PNNL-13121

Groundwater Monitoring and Tritium-Tracking Plan for the 200 Area State-Approved Land Disposal Site

D. B. Barnett

August 2000

Prepared for
the U.S. Department of Energy
under Contract DE-AC06-76RLO 1830

Pacific Northwest National Laboratory
Richland, Washington 99352

DISCLAIMER

DISCLAIMER

Summary

The 200 Area State-Approved Land Disposal Site (SALDS) is a drainfield which receives treated wastewater, occasionally containing tritium from treatment of Hanford Site liquid wastes at the 200 Area Effluent Treatment Facility (ETF). Since operation of the SALDS began in December 1995, discharges of tritium have totaled ~304 Ci, only half of what was originally predicted for tritium quantity through 1999. Total discharge volumes (~2.7E+8 L) have been commensurate with predicted volumes to date.

This document reports the results of all tritium analyses in groundwater as determined from the SALDS tritium-tracking network since the first SALDS wells were installed in 1992 through July 1999, and provides interpretation of these results as they relate to SALDS operation and its effect on groundwater. Hydrologic and geochemical information are synthesized to derive a conceptual model, which is in turn used to arrive at an appropriate approach to continued groundwater monitoring at the facility.

Hydrostratigraphic relationships beneath the SALDS cause a slight translocation of infiltrating effluent southward toward a former upgradient well 699-48-77A before entering groundwater. Discharges to the SALDS have produced a limited, but persistent groundwater mound near the facility, such that groundwater flows radially away from the facility for a short distance before resuming a northeasterly direction of flow.

Groundwater numerical modeling conducted in 1997 predicted hydraulic heads and tritium distribution in the uppermost aquifer in the vicinity of the SALDS through 2095. As of March 1999, the head values appear to agree with model predictions, but the extent of the tritium plume created by the SALDS is somewhat overestimated by the model. This may be because the actual quantity of tritium sent to the SALDS thus far is only half of the predicted amount.

Only the SALDS proximal wells (699-48-77A, 699-48-77C, and 699-48-77D) have been affected by tritium from the facility thus far; the highest activity was observed in well 699-48-77D in February 1998 (2.1E+6 pCi/L). Analytical results of groundwater geochemistry since groundwater monitoring began at the SALDS indicate that all constituents with permit enforcement limits have been below those limits, with the exception of one measurement of total dissolved solids (TDS) in 1996. The average concentrations of most constituents with enforcement limits are also below estimates of Hanford Site groundwater background concentrations for these constituents. Some parameters, such as conductivity, sulfate, and TDS have been elevated in groundwater due to leaching of natural salts in the vadose zone beneath the SALDS.

The revised groundwater monitoring, sampling, and analysis plan will retain most of the constituents and parameters from the first State Waste Discharge Permit, ST-4500, but eliminates ammonia as a constituent. Replicate field measurements will replace laboratory measurements of pH for compliance purposes. A deep companion well to well 699-51-75 will be monitored for tritium deeper in the uppermost aquifer. Well 299-W8-1 is reduced to tritium monitoring only, because this well is no longer a legitimate upgradient location for the SALDS.

Acknowledgments

The author deeply appreciates the contributions of R. M. Smith, M. J. Hartman, and M. D. Sweeney of Pacific Northwest National Laboratory, and P. M. Olson, and K. J. Lueck of Fluor Hanford Company, Inc. in the critical review of the document. Thanks are also extended to G. P. O'Connor, L. M. Andor, and K. R. Neiderhiser, PNNL, for editing and processing of the document.

Acronyms and Abbreviations

µg/L	micrograms per liter
CFEST	Coupled Fluid, Energy, and Solute Transport
Ci	Curie
DAVE	Data Viewer and Evaluator
DMR	Discharge Monitoring Reports
DOE	U.S. Department of Energy
DOE/RL	U.S. Department of Energy, Richland Operations Office
DTW	depth to water
DWS	drinking water standard
Ecology	Washington State Department of Ecology
ERDF	Environmental Remediation Disposal Facility
ETF	200 Area Effluent Treatment Facility
HEIS	Hanford Environmental Information System
K_s	saturated hydraulic conductivity
LEMIS	Liquid Effluent Monitoring Information System
LERF	Liquid Effluent Retention Facility
LLBG	Low-Level Burial Ground
LWPF	Liquid Waste Processing Facilities
MDA	minimum detectable activity
pCi/L	picocuries per liter
PNNL	Pacific Northwest National Laboratory
QAPjP	Liquid Waste Processing Facilities Quality Assurance Project Plan
RCRA	Resource Conservation and Recovery Act
RDR	Request for Data Review
SALDS	State-Approved Land Disposal Site
TDS	total dissolved solids

Contents

Figures

Tables

1.0 Introduction

Treated water from the 200 Area Effluent Treatment Facility (ETF) is discharged to a disposal site in accordance with the State Waste Discharge Permit ST-4500 (ST-4500, Ecology 1995) promulgated by WAC 173-216. This disposal site, referred to as the State-Approved Land Disposal Site (SALDS), is located north of the 200 West Area of the Hanford Site (Figure 1.1). The treated effluent disposed to the SALDS contains varying amounts of tritium, with allowable concentrations of up to 2.4E+07 pCi/L. As required by ST-4500, the groundwater at the SALDS is routinely sampled using a network of wells. The objective of the monitoring well network is to track tritium from the SALDS facility as it enters and moves within the groundwater system. Three "proximal" wells near the SALDS, and one upgradient well have been sampled for additional constituents to ensure groundwater protection. Analytical results from these four wells are reported in quarterly discharge monitoring reports. Tritium analyses from the entire network are evaluated quarterly to annually. In 1997, the U.S. Department of Energy (DOE) also committed to the issuance of an annual summary report of groundwater monitoring results and evaluation, review of the monitoring network, and updates to the groundwater monitoring plan, as appropriate. In FY 2000, a new permit will be issued for the facility, requiring an updated groundwater monitoring strategy. This document reports on tritium results from the groundwater tritium-tracking network through FY 1999, presents pertinent historical information on groundwater hydrology and hydrochemistry for the site, estimates performance of numerical modeling predictions to date, and provides an updated program for groundwater monitoring at the SALDS.

