS	WT	0.3	0.4	0.7	1.2	3.7	15.8	174.5	45.5	57.7
SORT= 0.82	MEDIAN=		4.00	MODE=	4.00	MEAN= 3.89	WT %	0.1	0.1	0.2	0.4	1.2	5.3	58.2	15.2	19.3
SPLIT WT= 299.9							CUM WT %	0.1	0.2	0.5	0.9	2.1	7.4	65.6	80.8	100.0
100	1.1	C	7.2	90.9	1.8	S	WT	2.3	1.7	12.6	73.9	69.2	31.1	12.7	4.8	11.1
SORT= 1.27	MEDIAN=		2.00	MODE=	1.00	MEAN= 1.44	WT %	1.1	0.8	5.7	33.7	31.5	14.2	5.8	2.2	5.1
SPLIT WT= 219.5							CUM WT %	1.1	1.8	7.6	41.2	72.8	87.0	92.8	94.9	100.0
105	1.0	C	9.6	90.1	0.3	S	WT	0.0	1.0	7.0	37.4	90.2	120.7	43.7	11.6	20.3
SORT= 1.21	MEDIAN=		3.00	MODE=	3.00	MEAN= 2.28	WT %	0.0	0.3	2.1	11.3	27.2	36.4	13.2	3.5	6.1
SPLIT WT= 332.8							CUM WT %	0.0	0.3	2.4	13.7	40.9	77.2	90.4	93.9	100.0
110	1.0	C	3.7	94.7	1.5	S	WT	0.6	3.5	29.0	110.6	87.6	22.3	8.2	3.1	7.1
SORT= 0.94	MEDIAN=		1.00	MODE=	1.00	MEAN= 1.00	WT %	0.2	1.3	10.7	40.7	32.2	8.2	3.0	1.1	2.6
SPLIT WT= 269.8							CUM WT %	0.2	1.5	12.2	52.8	85.0	93.2	96.3	97.4	100.0
115	1.1	C	5.5	93.7	0.8	S	WT	0.1	2.1	15.7	69.1	107.4	38.9	12.4	3.7	10.6
SORT= 1.14	MEDIAN=		2.00	MODE=	2.00	MEAN= 1.45	WT %	0.0	0.8	6.0	26.6	41.3	15.0	4.8	1.4	4.1
SPLIT WT= 260.4							CUM WT %	0.0	0.9	6.9	33.5	74.8	89.7	94.5	95.9	100.0
120	0.9	C	3.3	95.8	0.9	S	WT	0.0	2.3	24.1	127.4	66.5	18.8	6.5	2.4	5.9
SORT= 0.89	MEDIAN=		1.00	MODE=	1.00	MEAN= 0.93	WT %	0.0	0.9	9.5	50.2	26.2	7.4	2.6	1.0	2.3
SPLIT WT= 253.6							CUM WT %	0.0	0.9	10.4	60.6	86.8	94.2	96.7	97.7	100.0
125	1.6	C	5.9	90.7	3.4	S	WT	1.2	7.3	32.2	84.6	72.7	23.3	10.6	3.9	10.6
SORT= 1.21	MEDIAN=		1.00	MODE=	1.00	MEAN= 1.11	WT %	0.5	3.0	13.1	34.3	29.5	9.5	4.3	1.6	4.3
SPLIT WT= 243.8							CUM WT %	0.5	3.5	16.5	50.9	80.4	89.8	94.1	95.7	100.0
130	1.6	C	6.9	92.8	0.2	S	WT	0.0	0.6	8.0	45.1	91.3	68.3	20.0	5.1	12.3
SORT= 1.13	MEDIAN=		2.00	MODE=	2.00	MEAN= 1.81	WT %	0.0	0.2	3.2	18.0	36.4	27.2	8.0	2.0	4.9
SPLIT WT= 250.7							CUM WT %	0.0	0.2	3.4	21.4	57.8	85.1	93.1	95.1	100.0
135	1.3	C	3.8	91.2	5.0	(g)S	WT	2.0	9.2	48.5	71.6	55.9	20.5	7.0	2.1	6.4
SORT= 1.25	MEDIAN=		1.00	MODE=	1.00	MEAN= 0.75	WT %	0.9	4.1	21.7	32.1	25.0	9.2	3.1	0.9	2.9
SPLIT WT= 223.3							CUM WT %	0.9	5.0	26.8	58.8	83.9	93.1	96.2	97.1	100.0
140	1.3	C	3.0	96.3	0.7	S	WT	0.0	1.7	19.8	97.4	78.3	17.1	5.9	2.1	4.7
SORT= 0.88	MEDIAN=		1.00	MODE=	1.00	MEAN= 1.00	WT %	0.0	0.8	8.7	42.9	34.5	7.5	2.6	0.9	2.1
SPLIT WT= 226.2							CUM WT %	0.0	0.8	9.5	52.4	86.9	94.4	97.0	97.9	100.0
145	1.1	C	6.3	93.6	0.0	S	WT	0.1	0.0	2.3	31.0	144.0	65.7	17.2	4.7	12.9
SORT= 0.88	MEDIAN=		2.00	MODE=	2.00	MEAN= 1.89	WT %	0.0	0.0	0.8	11.2	51.8	23.6	6.2	1.7	4.6
SPLIT WT= 278.3							CUM WT %	0.0	0.0	0.9	12.0	63.9	87.5	93.7	95.4	100.0

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DEPTH	%CACO3	DM	%MUD	%SAND	%GRAVEL	CLASS		FINE PEB (<=-2)	VFINE PEB (-1)	VERY COARS (0)	COARS (1)	MED (2)	FINE (3)	VERY FINE (4)	SILT (4.75)	PAN (>4.75)
150	1.2	C	7.2	92.6	0.2	S	WT	0.0	0.5	1.3	9.5	116.1	81.7	17.5	5.4	12.2
SORT= 0.85	MEDIAN=	2.00	MODE=	2.00	MEAN=	2.05	WT %	0.0	0.2	0.5	3.9	47.5	33.5	7.2	2.2	5.0
SPLIT WT= 243.8							CUM WT %	0.0	0.2	0.7	4.6	52.2	85.6	92.8	95.0	100.0
155	1.4	C	6.4	93.5	0.1	S	WT	0.0	0.3	0.6	1.5	76.6	263.4	39.0	8.6	17.4
SORT= 0.59	MEDIAN=	3.00	MODE=	3.00	MEAN=	2.43	WT %	0.0	0.1	0.2	0.4	18.8	64.7	9.6	2.1	4.3
SPLIT WT= 406.3							CUM WT %	0.0	0.1	0.2	0.6	19.4	84.0	93.6	95.7	100.0
160	1.2	C	7.0	92.8	0.2	S	WT	0.0	1.3	12.3	63.4	205.4	181.8	42.2	11.2	26.9
SORT= 0.95	MEDIAN=	2.00	MODE=	2.00	MEAN=	1.99	WT %	0.0	0.2	2.3	11.6	37.7	33.4	7.8	2.1	4.9
SPLIT WT= 545.1							CUM WT %	0.0	0.2	2.5	14.1	51.9	85.3	93.0	95.1	100.0
165	1.4	C	6.0	93.5	0.5	S	WT	0.0	2.3	10.4	73.2	191.9	107.0	26.6	7.9	18.3
SORT= 1.03	MEDIAN=	2.00	MODE=	2.00	MEAN=	1.77	WT %	0.0	0.5	2.4	16.7	43.9	24.5	6.1	1.8	4.2
SPLIT WT= 438.2							CUM WT %	0.0	0.5	2.9	19.6	63.5	87.9	94.0	95.8	100.0
170	1.3	C	7.7	92.2	0.2	S	WT	0.0	0.7	4.6	28.7	146.2	157.8	37.3	10.5	20.7
SORT= 0.94	MEDIAN=	3.00	MODE=	3.00	MEAN=	2.15	WT %	0.0	0.2	1.1	7.1	36.0	38.8	9.2	2.6	5.1
SPLIT WT= 405.6							CUM WT %	0.0	0.2	1.3	8.4	44.3	83.2	92.3	94.9	100.0
175	1.2	C	6.4	92.5	1.1	S	WT	0.3	4.6	35.5	114.7	184.0	49.5	20.8	6.8	21.0
SORT= 1.15	MEDIAN=	2.00	MODE=	2.00	MEAN=	1.39	WT %	0.1	1.1	8.1	26.2	42.1	11.3	4.8	1.6	4.8
SPLIT WT= 437.5							CUM WT %	0.1	1.1	9.2	35.5	77.6	88.9	93.7	95.2	100.0
180	1.3	C	7.9	91.2	0.9	S	WT	0.5	4.3	24.7	137.3	194.6	96.2	34.1	12.3	30.1
SORT= 1.25	MEDIAN=	2.00	MODE=	2.00	MEAN=	1.61	WT %	0.1	0.8	4.6	25.7	36.4	18.0	6.4	2.3	5.6
SPLIT WT= 534.7							CUM WT %	0.1	0.9	5.5	31.2	67.7	85.7	92.1	94.4	100.0
185	1.4	C	8.8	90.2	1.1	S	WT	0.1	2.8	10.5	55.1	96.3	62.4	21.8	7.3	16.6
SORT= 1.27	MEDIAN=	2.00	MODE=	2.00	MEAN=	1.78	WT %	0.0	1.0	3.9	20.2	35.3	22.9	8.0	2.7	6.1
SPLIT WT= 270.7							CUM WT %	0.0	1.1	4.9	25.1	60.4	83.3	91.3	93.9	100.0
190	0.7	C	4.3	95.5	0.2	S	WT	0.0	1.0	20.4	208.4	183.8	47.7	18.8	6.7	15.0
SORT= 0.94	MEDIAN=	2.00	MODE=	1.00	MEAN=	1.19	WT %	0.0	0.2	4.1	41.5	36.6	9.5	3.8	1.3	3.0
SPLIT WT= 500.3							CUM WT %	0.0	0.2	4.3	45.8	82.4	91.9	95.7	97.0	100.0
193	1.9	C	46.8	53.2	0.0	mS	WT	0.0	0.0	1.5	6.6	7.3	24.2	233.6	90.8	149.5
SORT= 0.84	MEDIAN=	4.00	MODE=	4.00	MEAN=	3.99	WT %	0.0	0.0	0.3	1.3	1.4	4.7	45.5	17.7	29.1
SPLIT WT= 518.2							CUM WT %	0.0	0.0	0.3	1.6	3.0	7.7	53.2	70.9	100.0
195	1.7	C	31.8	68.0	0.1	mS	WT	0.1	0.7	1.3	0.6	1.1	30.7	332.9	83.4	88.3
SORT= 0.80	MEDIAN=	4.00	MODE=	4.00	MEAN=	3.88	WT %	0.0	0.1	0.2	0.1	0.2	5.7	61.8	15.5	16.4
SPLIT WT= 540.9							CUM WT %	0.0	0.2	0.4	0.5	0.7	6.4	68.1	83.6	100.0

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200	1.0	C	7.3	92.1	0.6	S	WT	0.1	2.7	20.2	124.8	179.2	73.7	28.9	9.9	23.8
SORT= 1.21	MEDIAN=		2.00	MODE=	2.00	MEAN= 1.57	WT %	0.0	0.6	4.4	26.9	38.7	15.9	6.2	2.1	5.1
SPLIT WT= 462.1							CUM WT %	0.0	0.6	5.0	31.9	70.6	86.5	92.7	94.9	100.0
205	1.7	C	5.4	92.8	1.8	S	WT	1.4	6.2	26.8	145.2	154.9	45.3	21.2	6.1	17.0
SORT= 1.13	MEDIAN=		2.00	MODE=	2.00	MEAN= 1.31	WT %	0.3	1.5	6.3	34.2	36.5	10.7	5.0	1.4	4.0
SPLIT WT= 425.0							CUM WT %	0.3	1.8	8.1	42.4	78.9	89.6	94.6	96.0	100.0
210	1.0	C	5.5	94.2	0.3	S	WT	0.1	1.2	7.7	62.6	194.9	122.5	26.6	7.1	17.0
SORT= 0.93	MEDIAN=		2.00	MODE=	2.00	MEAN= 1.86	WT %	0.0	0.3	1.8	14.2	44.3	27.9	6.1	1.6	3.9
SPLIT WT= 440.2							CUM WT %	0.0	0.3	2.0	16.3	60.6	88.5	94.5	96.1	100.0
215	0.7	C	3.6	96.1	0.3	S	WT	0.0	1.7	27.3	219.4	195.7	45.4	16.3	5.6	13.4
SORT= 0.86	MEDIAN=		2.30	MODE=	1.00	MEAN= 1.10	WT %	0.0	0.3	5.2	41.8	37.3	8.7	3.1	1.1	2.6
SPLIT WT= 524.1							CUM WT %	0.0	0.3	5.5	47.3	84.6	93.3	96.4	97.5	100.0
220	1.2	C	9.5	90.4	0.2	S	WT	0.0	0.9	25.6	199.4	128.1	40.5	69.3	20.4	28.1
SORT= 1.62	MEDIAN=		2.00	MODE=	1.00	MEAN= 1.68	WT %	0.0	0.2	5.0	38.9	25.0	7.9	13.5	4.0	5.5
SPLIT WT= 512.1							CUM WT %	0.0	0.2	5.2	44.1	69.1	77.0	90.5	94.5	100.0
222	1.6	C	31.2	68.7	0.1	mS	WT	0.0	0.3	3.7	27.6	36.2	25.5	245.4	77.5	76.4
SORT= 1.15	MEDIAN=		4.00	MODE=	4.00	MEAN= 3.59	WT %	0.0	0.1	0.8	5.6	7.4	5.2	49.8	15.7	15.5
SPLIT WT= 492.4							CUM WT %	0.0	0.1	0.8	6.4	13.8	18.9	68.8	84.5	100.0
225	0.8	C	5.6	93.9	0.5	S	WT	0.0	2.4	15.6	116.3	243.6	64.0	21.7	8.0	19.7
SORT= 1.01	MEDIAN=		2.00	MODE=	2.00	MEAN= 1.51	WT %	0.0	0.5	3.2	23.7	49.6	13.0	4.4	1.6	4.0
SPLIT WT= 489.9							CUM WT %	0.0	0.5	3.7	27.3	76.9	90.0	94.4	96.0	100.0
230	1.4	C	7.7	91.4	1.0	S	WT	0.3	4.0	37.1	91.1	175.5	79.2	28.7	9.6	24.9
SORT= 1.27	MEDIAN=		2.00	MODE=	2.00	MEAN= 1.59	WT %	0.1	0.9	8.2	20.2	39.0	17.6	6.4	2.1	5.5
SPLIT WT= 450.8							CUM WT %	0.1	1.0	9.2	29.4	68.4	86.0	92.4	94.5	100.0
235	1.3	C	4.2	66.7	29.1	gS	WT	133.2	42.8	71.2	179.1	102.9	34.5	15.8	6.4	19.0
SORT= N/A	MEDIAN=		1.00	MODE=	1.00	MEAN= N/A	WT %	22.0	7.1	11.8	29.6	17.0	5.7	2.6	1.1	3.1
SPLIT WT= 605.7							CUM WT %	22.0	29.1	40.9	70.5	87.5	93.2	95.8	96.9	100.0
240	1.0	H	8.0	47.1	44.9	msG	WT	216.1	87.0	79.8	87.8	61.0	60.1	29.5	13.0	41.1
SORT= N/A	MEDIAN=		0.00	MODE=	-2.00	MEAN= N/A	WT %	32.0	12.9	11.8	13.0	9.0	8.9	4.4	1.9	6.1
SPLIT WT= 675.1							CUM WT %	32.0	44.9	56.7	69.7	78.7	87.6	92.0	93.9	100.0
245	0.4	H	10.9	56.8	32.3	msG	WT	100.4	142.9	106.7	96.6	82.3	90.0	53.2	37.8	44.4
SORT= 2.57	MEDIAN=		1.00	MODE=	-1.00	MEAN= 0.57	WT %	13.3	18.9	14.2	12.8	10.9	11.9	7.1	5.0	5.9
SPLIT WT= 752.5							CUM WT %	13.3	32.3	46.4	59.2	70.1	82.1	89.1	94.1	100.0

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250	0.3	H	10.0	41.3	48.7	msG	WT	240.5	134.1	86.5	70.8	61.4	52.4	46.4	19.4	57.2
SORT= N/A MEDIAN= 0.00 MODE= -2.00 MEAN= N/A							WT %	31.3	17.5	11.3	9.2	8.0	6.8	6.0	2.5	7.4
SPLIT WT= 766.0							CUM WT %	31.3	48.7	60.0	69.2	77.2	84.0	90.1	92.6	100.0
255	0.3	H	7.2	56.1	36.7	msG	WT	126.2	163.1	110.0	93.1	93.0	89.2	57.2	40.1	16.6
SORT= N/A MEDIAN= 0.00 MODE= -1.00 MEAN= N/A							WT %	16.0	20.7	14.0	11.8	11.8	11.3	7.3	5.1	2.1
SPLIT WT= 788.4							CUM WT %	16.0	36.7	50.6	62.5	74.2	85.6	92.8	97.9	100.0
260	0.4	H	11.0	40.1	49.0	msG	WT	241.9	141.4	87.5	63.2	60.1	56.4	46.5	31.5	54.3
SORT= N/A MEDIAN= 0.00 MODE= -2.00 MEAN= N/A							WT %	30.9	18.1	11.2	8.1	7.7	7.2	5.9	4.0	6.9
SPLIT WT= 780.9							CUM WT %	30.9	49.0	60.1	68.2	75.9	83.1	89.0	93.1	100.0
265	0.6	H	12.9	47.9	39.3	msG	WT	171.1	151.8	101.7	83.7	77.4	60.4	70.4	32.6	73.4
SORT= N/A MEDIAN= 0.00 MODE= -2.00 MEAN= N/A							WT %	20.8	18.5	12.4	10.2	9.4	7.3	8.6	4.0	8.9
SPLIT WT= 820.5							CUM WT %	20.8	39.3	51.6	61.8	71.2	78.6	87.1	91.1	100.0
270	0.6	H	10.4	46.3	43.3	msG	WT	187.2	145.3	98.5	78.5	72.7	68.6	37.6	30.2	50.1
SORT= N/A MEDIAN= 0.00 MODE= -2.00 MEAN= N/A							WT %	24.4	18.9	12.8	10.2	9.5	8.9	4.9	3.9	6.5
SPLIT WT= 766.6							CUM WT %	24.4	43.3	56.1	66.3	75.7	84.7	89.5	93.5	100.0
275	0.3	H	8.9	52.1	39.1	msG	WT	184.4	128.2	93.3	110.8	81.5	72.0	58.9	61.4	9.4
SORT= N/A MEDIAN= 0.00 MODE= -2.00 MEAN= N/A							WT %	23.1	16.0	11.7	13.9	10.2	9.0	7.4	7.7	1.2
SPLIT WT= 799.1							CUM WT %	23.1	39.1	50.7	64.6	74.8	83.8	91.1	98.8	100.0
280	0.1	H	4.3	52.7	43.0	sG	WT	191.1	129.6	91.1	109.7	77.6	64.7	49.4	24.5	7.6
SORT= N/A MEDIAN= 0.00 MODE= -2.00 MEAN= N/A							WT %	25.6	17.4	12.2	14.7	10.4	8.7	6.6	3.3	1.0
SPLIT WT= 743.8							CUM WT %	25.6	43.0	55.3	70.0	80.4	89.1	95.7	99.0	100.0
285	0.4	H	9.0	50.6	40.4	msG	WT	190.0	150.1	95.7	98.9	85.4	75.9	69.3	55.8	19.7
SORT= N/A MEDIAN= 0.00 MODE= -2.00 MEAN= N/A							WT %	22.6	17.9	11.4	11.8	10.2	9.0	8.2	6.6	2.3
SPLIT WT= 839.5							CUM WT %	22.6	40.5	51.8	63.6	73.8	82.8	91.0	97.7	100.0
290	0.3	H	6.2	49.9	43.9	msG	WT	199.5	107.5	72.5	88.3	64.9	67.1	55.9	37.3	6.1
SORT= N/A MEDIAN= 0.00 MODE= -2.00 MEAN= N/A							WT %	28.5	15.4	10.4	12.6	9.3	9.6	8.0	5.3	0.9
SPLIT WT= 698.2							CUM WT %	28.5	43.9	54.3	66.9	76.2	85.8	93.8	99.1	100.0
295	0.3	H	9.9	44.0	46.0	msG	WT	200.7	128.3	87.0	63.6	64.7	58.8	40.6	15.9	55.1
SORT= N/A MEDIAN= 0.00 MODE= -2.00 MEAN= N/A							WT %	28.1	18.0	12.2	8.9	9.1	8.2	5.7	2.2	7.7
SPLIT WT= 714.0							CUM WT %	28.1	46.0	58.2	67.1	76.2	84.4	90.1	92.3	100.0
300	0.5	H	10.9	43.8	45.3	msG	WT	219.4	98.6	71.3	56.9	62.9	61.3	54.5	45.1	31.4
SORT= N/A MEDIAN= 0.00 MODE= -2.00 MEAN= N/A							WT %	31.3	14.1	10.2	8.1	9.0	8.7	7.8	6.4	4.5
SPLIT WT= 701.8							CUM WT %	31.3	45.3	55.5	63.6	72.6	81.3	89.1	95.5	100.0

WESTINGHOUSE HANFORD OPERATIONS SIEVE ANALYSIS
ROCKSAN REPORT

**** REPORT ON WELL 0299-E18-003 ****

09/21/89

DEPTH	%CACO3	DM	%MUD	%SAND	%GRAVEL	CLASS		FINE PEB (<=-2)	VFINE PEB (-1)	VERY COARS (0)	COARS (1)	MED (2)	FINE (3)	VERY FINE (4)	SILT (4.75)	PAN (>4.75)
305	0.5	H	7.8	33.6	58.4	msG	WT	317.8	112.5	61.0	47.4	43.6	59.9	37.5	12.2	45.1
SORT=	N/A	MEDIAN=	-1.00	MODE=	-2.00	MEAN= N/A	WT %	43.1	15.3	8.3	6.4	5.9	8.1	5.1	1.7	6.1
SPLIT WT= 736.5							CUM WT %	43.1	58.4	66.7	73.1	79.0	87.1	92.2	93.9	100.0
310	0.5	H	9.3	46.5	44.2	msG	WT	218.3	106.2	80.0	76.0	65.1	80.4	39.5	40.1	28.1
SORT=	N/A	MEDIAN=	0.00	MODE=	-2.00	MEAN= N/A	WT %	29.8	14.5	10.9	10.4	8.9	11.0	5.4	5.5	3.8
SPLIT WT= 733.0							CUM WT %	29.8	44.2	55.1	65.5	74.4	85.5	90.7	96.2	100.0
315	0.5	H	8.6	46.7	44.7	msG	WT	209.7	131.0	75.5	70.5	88.8	74.0	47.6	10.7	55.1
SORT=	N/A	MEDIAN=	0.00	MODE=	-2.00	MEAN= N/A	WT %	27.5	17.2	9.9	9.2	11.6	9.7	6.2	1.4	7.2
SPLIT WT= 761.5							CUM WT %	27.5	44.7	54.6	63.8	75.4	85.1	91.4	92.8	100.0
320	0.4	H	7.3	45.7	47.0	msG	WT	245.6	106.5	73.3	59.5	87.9	85.5	36.0	13.2	41.3
SORT=	N/A	MEDIAN=	0.00	MODE=	-2.00	MEAN= N/A	WT %	32.8	14.2	9.8	8.0	11.7	11.4	4.8	1.8	5.5
SPLIT WT= 748.0							CUM WT %	32.8	47.0	56.8	64.8	76.5	87.9	92.7	94.5	100.0
325	0.2	H	8.1	48.0	44.0	msG	WT	188.3	140.2	93.1	55.3	84.9	78.6	47.0	31.6	28.8
SORT=	N/A	MEDIAN=	0.00	MODE=	-2.00	MEAN= N/A	WT %	25.2	18.7	12.4	7.4	11.4	10.5	6.3	4.2	3.9
SPLIT WT= 749.2							CUM WT %	25.2	44.0	56.4	63.8	75.1	85.6	91.9	96.1	100.0
330	0.1	H	8.4	66.6	25.0	(m)gS	WT	71.7	115.6	96.1	71.3	132.7	151.2	47.7	32.0	31.3
SORT=	2.26	MEDIAN=	2.00	MODE=	3.00	MEAN= 0.84	WT %	9.6	15.4	12.8	9.5	17.7	20.2	6.4	4.3	4.2
SPLIT WT= 749.4							CUM WT %	9.6	25.0	37.8	47.3	65.0	85.2	91.6	95.8	100.0

SIEVE DATA FOR WELL 299-E18-4

WESTINGHOUSE HANFORD OPERATIONS SIEVE ANALYSIS
ROCKSAN REPORT

**** REPORT ON WELL 0299-E18-004 ****

09/20/89

DEPTH	%CACO3	DM	%MUD	%SAND	%GRAVEL	CLASS		FINE PEB (<=-2)	VFINE PEB (-1)	VERY COARS (0)	COARS (1)	MED (2)	FINE (3)	VERY FINE (4)	SILT (4.75)	PAN (>4.75)
5	1.9	C	6.3	90.7	2.9	S	WT	9.8	7.7	54.5	278.2	106.5	58.8	45.6	15.3	22.7
SORT=	1.35	MEDIAN=	1.00	MODE=	1.00	MEAN= 1.23	WT %	1.6	1.3	9.1	46.4	17.8	9.8	7.6	2.6	3.8
SPLIT WT= 594.8							CUM WT %	1.6	2.9	12.0	58.5	76.3	86.1	93.7	96.2	100.0
10	0.9	C	3.0	81.8	15.2	gS	WT	22.5	70.1	124.7	209.5	110.0	34.8	19.1	6.2	12.1
SORT=	1.36	MEDIAN=	1.00	MODE=	1.00	MEAN= 0.41	WT %	3.7	11.5	20.5	34.4	18.1	5.7	3.1	1.0	2.0
SPLIT WT= 605.8							CUM WT %	3.7	15.2	35.7	70.1	88.1	93.9	97.0	98.0	100.0
15	1.1	C	2.3	85.1	12.6	gS	WT	19.8	46.1	133.8	198.8	81.5	20.7	9.0	2.9	9.2
SORT=	1.18	MEDIAN=	1.00	MODE=	1.00	MEAN= 0.31	WT %	3.8	8.8	25.6	38.1	15.6	4.0	1.7	0.6	1.8
SPLIT WT= 517.1							CUM WT %	3.8	12.6	38.3	76.4	92.0	96.0	97.7	98.2	100.0
20	1.9	C	4.2	93.8	2.0	S	WT	2.6	6.7	50.6	199.6	140.7	28.2	12.8	4.5	14.7
SORT=	0.91	MEDIAN=	1.00	MODE=	1.00	MEAN= 0.94	WT %	0.6	1.5	11.0	43.4	30.6	6.1	2.8	1.0	3.2
SPLIT WT= 454.9							CUM WT %	0.6	2.0	13.0	56.4	86.9	93.1	95.8	96.8	100.0
25	1.6	C	3.5	94.8	1.8	S	WT	1.5	6.7	45.3	170.4	162.9	49.9	14.2	4.8	11.5
SORT=	0.99	MEDIAN=	2.00	MODE=	1.00	MEAN= 1.10	WT %	0.3	1.4	9.7	36.5	34.9	10.7	3.0	1.0	2.5
SPLIT WT= 462.8							CUM WT %	0.3	1.8	11.5	47.9	82.8	93.5	96.5	97.5	100.0
30	1.8	C	7.4	89.8	2.7	S	WT	1.7	10.0	23.9	68.5	153.3	97.7	39.0	9.1	22.6
SORT=	1.30	MEDIAN=	2.00	MODE=	2.00	MEAN= 1.75	WT %	0.4	2.4	5.6	16.1	36.0	23.0	9.2	2.1	5.3
SPLIT WT= 418.8							CUM WT %	0.4	2.8	8.4	24.5	60.5	83.4	92.6	94.7	100.0
35	1.4	C	4.6	95.1	0.4	S	WT	0.0	2.0	24.0	272.0	142.9	35.7	9.7	4.5	18.7
SORT=	0.85	MEDIAN=	1.00	MODE=	1.00	MEAN= 0.98	WT %	0.0	0.4	4.7	53.4	28.1	7.0	1.9	0.9	3.7
SPLIT WT= 504.4							CUM WT %	0.0	0.4	5.1	58.5	86.5	93.6	95.5	96.3	100.0
40	1.5	C	11.3	87.9	0.8	(m)S	WT	0.5	3.1	21.8	85.0	156.9	83.2	41.7	23.8	26.2
SORT=	1.48	MEDIAN=	2.00	MODE=	2.00	MEAN= 1.91	WT %	0.1	0.7	4.9	19.2	35.5	18.8	9.4	5.4	5.9
SPLIT WT= 436.8							CUM WT %	0.1	0.8	5.7	25.0	60.4	79.3	88.7	94.1	100.0
45	1.6	C	17.4	81.0	1.6	(m)S	WT	0.4	6.9	64.0	159.8	50.3	39.5	61.6	24.5	56.3
SORT=	2.09	MEDIAN=	2.00	MODE=	1.00	MEAN= 1.74	WT %	0.1	1.5	13.8	34.5	10.9	8.5	13.3	5.3	12.2
SPLIT WT= 458.8							CUM WT %	0.1	1.6	15.4	49.9	60.7	69.3	82.6	87.9	100.0
50	1.4	C	3.8	94.0	2.2	S	WT	1.6	8.5	73.5	232.9	87.2	25.3	12.9	4.9	12.5
SORT=	0.96	MEDIAN=	1.00	MODE=	1.00	MEAN= 0.76	WT %	0.4	1.9	16.0	50.7	19.0	5.5	2.8	1.1	2.7
SPLIT WT= 453.3							CUM WT %	0.4	2.2	18.2	68.9	87.9	93.4	96.2	97.3	100.0
55	1.5	C	3.6	91.7	4.7	S	WT	6.2	14.7	116.9	170.6	92.3	22.5	8.0	3.8	12.3
SORT=	1.15	MEDIAN=	1.00	MODE=	1.00	MEAN= 0.55	WT %	1.4	3.3	26.1	38.1	20.6	5.0	1.8	0.9	2.8
SPLIT WT= 442.9							CUM WT %	1.4	4.7	30.8	69.0	89.6	94.6	96.4	97.3	100.0

WESTINGHOUSE HANFORD OPERATIONS SIEVE ANALYSIS
ROCKSAN REPORT

**** REPORT ON WELL 0299-E18-004 ****

09/20/89

DEPTH	%CACO3	DM	%MUD	%SAND	%GRAVEL	CLASS		FINE PEB (<=-2)	VFINE PEB (-1)	VERY COARS (0)	COARS (1)	MED (2)	FINE (3)	VERY FINE (4)	SILT (4.75)	PAN (>4.75)
60	1.4	C	9.0	89.2	1.8	S	WT	1.0	7.3	42.6	123.0	134.2	65.4	38.3	12.4	28.2
SORT= 1.50	MEDIAN=		2.00	MODE=	2.00	MEAN= 1.58	WT %	0.2	1.6	9.4	27.2	29.7	14.5	8.5	2.7	6.2
SPLIT WT= 445.8							CUM WT %	0.2	1.8	11.3	38.4	68.1	82.6	91.0	93.8	100.0
65	1.4	C	3.6	95.1	1.2	S	WT	0.8	5.3	58.6	280.5	88.5	27.1	13.0	4.8	13.0
SORT= 0.86	MEDIAN=		1.00	MODE=	1.00	MEAN= 0.82	WT %	0.2	1.1	11.9	57.1	18.0	5.5	2.6	1.0	2.6
SPLIT WT= 488.1							CUM WT %	0.2	1.2	13.2	70.3	88.3	93.7	96.4	97.4	100.0
70	1.4	C	0.9	97.4	1.7	S	WT	1.5	6.2	59.6	271.6	88.3	13.7	5.7	2.1	1.8
SORT= 0.71	MEDIAN=		1.00	MODE=	1.00	MEAN= 0.68	WT %	0.3	1.4	13.2	60.3	19.6	3.0	1.3	0.5	0.4
SPLIT WT= 446.6							CUM WT %	0.3	1.7	14.9	75.2	94.8	97.9	99.1	99.6	100.0
75	1.4	C	1.1	98.1	0.8	S	WT	0.4	2.9	32.9	177.6	151.8	18.4	4.2	1.2	3.1
SORT= 0.80	MEDIAN=		1.00	MODE=	1.00	MEAN= 0.94	WT %	0.1	0.7	8.4	45.3	38.7	4.7	1.1	0.3	0.8
SPLIT WT= 385.4							CUM WT %	0.1	0.8	9.2	54.5	93.2	97.8	98.9	99.2	100.0
80	1.3	C	4.2	95.0	0.9	S	WT	0.0	3.8	23.8	136.4	177.4	60.1	16.5	4.9	13.2
SORT= 1.05	MEDIAN=		2.00	MODE=	2.00	MEAN= 1.34	WT %	0.0	0.9	5.5	31.3	40.7	13.8	3.8	1.1	3.0
SPLIT WT= 430.0							CUM WT %	0.0	0.9	6.3	37.6	78.3	92.1	95.9	97.0	100.0
85	1.7	C	12.7	86.2	1.2	(m)S	WT	1.2	3.8	10.0	39.5	136.6	131.3	48.7	16.0	37.8
SORT= 1.30	MEDIAN=		3.00	MODE=	2.00	MEAN= 2.32	WT %	0.3	0.9	2.4	9.3	32.2	30.9	11.5	3.8	8.9
SPLIT WT= 418.4							CUM WT %	0.3	1.2	3.5	12.8	45.0	75.9	87.3	91.1	100.0
90	1.4	C	7.6	87.9	4.4	S	WT	2.7	16.5	69.4	128.7	99.6	59.3	25.0	8.6	24.6
SORT= 1.54	MEDIAN=		1.00	MODE=	1.00	MEAN= 1.18	WT %	0.6	3.8	16.0	29.6	22.9	13.7	5.8	2.0	5.7
SPLIT WT= 427.7							CUM WT %	0.6	4.4	20.4	50.0	73.0	86.6	92.4	94.4	100.0
95	1.5	C	9.2	88.2	2.7	S	WT	3.0	8.2	27.2	83.7	132.3	93.2	34.2	12.4	26.2
SORT= 1.40	MEDIAN=		2.00	MODE=	2.00	MEAN= 1.73	WT %	0.7	2.0	6.5	19.9	31.5	22.2	8.1	3.0	6.2
SPLIT WT= 415.1							CUM WT %	0.7	2.7	9.1	29.0	60.5	82.7	90.8	93.8	100.0
100	1.3	C	7.6	89.3	3.1	S	WT	3.2	11.1	57.9	155.2	111.2	58.0	35.4	12.5	23.2
SORT= 1.46	MEDIAN=		2.00	MODE=	1.00	MEAN= 1.34	WT %	0.7	2.4	12.4	33.2	23.8	12.4	7.6	2.7	5.0
SPLIT WT= 460.6							CUM WT %	0.7	3.1	15.4	48.6	72.4	84.8	92.4	95.0	100.0
105	1.5	C	3.6	94.9	1.5	S	WT	0.0	5.8	24.1	85.5	163.3	85.1	18.6	4.2	10.1
SORT= 1.13	MEDIAN=		2.00	MODE=	2.00	MEAN= 1.51	WT %	0.0	1.5	6.1	21.6	41.2	21.5	4.7	1.1	2.6
SPLIT WT= 390.3							CUM WT %	0.0	1.5	7.5	29.1	70.3	91.7	96.4	97.5	100.0
110	1.3	C	4.9	93.1	2.0	S	WT	0.8	8.2	46.1	171.4	130.3	48.9	17.7	5.9	15.9
SORT= 1.13	MEDIAN=		1.00	MODE=	1.00	MEAN= 1.14	WT %	0.2	1.8	10.4	38.5	29.3	11.0	4.0	1.3	3.6
SPLIT WT= 443.8							CUM WT %	0.2	2.0	12.4	50.9	80.1	91.1	95.1	96.4	100.0

WESTINGHOUSE HANFORD OPERATIONS SIEVE ANALYSIS
ROCKSAN REPORT

**** REPORT ON WELL 0299-E18-004 ****

09/20/89

DEPTH	%CACO3	DM	%MUD	%SAND	%GRAVEL	CLASS		FINE PEB (<=-2)	VFINE PEB (-1)	VERY COARS (0)	COARS (1)	MED (2)	FINE (3)	VERY FINE (4)	SILT (4.75)	PAN (>4.75)
115	1.6	C	3.2	96.1	0.7	S	WT	0.0	2.7	18.2	108.6	167.7	77.4	16.4	4.1	8.9
SORT= 1.07 MEDIAN= 2.00 MODE= 2.00 MEAN= 1.46							WT %	0.0	0.7	4.5	26.9	41.5	19.2	4.1	1.0	2.2
SPLIT WT= 398.2							CUM WT %	0.0	0.7	5.2	32.1	73.6	92.7	96.8	97.8	100.0
120	1.3	C	3.1	96.1	0.8	S	WT	0.0	3.3	37.5	199.1	140.3	34.0	11.0	3.3	10.5
SORT= 0.88 MEDIAN= 1.00 MODE= 1.00 MEAN= 0.99							WT %	0.0	0.8	8.5	45.4	32.0	7.7	2.5	0.8	2.4
SPLIT WT= 431.8							CUM WT %	0.0	0.8	9.3	54.6	86.6	94.3	96.8	97.6	100.0
125	1.6	C	5.2	93.0	1.8	S	WT	1.0	6.8	22.8	123.9	191.7	49.7	15.9	5.7	16.9
SORT= 1.03 MEDIAN= 2.00 MODE= 2.00 MEAN= 1.34							WT %	0.2	1.6	5.3	28.5	44.1	11.4	3.7	1.3	3.9
SPLIT WT= 428.3							CUM WT %	0.2	1.8	7.1	35.6	79.7	91.1	94.8	96.1	100.0
130	2.0	C	8.4	91.0	0.6	S	WT	0.0	2.4	16.5	48.2	161.1	96.0	38.5	10.5	22.8
SORT= 1.15 MEDIAN= 2.00 MODE= 2.00 MEAN= 1.98							WT %	0.0	0.6	4.2	12.2	40.7	24.2	9.7	2.7	5.8
SPLIT WT= 395.7							CUM WT %	0.0	0.6	4.8	17.0	57.6	81.9	91.6	94.2	100.0
135	1.7	C	17.6	81.8	0.6	(m)S	WT	0.3	1.8	5.4	19.5	60.7	115.7	82.1	21.2	39.7
SORT= 1.36 MEDIAN= 3.00 MODE= 3.00 MEAN= 2.80							WT %	0.1	0.5	1.6	5.6	17.5	33.4	23.7	6.1	11.5
SPLIT WT= 341.2							CUM WT %	0.1	0.6	2.2	7.8	25.3	58.7	82.4	88.5	100.0
140	1.3	C	3.5	95.5	1.0	S	WT	0.1	4.1	28.4	159.7	165.3	35.7	12.1	4.2	10.5
SORT= 0.88 MEDIAN= 2.00 MODE= 2.00 MEAN= 1.10							WT %	0.0	1.0	6.8	38.0	39.4	8.5	2.9	1.0	2.5
SPLIT WT= 413.8							CUM WT %	0.0	1.0	7.8	45.8	85.1	93.6	96.5	97.5	100.0
145	1.0	C	3.0	96.7	0.3	S	WT	0.0	1.4	2.1	68.8	255.3	75.8	14.7	4.1	8.8
SORT= 0.75 MEDIAN= 2.00 MODE= 2.00 MEAN= 1.65							WT %	0.0	0.3	0.5	16.0	59.2	17.6	3.4	1.0	2.0
SPLIT WT= 427.4							CUM WT %	0.0	0.3	0.8	16.8	76.0	93.6	97.0	98.0	100.0
150	1.1	C	9.9	89.6	0.6	S	WT	0.3	2.5	17.3	97.8	178.3	108.3	36.8	16.9	31.4
SORT= 1.29 MEDIAN= 2.00 MODE= 2.00 MEAN= 1.83							WT %	0.1	0.5	3.5	20.0	36.4	22.1	7.5	3.5	6.4
SPLIT WT= 487.1							CUM WT %	0.1	0.6	4.1	24.1	60.5	82.6	90.1	93.6	100.0
155	1.2	C	6.4	93.5	0.1	S	WT	0.0	0.3	0.6	1.5	76.6	263.4	39.0	8.6	17.4
SORT= 0.59 MEDIAN= 3.00 MODE= 3.00 MEAN= 2.43							WT %	0.0	0.1	0.2	0.4	18.8	64.7	9.6	2.1	4.3
SPLIT WT= 406.3							CUM WT %	0.0	0.1	0.2	0.6	19.4	84.0	93.6	95.7	100.0
160	1.4	C	4.2	94.5	1.3	S	WT	0.2	5.3	33.0	143.5	154.5	64.7	17.6	5.6	12.8
SORT= 1.13 MEDIAN= 2.00 MODE= 2.00 MEAN= 1.31							WT %	0.1	1.2	7.6	32.8	35.3	14.8	4.0	1.3	2.9
SPLIT WT= 434.4							CUM WT %	0.1	1.3	8.8	41.6	77.0	91.8	95.8	97.1	100.0
165	1.4	C	10.1	89.2	0.7	(m)S	WT	0.3	3.4	19.1	102.9	187.9	115.2	44.8	16.1	37.2
SORT= 1.35 MEDIAN= 2.00 MODE= 2.00 MEAN= 1.88							WT %	0.1	0.7	3.6	19.5	35.7	21.9	8.5	3.1	7.1
SPLIT WT= 523.3							CUM WT %	0.1	0.7	4.3	23.9	59.5	81.4	89.9	92.9	100.0

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DEPTH	%CACO3	DW	%MUD	%SAND	%GRAVEL	CLASS		FINE PEB (<=-2)	VFINE PEB (-1)	VERY COARS (0)	COARS (1)	MED (2)	FINE (3)	VERY FINE (4)	SILT (4.75)	PAN (>4.75)
170	1.2	C	9.0	89.9	1.0	S	WT	0.1	2.9	5.8	24.1	118.6	85.5	26.2	7.1	19.0
SORT= 1.06	MEDIAN=		2.00	MODE=	2.00	MEAN= 2.09	WT %	0.0	1.0	2.0	8.3	41.0	29.6	9.1	2.5	6.6
SPLIT WT= 284.9							CUM WT %	0.0	1.0	3.0	11.4	52.4	81.9	91.0	93.4	100.0
175	1.1	C	8.0	90.6	1.5	S	WT	0.0	7.0	44.3	151.0	145.7	64.3	31.0	10.4	28.1
SORT= 1.35	MEDIAN=		2.00	MODE=	1.00	MEAN= 1.44	WT %	0.0	1.5	9.2	31.3	30.2	13.4	6.4	2.2	5.8
SPLIT WT= [illegible]							CUM WT %	0.0	1.5	10.6	42.0	72.1	85.5	91.0	94.1	100.0
180	1.2	C	5.1	93.1	1.8	S	WT	1.5	5.3	23.4	115.9	144.6	51.5	17.8	6.3	13.2
SORT= 1.14	MEDIAN=		2.00	MODE=	2.00	MEAN= 1.37	WT %	0.4	1.4	6.2	30.5	38.1	13.6	4.7	1.7	3.5
SPLIT WT= 374.9							CUM WT %	0.4	1.8	8.0	38.5	76.6	90.2	94.9	96.5	100.0
185	1.3	C	10.3	88.4	1.3	(m)S	WT	0.7	4.7	22.2	100.6	149.5	69.8	35.3	11.0	33.1
SORT= 1.45	MEDIAN=		2.00	MODE=	2.00	MEAN= 1.76	WT %	0.2	1.1	5.2	23.6	35.0	16.4	8.3	2.6	7.8
SPLIT WT= 426.1							CUM WT %	0.2	1.3	6.5	30.0	65.1	81.4	89.7	92.3	100.0
190	0.9	C	5.1	94.0	0.9	S	WT	0.1	4.4	27.1	200.0	177.7	50.0	21.1	7.7	18.2
SORT= 1.03	MEDIAN=		2.00	MODE=	1.00	MEAN= 1.23	WT %	0.0	0.9	5.4	39.5	35.1	9.9	4.2	1.5	3.6
SPLIT WT= 500.1							CUM WT %	0.0	0.9	6.2	45.7	80.8	90.7	94.9	96.4	100.0
195	1.2	C	6.0	93.3	0.7	S	WT	0.2	2.5	5.4	41.9	218.1	88.4	24.7	6.8	17.7
SORT= 0.88	MEDIAN=		2.00	MODE=	2.00	MEAN= 1.86	WT %	0.1	0.6	1.3	10.3	53.8	21.8	6.1	1.7	4.4
SPLIT WT= 399.4							CUM WT %	0.1	0.7	2.0	12.3	66.1	87.9	94.0	95.7	100.0
200	1.2	C	4.5	94.8	0.7	S	WT	0.0	2.7	15.9	129.2	174.5	56.1	17.0	5.7	13.0
SORT= 1.04	MEDIAN=		2.00	MODE=	2.00	MEAN= 1.39	WT %	0.0	0.7	3.8	31.2	42.1	13.6	4.1	1.4	3.1
SPLIT WT= 409.3							CUM WT %	0.0	0.7	4.5	35.7	77.8	91.4	95.5	96.9	100.0
205	1.2	C	4.5	93.5	1.9	S	WT	0.9	6.7	22.0	128.0	159.2	44.3	15.0	5.2	12.7
SORT= 1.03	MEDIAN=		2.00	MODE=	2.00	MEAN= 1.28	WT %	0.2	1.7	5.6	32.5	40.4	11.2	3.8	1.3	3.2
SPLIT WT= 388.8							CUM WT %	0.2	1.9	7.5	40.0	80.4	91.7	95.5	96.8	100.0
210	1.1	C	5.5	92.3	2.2	S	WT	4.1	5.3	18.9	105.5	183.4	59.5	21.0	6.3	16.7
SORT= 1.12	MEDIAN=		2.00	MODE=	2.00	MEAN= 1.47	WT %	1.0	1.3	4.5	25.1	43.6	14.1	5.0	1.5	4.0
SPLIT WT= 415.5							CUM WT %	1.0	2.2	6.7	31.8	75.4	89.5	94.5	96.0	100.0
215	1.0	C	4.4	94.8	0.7	S	WT	0.1	3.5	28.8	201.2	163.3	48.4	17.3	5.9	15.6
SORT= 0.99	MEDIAN=		2.00	MODE=	1.00	MEAN= 1.16	WT %	0.0	0.7	6.0	41.6	33.7	10.0	3.6	1.2	3.2
SPLIT WT= 479.3							CUM WT %	0.0	0.7	6.7	48.3	82.0	92.0	95.6	96.8	100.0
221	1.2	C	10.0	89.3	0.7	(m)S	WT	0.2	2.6	16.3	147.7	88.8	42.0	77.2	20.3	21.4
SORT= 1.68	MEDIAN=		2.00	MODE=	1.00	MEAN= 1.82	WT %	0.1	0.6	3.9	35.5	21.3	10.1	18.5	4.9	5.1
SPLIT WT= 412.3							CUM WT %	0.1	0.7	4.6	40.0	61.4	71.4	90.0	94.9	100.0

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DEPTH	%CACO3	DM	%MUD	%SAND	%GRAVEL	CLASS		FINE PEB (<=-2)	VFINE PEB (-1)	VERY COARS (0)	COARS (1)	MED (2)	FINE (3)	VERY FINE (4)	SILT (4.75)	PAN (>4.75)
225	1.5	C	6.2	92.1	1.7	S	WT	1.9	4.3	14.5	80.8	171.7	57.2	19.9	6.5	16.7
SORT= 1.11 MEDIAN= 2.00 MODE= 2.00 MEAN= 1.56							WT %	0.5	1.2	3.9	21.6	46.0	15.3	5.3	1.7	4.5
SPLIT WT= 367.9							CUM WT %	0.5	1.7	5.5	27.2	73.1	88.5	93.8	95.5	100.0
230	1.3	C	5.1	94.4	0.5	S	WT	0.3	1.6	4.1	49.9	198.7	81.2	18.5	5.8	13.4
SORT= 0.95 MEDIAN= 2.00 MODE= 2.00 MEAN= 1.80							WT %	0.1	0.4	1.1	13.4	53.2	21.7	5.0	1.6	3.6
SPLIT WT= 369.4							CUM WT %	0.1	0.5	1.6	15.0	68.2	89.9	94.9	96.4	100.0
235	1.5	C	4.3	46.0	49.7	sG	WT	208.6	42.7	45.1	85.9	62.6	26.6	12.1	4.9	17.1
SORT= N/A MEDIAN= 0.00 MODE= -2.00 MEAN= N/A							WT %	41.2	8.4	8.9	17.0	12.4	5.3	2.4	1.0	3.4
SPLIT WT= 507.5							CUM WT %	41.2	49.7	58.6	75.6	88.0	93.3	95.7	96.6	100.0
240	0.3	H	9.5	47.3	43.2	msG	WT	163.6	156.7	129.2	80.7	53.9	48.0	38.9	14.6	56.1
SORT= N/A MEDIAN= 0.00 MODE= -2.00 MEAN= N/A							WT %	22.1	21.1	17.4	10.9	7.3	6.5	5.2	2.0	7.6
SPLIT WT= 744.9							CUM WT %	22.1	43.2	60.6	71.5	78.8	85.2	90.5	92.4	100.0
245	0.2	H	8.7	33.9	57.4	msG	WT	298.0	100.5	64.6	43.9	45.8	47.6	33.1	20.2	40.0
SORT= N/A MEDIAN= -1.00 MODE= -2.00 MEAN= N/A							WT %	43.0	14.5	9.3	6.3	6.6	6.9	4.8	2.9	5.8
SPLIT WT= 693.6							CUM WT %	43.0	57.5	66.8	73.1	79.7	86.6	91.3	94.2	100.0
250	0.3	H	11.9	43.6	44.5	msG	WT	197.0	101.5	69.2	63.7	59.4	52.2	48.5	19.7	60.2
SORT= N/A MEDIAN= 0.00 MODE= -2.00 MEAN= N/A							WT %	29.3	15.1	10.3	9.5	8.9	7.8	7.2	2.9	9.0
SPLIT WT= 672.5							CUM WT %	29.3	44.5	54.8	64.3	73.1	80.9	88.1	91.0	100.0
255	0.3	H	7.7	42.1	50.2	msG	WT	201.7	164.0	108.6	68.3	56.6	57.1	33.2	12.0	47.5
SORT= N/A MEDIAN= -1.00 MODE= -2.00 MEAN= N/A							WT %	26.2	23.9	14.1	8.9	7.4	7.4	4.3	1.6	6.2
SPLIT WT= 768.2							CUM WT %	26.2	50.2	64.3	73.2	80.5	88.0	92.3	93.8	100.0
260	0.5	H	12.3	47.8	40.0	msG	WT	143.2	126.3	84.0	68.0	66.7	57.3	46.2	28.2	54.5
SORT= N/A MEDIAN= 0.00 MODE= -2.00 MEAN= N/A							WT %	21.2	18.7	12.5	10.1	9.9	8.5	6.9	4.2	8.1
SPLIT WT= 673.6							CUM WT %	21.2	40.0	52.4	62.5	72.4	80.9	87.7	91.9	100.0
265	0.5	H	10.3	52.3	37.4	msG	WT	138.2	118.6	87.1	100.3	70.7	67.4	33.0	18.2	52.4
SORT= N/A MEDIAN= 0.00 MODE= -2.00 MEAN= N/A							WT %	20.2	17.3	12.7	14.6	10.3	9.8	4.8	2.7	7.6
SPLIT WT= 685.4							CUM WT %	20.2	37.4	50.1	64.8	75.1	84.9	89.7	92.4	100.0
270	0.4	H	13.4	56.2	30.4	msG	WT	81.0	135.1	98.4	99.8	78.5	61.3	61.4	35.6	59.8
SORT= 2.73 MEDIAN= 1.00 MODE= -1.00 MEAN= 0.78							WT %	11.4	19.0	13.8	14.0	11.0	8.6	8.6	5.0	8.4
SPLIT WT= 709.1							CUM WT %	11.4	30.4	44.2	58.3	69.3	77.9	86.6	91.6	100.0
275	0.2	H	9.2	55.2	35.5	msG	WT	118.4	130.7	100.4	99.5	76.2	74.4	36.6	29.5	35.2
SORT= N/A MEDIAN= 1.00 MODE= -1.00 MEAN= N/A							WT %	16.9	18.7	14.3	14.2	10.9	10.6	5.2	4.2	5.0
SPLIT WT= 698.9							CUM WT %	16.9	35.5	49.9	64.1	74.9	85.5	90.8	95.0	100.0

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DEPTH	%CACO3	DM	%MUD	%SAND	%GRAVEL	CLASS		FINE PEB (<=-2)	VFINE PEB (-1)	VERY COARS (0)	COARS (1)	MED (2)	FINE (3)	VERY FINE (4)	SILT (4.75)	PAN (>4.75)
280	0.3	H	13.6	55.4	31.0	msG	WT	101.3	94.2	65.0	86.2	76.2	66.5	55.6	23.6	62.5
SORT= N/A MEDIAN= 1.00 MODE= -2.00 MEAN= N/A							WT %	16.1	14.9	10.3	13.7	12.1	10.5	8.8	3.7	9.9
SPLIT WT= 628.8							CUM WT %	16.1	31.0	41.3	54.9	67.0	77.6	86.4	90.1	100.0
285	0.3	H	9.9	50.5	39.6	msG	WT	164.0	109.9	77.2	89.4	72.5	71.3	39.2	29.6	39.2
SORT= N/A MEDIAN= 0.00 MODE= -2.00 MEAN= N/A							WT %	23.7	15.9	11.2	12.9	10.5	10.3	5.7	4.3	5.7
SPLIT WT= 691.2							CUM WT %	23.7	39.6	50.7	63.6	74.1	84.4	90.1	94.3	100.0
290	0.2	H	11.3	42.6	46.1	msG	WT	218.7	86.0	65.2	55.0	60.2	52.6	48.2	25.1	49.7
SORT= N/A MEDIAN= 0.00 MODE= -2.00 MEAN= N/A							WT %	33.1	13.0	9.9	8.3	9.1	8.0	7.3	3.8	7.5
SPLIT WT= 659.0							CUM WT %	33.1	46.1	56.0	64.3	73.4	81.4	88.7	92.5	100.0
295	0.3	H	8.3	39.9	51.8	msG	WT	250.3	111.9	69.0	60.9	54.8	62.5	31.5	15.1	42.6
SORT= N/A MEDIAN= -1.00 MODE= -2.00 MEAN= N/A							WT %	35.8	16.0	9.9	8.7	7.8	9.0	4.5	2.2	6.1
SPLIT WT= 697.7							CUM WT %	35.8	51.9	61.7	70.5	78.3	87.2	91.8	93.9	100.0
300	0.4	H	10.9	43.6	45.5	msG	WT	220.6	99.7	70.6	58.3	68.4	55.9	53.4	23.6	53.2
SORT= N/A MEDIAN= 0.00 MODE= -2.00 MEAN= N/A							WT %	31.4	14.2	10.0	8.3	9.7	7.9	7.6	3.4	7.6
SPLIT WT= 702.1							CUM WT %	31.4	45.5	55.6	63.8	73.6	81.5	89.1	92.4	100.0
305	0.2	H	8.6	46.5	44.9	msG	WT	219.4	85.5	64.9	69.7	74.2	72.3	34.4	21.5	36.6
SORT= N/A MEDIAN= 0.00 MODE= -2.00 MEAN= N/A							WT %	32.3	12.6	9.6	10.3	10.9	10.7	5.1	3.2	5.4
SPLIT WT= 677.1							CUM WT %	32.3	44.9	54.5	64.8	75.7	86.4	91.5	94.6	100.0
310	0.2	H	9.8	52.3	37.9	msG	WT	201.5	81.3	59.6	116.9	93.1	68.2	51.8	20.1	52.7
SORT= N/A MEDIAN= 1.00 MODE= -2.00 MEAN= N/A							WT %	27.0	10.9	8.0	15.7	12.5	9.2	7.0	2.7	7.1
SPLIT WT= 745.4							CUM WT %	27.0	38.0	46.0	61.6	74.1	83.3	90.2	92.9	100.0
315	0.3	H	10.9	58.4	30.8	msG	WT	107.8	110.5	85.3	78.5	102.9	99.7	47.6	30.3	46.9
SORT= 2.59 MEDIAN= 1.00 MODE= -1.00 MEAN= 0.65							WT %	15.2	15.6	12.0	11.1	14.5	14.1	6.7	4.3	6.6
SPLIT WT= 708.0							CUM WT %	15.2	30.8	42.8	53.8	68.3	82.4	89.1	93.4	100.0
320	0.2	H	12.0	54.1	33.9	msG	WT	129.7	98.8	72.8	54.9	79.3	97.4	60.2	29.6	51.2
SORT= N/A MEDIAN= 1.00 MODE= -2.00 MEAN= N/A							WT %	19.3	14.7	10.8	8.2	11.8	14.5	8.9	4.4	7.6
SPLIT WT= 672.4							CUM WT %	19.3	33.9	44.7	52.9	64.6	79.1	88.0	92.4	100.0
325	0.1	H	8.2	49.1	42.8	msG	WT	182.1	112.2	76.4	64.2	73.6	88.9	34.6	15.6	40.8
SORT= N/A MEDIAN= 0.00 MODE= -2.00 MEAN= N/A							WT %	26.5	16.3	11.1	9.3	10.7	12.9	5.0	2.3	5.9
SPLIT WT= 687.7							CUM WT %	26.5	42.8	53.9	63.2	73.9	86.8	91.8	94.1	100.0
330	0.2	H	13.3	62.5	24.2	(m)gS	WT	56.5	79.0	66.1	52.9	78.6	107.3	44.7	17.8	56.8
SORT= 2.63 MEDIAN= 2.00 MODE= 3.00 MEAN= 1.14							WT %	10.1	14.1	11.8	9.5	14.0	19.2	8.0	3.2	10.2
SPLIT WT= 558.5							CUM WT %	10.1	24.2	36.0	45.5	59.5	78.7	86.7	89.8	100.0

SEDIMENT CHEMISTRY

TABLE D.1. Results of the Vadose Zone Sediment Analyses Using XRF

Constituent[a]	Metals Results		
	2-E18-1 (195 ft)	2-E18-3 (45 ft)	2-E18-3 (45 ft)[b]
Aluminum (%)	6.79 ± 0.39	6.63 ± 0.38	6.56 ± 0.38
Silica (%)	30.0 ± 1.5	30.4 ± 1.5	31.7 ± 1.6
Phosphorus (%)	<0.069	<0.064	<0.068
Sulfur (%)	<0.019	<0.018	<0.019
Chlorine (%)	<0.010	<0.010	<0.010
Potassium (%)	1.833 ± 0.093	2.07 ± 0.10	2.12 ± 0.11
Calcium (%)	2.64 ± 0.13	2.26 ± 0.12	2.27 ± 0.12
Titanium (%)	0.385 ± 0.020	0.292 ± 0.015	0.291 ± 0.015
Vanadium (ppm)	98 ± 23	65 ± 20	58 ± 20
Chromium (ppm)	34 ± 12	32 ± 11	24 ± 11
Manganese (ppm)	625 ± 34	484 ± 27	459 ± 26
Iron (ppm)	3.33 ± 0.17	2.57 ± 0.13	2.52 ± 0.13
Cobalt (ppm)	<35	43 ± 16	<31
Nickel (ppm)	19.3 ± 4.1	21.4 ± 3.7	15.4 ± 3.6
Copper (ppm)	19.6 ± 1.8	14.7 ± 1.5	15.8 ± 1.6
Zinc (ppm)	57.0 ± 3.3	45.0 ± 2.7	45.1 ± 2.6
Gallium (ppm)	14.5 ± 1.1	13.2 ± 1.0	13.4 ± 1.0
Mercury (ppm)	<2.5	<2.4	<2.4
Selenium (ppm)	<0.89	<0.87	<0.86
Lead (ppm)	13.1 ± 1.4	11.1 ± 1.4	10.6 ± 1.3
Arsenic (ppm)	4.63 ± 0.74	4.46 ± 0.72	5.11 ± 0.74
Bromine (ppm)	<0.84	<0.80	0.83 ± 0.40
Rubidium (ppm)	70.5 ± 3.6	87.5 ± 4.5	87.0 ± 4.4
Strontium (ppm)	412 ± 21	358 ± 18	352 ± 18
	2-E18-3 (62 ft)	2-E18-3 (84 ft)	2-E18-3 (97 ft)
Aluminum (%)	6.74 ± 0.39	6.73 ± 0.39	6.92 ± 0.40
Silica (%)	30.0 ± 1.5	29.9 ± 1.5	30.8 ± 1.6
Phosphorus (%)	<0.066	<0.066	<0.066
Sulfur (%)	<0.018	<0.018	<0.018
Chlorine (%)	<0.010	<0.009	<0.010
Potassium (%)	2.02 ± 0.10	2.00 ± 0.10	1.971 ± 0.099
Calcium (%)	2.23 ± 0.11	2.32 ± 0.12	2.26 ± 0.12
Titanium (%)	0.386 ± 0.020	0.355 ± 0.019	0.347 ± 0.018
Vanadium (ppm)	121 ± 23	92 ± 22	91 ± 21
Chromium (ppm)	32 ± 11	38 ± 11	40 ± 11
Manganese (ppm)	593 ± 32	546 ± 30	542 ± 30
Iron (ppm)	3.14 ± 0.16	2.93 ± 0.15	2.73 ± 0.14
Cobalt (ppm)	<34	<33	<32
Nickel (ppm)	23.0 ± 4.0	20.4 ± 3.9	23.5 ± 3.8
Copper (ppm)	18.7 ± 1.7	17.9 ± 1.7	18.0 ± 1.7
Zinc (ppm)	58.1 ± 3.3	58.8 ± 3.4	59.3 ± 3.4
Gallium (ppm)	13.5 ± 1.0	14.9 ± 1.1	14.5 ± 1.1
Mercury (ppm)	<2.5	<2.5	<2.4
Selenium (ppm)	<0.88	<0.87	<0.86
Lead (ppm)	13.4 ± 1.4	15.5 ± 1.5	13.3 ± 1.5
Arsenic (ppm)	6.58 ± 0.82	6.34 ± 0.81	9.60 ± 0.90
Bromine (ppm)	<0.86	<0.87	<0.86
Rubidium (ppm)	79.5 ± 4.1	86.4 ± 4.4	80.7 ± 4.1
Strontium (ppm)	363 ± 19	352 ± 18	

TABLE D.1. (contd)

Constituent	Metals Results 2-E18-3 (194 ft)	2-E18-3 (194 ft)[b]
Aluminum (%)	6.68 ± 0.39	6.53 ± 0.38
Silica (%)	29.3 ± 1.5	30.0 ± 1.5
Phosphorus (%)	<0.067	<0.067
Sulfur (%)	<0.018	<0.018
Chlorine (%)	<0.010	<0.010
Potassium (%)	2.01 ± 0.10	1.98 ± 0.10
Calcium (%)	2.50 ± 0.13	2.51 ± 0.13
Titanium (%)	0.347 ± 0.018	0.344 ± 0.018
Vanadium (ppm)	<41	93 ± 22
Chromium (ppm)	46 ± 12	48 ± 12
Manganese (ppm)	473 ± 27	481 ± 27
Iron (ppm)	2.85 ± 0.14	2.84 ± 0.14
Cobalt (ppm)	47 ± 17	<33
Nickel (ppm)	30.4 ± 4.0	25.1 ± 2.4
Copper (ppm)	19.5 ± 1.8	19.6 ± 1.7
Zinc (ppm)	58.5 ± 3.3	60.3 ± 3.4
Gallium (ppm)	14.6 ± 1.1	13.8 ± 1.1
Mercury (ppm)	<2.4	<2.5
Selenium (ppm)	1.14 ± 0.43	<0.87
Lead (ppm)	13.8 ± 1.4	15.1 ± 1.5
Arsenic (ppm)	10.08 ± 0.92	10.00 ± 0.92
Bromine (ppm)	<0.85	<0.86
Rubidium (ppm)	81.1 ± 4.2	79.8 ± 4.1
Strontium (ppm)	383 ± 20	374 ± 19

(a) % = weight percent

(b) Duplicate anlaysis.

TABLE D.2. Results of Borehole Sediment Analysis Using ICP Method

Well Number	Depth, ft	Constituent	Result, ppm
299-E18-1	80	Beryllium	<5.00E-01
299-E18-1	80	Strontium	3.61E+01
299-E18-1	80	Zinc	2.73E+01
299-E18-1	80	Calcium	8.82E+03
299-E18-1	80	Barium	5.65E+01
299-E18-1	80	Cadmium	<2.00E-01
299-E18-1	80	Chromium	1.02E+01
299-E18-1	80	Silver	<1.00E+00
299-E18-1	80	Sodium	1.59E+02
299-E18-1	80	Nickel	8.30E+00
299-E18-1	80	Copper	3.30E+00
299-E18-1	80	Vanadium	2.42E+01
299-E18-1	80	Antimony	<1.00E+01
299-E18-1	80	Aluminum	6.05E+03
299-E18-1	80	Manganese	2.96E+02
299-E18-1	80	Potassium	1.14E+03
299-E18-1	80	Iron	1.39E+04
299-E18-1	80	Magnesium	4.72E+03
299-E18-1	80	Arsenic	3.30E+00
299-E18-1	80	Selenium	<5.00E-01
299-E18-1	110	Beryllium	<5.00E-01
299-E18-1	110	Strontium	2.53E+01
299-E18-1	110	Zinc	2.97E+01
299-E18-1	110	Calcium	7.10E+03
299-E18-1	110	Barium	5.81E+01
299-E18-1	110	Cadmium	<2.00E-01
299-E18-1	110	Chromium	1.25E+01
299-E18-1	110	Silver	<1.00E+00
299-E18-1	110	Sodium	1.24E+02
299-E18-1	110	Nickel	1.10E+01
299-E18-1	110	Copper	5.40E+00
299-E18-1	110	Vanadium	2.52E+01
299-E18-1	110	Antimony	<1.00E+01
299-E18-1	110	Aluminum	6.08E+03
299-E18-1	110	Manganese	2.65E+02
299-E18-1	110	Potassium	1.31E+03
299-E18-1	110	Iron	1.37E+04
299-E18-1	110	Magnesium	4.68E+03
299-E18-1	110	Arsenic	4.90E+00
299-E18-1	110	Selenium	<5.00E-01
299-E18-1	190	Beryllium	<5.00E-01
299-E18-1	190	Strontium	2.71E+01
299-E18-1	190	Zinc	3.04E+01
299-E18-1	190	Calcium	9.19E+03

TABLE D.2. (contd)

Well Number	Depth, ft	Constituent	Result, ppm
299-E18-1	190	Barium	7.11E+01
299-E18-1	190	Cadmium	<2.00E-01
299-E18-1	190	Chromium	1.18E+01
299-E18-1	190	Silver	<1.00E+00
299-E18-1	190	Sodium	1.52E+02
299-E18-1	190	Nickel	9.00E+00
299-E18-1	190	Copper	1.20E+00
299-E18-1	190	Vanadium	3.66E+01
299-E18-1	190	Antimony	<1.00E+01
299-E18-1	190	Aluminum	8.51E+03
299-E18-1	190	Manganese	2.95E+02
299-E18-1	190	Potassium	1.71E+03
299-E18-1	190	Iron	2.14E+04
299-E18-1	190	Magnesium	6.03E+03
299-E18-1	190	Arsenic	2.10E+00
299-E18-1	190	Selenium	<5.00E-01
299-E18-2	84	Beryllium	<5.00E-01
299-E18-2	84	Strontium	3.21E+01
299-E18-2	84	Zinc	4.15E+01
299-E18-2	84	Calcium	9.90E+03
299-E18-2	84	Barium	9.93E+01
299-E18-2	84	Cadmium	<2.00E-01
299-E18-2	84	Chromium	1.49E+01
299-E18-2	84	Silver	<1.00E+00
299-E18-2	84	Sodium	1.27E+02
299-E18-2	84	Nickel	1.21E+01
299-E18-2	84	Copper	2.78E+01
299-E18-2	84	Vanadium	3.15E+01
299-E18-2	84	Antimony	<1.00E+01
299-E18-2	84	Aluminum	9.67E+03
299-E18-2	84	Manganese	3.90E+02
299-E18-2	84	Potassium	2.25E+03
299-E18-2	84	Iron	1.94E+04
299-E18-2	84	Magnesium	6.71E+03
299-E18-2	84	Arsenic	4.30E+00
299-E18-2	84	Selenium	<5.00E-01
299-E18-2	99	Beryllium	<5.00E-01
299-E18-2	99	Strontium	3.31E+01
299-E18-2	99	Zinc	4.73E+01
299-E18-2	99	Calcium	1.03E+04
299-E18-2	99	Barium	7.67E+01
299-E18-2	99	Cadmium	<2.00E-01
299-E18-2	99	Chromium	1.66E+01
299-E18-2	99	Silver	<1.00E+00

TABLE D.2. (contd)

Well Number	Depth, ft	Constituent	Result, ppm
299-E18-2	99	Sodium	1.24E+02
299-E18-2	99	Nickel	1.47E+01
299-E18-2	99	Copper	5.60E+01
299-E18-2	99	Vanadium	3.39E+01
299-E18-2	99	Antimony	<1.00E+01
299-E18-2	99	Aluminum	9.28E+03
299-E18-2	99	Manganese	3.10E+02
299-E18-2	99	Potassium	1.96E+03
299-E18-2	99	Iron	2.00E+04
299-E18-2	99	Magnesium	6.38E+03
299-E18-2	99	Arsenic	7.80E+00
299-E18-2	99	Selenium	<5.00E-01
299-E18-2	109	Beryllium	<5.00E-01
299-E18-2	109	Strontium	3.11E+01
299-E18-2	109	Zinc	4.33E+01
299-E18-2	109	Calcium	9.55E+03
299-E18-2	109	Barium	7.95E+01
299-E18-2	109	Cadmium	<2.00E-01
299-E18-2	109	Chromium	1.58E+01
299-E18-2	109	Silver	<1.00E+00
299-E18-2	109	Sodium	1.23E+02
299-E18-2	109	Nickel	1.34E+01
299-E18-2	109	Copper	4.21E+01
299-E18-2	109	Vanadium	3.01E+01
299-E18-2	109	Antimony	<1.00E+01
299-E18-2	109	Aluminum	9.45E+03
299-E18-2	109	Manganese	2.95E+02
299-E18-2	109	Potassium	2.43E+03
299-E18-2	109	Iron	1.95E+04
299-E18-2	109	Magnesium	6.80E+03
299-E18-2	109	Arsenic	5.20E+00
299-E18-2	109	Selenium	<5.00E-01
299-E18-4	45	Beryllium	<5.00E-01
299-E18-4	45	Strontium	2.91E+01
299-E18-4	45	Zinc	3.65E+01
299-E18-4	45	Calcium	1.29E+04
299-E18-4	45	Barium	7.69E+01
299-E18-4	45	Cadmium	<2.00E-01
299-E18-4	45	Chromium	1.09E+01
299-E18-4	45	Silver	<1.00E+00
299-E18-4	45	Sodium	1.04E+02
299-E18-4	45	Nickel	1.28E+01
299-E18-4	45	Copper	7.60E+00
299-E18-4	45	Vanadium	2.40E+01

TABLE D.2. (contd)

Well Number	Depth, ft	Constituent	Result, ppm
299-E18-4	45	Antimony	<1.00E+01
299-E18-4	45	Aluminum	8.67E+03
299-E18-4	45	Manganese	2.91E+02
299-E18-4	45	Potassium	1.78E+03
299-E18-4	45	Iron	1.79E+04
299-E18-4	45	Magnesium	6.30E+03
299-E18-4	45	Arsenic	3.90E+00
299-E18-4	45	Selenium	<5.00E-01
299-E18-4	85	Beryllium	<5.00E-01
299-E18-4	85	Strontium	2.93E+01
299-E18-4	85	Zinc	3.17E+01
299-E18-4	85	Calcium	9.71E+03
299-E18-4	85	Barium	6.63E+01
299-E18-4	85	Cadmium	<2.00E-01
299-E18-4	85	Chromium	1.16E+01
299-E18-4	85	Silver	<1.00E+00
299-E18-4	85	Sodium	1.04E+02
299-E18-4	85	Nickel	1.08E+01
299-E18-4	85	Copper	3.80E+00
299-E18-4	85	Vanadium	2.64E+01
299-E18-4	85	Antimony	<1.00E+01
299-E18-4	85	Aluminum	7.38E+03
299-E18-4	85	Manganese	2.79E+02
299-E18-4	85	Potassium	1.81E+03
299-E18-4	85	Iron	1.68E+04
299-E18-4	85	Magnesium	5.54E+03
299-E18-4	85	Arsenic	3.70E+00
299-E18-4	85	Selenium	<5.00E-01
299-E18-4	95	Beryllium	<5.00E-01
299-E18-4	95	Strontium	3.27E+01
299-E18-4	95	Zinc	3.16E+01
299-E18-4	95	Calcium	9.19E+03
299-E18-4	95	Barium	8.53E+01
299-E18-4	95	Cadmium	<2.00E-01
299-E18-4	95	Chromium	1.32E+01
299-E18-4	95	Silver	<1.00E+00
299-E18-4	95	Sodium	1.05E+02
299-E18-4	95	Nickel	3.66E+01
299-E18-4	95	Copper	3.90E+00
299-E18-4	95	Vanadium	3.30E+01
299-E18-4	95	Antimony	<1.00E+01
299-E18-4	95	Aluminum	7.31E+03
299-E18-4	95	Manganese	3.15E+02
299-E18-4	95	Potassium	1.44E+03

TABLE D.2. (contd)

Well Number	Depth, ft	Constituent	Result, ppm
299-E18-4	95	Iron	1.97E+04
299-E18-4	95	Magnesium	5.58E+03
299-E18-4	95	Arsenic	2.20E+00
299-E18-4	95	Selenium	<5.00E-01

TABLE D.3. Analytical Results for Drilled Sediment Samples

Well Number	Depth	Constituent	Result, µg/g	Sample Date	Analysis Date
299-E18-1	195′	Tetrachloromethane	<5.00E-03	6/21/88	6/24/88
		Methyl Ethyl Ketone	<1.00E-02	6/21/88	6/24/88
		1,1,1-Trichloroethane	<5.00E-03	6/21/88	6/24/88
		1,1,2-Trichloroethane	<5.00E-03	6/21/88	6/24/88
		Trichloroethylene	<5.00E-03	6/21/88	6/24/88
		Perchloroethylene	<5.00E-03	6/21/88	6/24/88
		Xylene-O,P	<5.00E-03	6/21/88	6/24/88
		Chloroform	<5.00E-03	6/21/88	6/24/88
		Methylene Chloride	<1.00E-02	6/21/88	6/24/88
		Xylene-M	<5.00E-03	6/21/88	6/24/88
		Hexone	<1.00E-02	6/21/88	6/24/88
299-E18-3	45′	Tetrachloromethane	<5.00E-03	6/8/88	6/17/88
		Methyl Ethyl Ketone	<1.00E-02	6/8/88	6/17/88
		1,1,1-Trichloroethane	<5.00E-03	6/8/88	6/17/88
		1,1,2-Trichloroethane	<5.00E-03	6/8/88	6/17/88
		Trichloroethylene	<5.00E-03	6/8/88	6/17/88
		Perchloroethylene	<5.00E-03	6/8/88	6/17/88
		Xylene-O,P	<5.00E-03	6/8/88	6/17/88
		Chloroform	<5.00E-03	6/8/88	6/17/88
		Methylene Chloride	<1.00E-02	6/8/88	6/17/88
		Xylene-M	<5.00E-03	6/8/88	6/17/88
		Hexone	<1.00E-02	6/8/88	6/17/88
299-E18-3	62′	Tetrachloromethane	<5.00E-03	6/8/88	6/17/88
		Methyl Ethyl Ketone	<1.00E-02	6/8/88	6/17/88
		1,1,1-Trichloroethane	<5.00E-03	6/8/88	6/17/88
		1,1,2-Trichloroethane	<5.00E-03	6/8/88	6/17/88
		Trichloroethylene	<5.00E-03	6/8/88	6/17/88
		Perchloroethylene	<5.00E-03	6/8/88	6/17/88
		Xylene-O,P	<5.00E-03	6/8/88	6/17/88
		Chloroform	<5.00E-03	6/8/88	6/17/88
		Methylene Chloride	<1.00E-02	6/8/88	6/17/88
		Xylene-M	<5.00E-03	6/8/88	6/17/88
		Hexone	<1.00E-02	6/8/88	6/17/88
299-E18-3	84′	Tetrachloromethane	<5.00E-03	6/9/88	6/17/88
		Methyl Ethyl Ketone	<1.00E-02	6/9/88	6/17/88
		1,1,1-Trichloroethane	<5.00E-03	6/9/88	6/17/88
		1,1,2-Trichloroethane	<5.00E-03	6/9/88	6/17/88
		Trichloroethylene	<5.00E-03	6/9/88	6/17/88
		Perchloroethylene	<5.00E-03	6/9/88	6/17/88
		Xylene-O,P	<5.00E-03	6/9/88	6/17/88
		Chloroform	<5.00E-03	6/9/88	6/17/88
		Methylene Chloride	<1.00E-02	6/9/88	6/17/88
		Xylene-M	<5.00E-03	6/9/88	6/17/88
		Hexone	<1.00E-02	6/9/88	6/17/88

TABLE D.3. (contd)

Well Number	Depth	Constituent	Result (µg/g)	Sample Date	Analysis Date
299-E18-3	97′	Tetrachloromethane	<5.00E-03	6/9/88	6/20/88
		Methyl Ethyl Ketone	<1.00E-02	6/9/88	6/20/88
		1,1,1-Trichloroethane	<5.00E-03	6/9/88	6/20/88
		1,1,2-Trichloroethane	<5.00E-03	6/9/88	6/20/88
		Trichloroethylene	<5.00E-03	6/9/88	6/20/88
		Perchloroethylene	<5.00E-03	6/9/88	6/20/88
		Xylene-O,P	<5.00E-03	6/9/88	6/20/88
		Chloroform	<5.00E-03	6/9/88	6/20/88
		Methylene Chloride	2.10E-02	6/9/88	6/20/88
		Xylene-M	<5.00E-03	6/9/88	6/20/88
		Hexone	<1.00E-02	6/9/88	6/20/88
299-E18-3	195′	Tetrachloromethane	<5.00E-03	6/14/88	6/21/88
		Methyl Ethyl Ketone	<1.00E-02	6/14/88	6/21/88
		1,1,1-Trichloroethane	<5.00E-03	6/14/88	6/21/88
		1,1,2-Trichloroethane	<5.00E-03	6/14/88	6/21/88
		Trichloroethylene	<5.00E-03	6/14/88	6/21/88
		Perchloroethylene	<5.00E-03	6/14/88	6/21/88
		Xylene-O,P	<5.00E-03	6/14/88	6/21/88
		Chloroform	<5.00E-03	6/14/88	6/21/88
		Methylene Chloride	2.90E-02	6/14/88	6/21/88
		Xylene-M	<5.00E-03	6/14/88	6/21/88
		Hexone	<1.00E-02	6/14/88	6/21/88
299-E18-3 DUPLICATE	195′	Tetrachloromethane	<5.00E-03	6/14/88	6/21/88
		Methyl Ethyl Ketone	<1.00E-02	6/14/88	6/21/88
		1,1,1-Trichloroethane	<5.00E-03	6/14/88	6/21/88
		1,1,2-Trichloroethane	<5.00E-03	6/14/88	6/21/88
		Trichloroethylene	<5.00E-03	6/14/88	6/21/88
		Perchloroethylene	<5.00E-03	6/14/88	6/21/88
		Xylene-O,P	<5.00E-03	6/14/88	6/21/88
		Chloroform	<5.00E-03	6/14/88	6/21/88
		Methylene Chloride	<1.00E-02	6/14/88	6/21/88
		Xylene-M	<5.00E-03	6/14/88	6/21/88
		Hexone	<1.00E-02	6/14/88	6/21/88

-END-

DATE FILMED

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