1.1 Background

A Washington State Waste Discharge Permit (ST-4500) was granted for the SALDS in June 1995, and the facility began receiving effluent in December 1995. In January 1996, the *Groundwater Screening Evaluation/Monitoring Plan -- 200 Area Effluent Treatment Facility (Project C-018H)* (Davis et al. 1996) was issued to: 1) summarize the hydrogeologic setting, 2) describe pre-operational groundwater monitoring results at the SALDS, 3) provide plans for continued groundwater monitoring for nonradiological constituents, and 4) establish a plan for monitoring and tracking of tritium entering groundwater from the facility. Also included in the 1996 document are plans for updating a numerical model for prediction of groundwater flow and tritium transport.

In 1997, a revised numerical groundwater model was developed to predict the pattern and rate of tritium migration in groundwater as it is discharged to the SALDS. The relevant predictions of this model and an evaluation of groundwater monitoring results through 1996 were presented in Barnett et al. (1997). A comparison of these predictions with actual conditions through late 1999 is presented in Section 2.2.3. The 1997 report also described results of previous groundwater numerical models for the SALDS.

Tritium originating from the SALDS was first detected in groundwater in July 1996 in well 699-48-77A, a former upgradient well, and the well most distant from the facility in the original SALDS

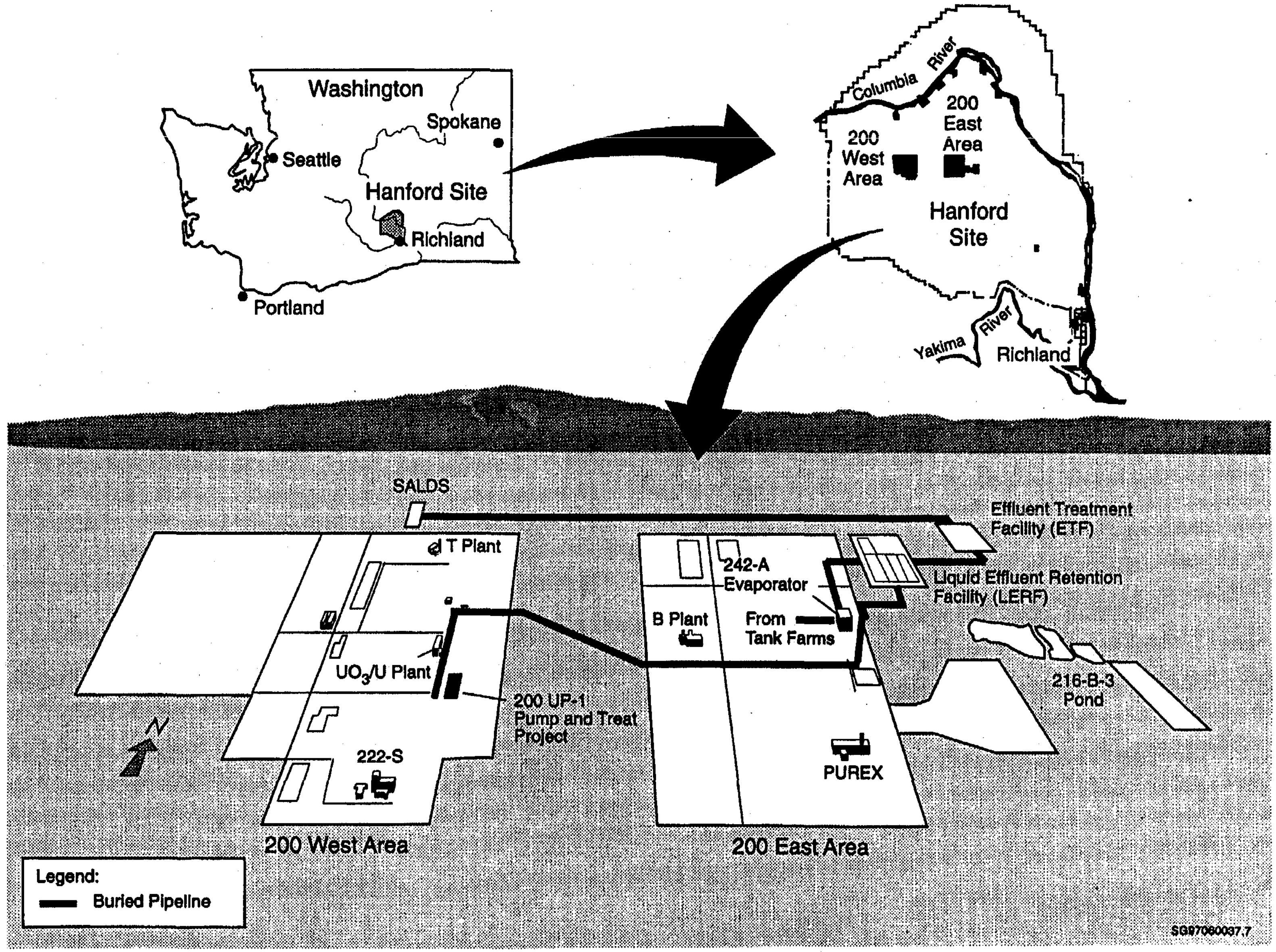


Figure 1.1. Schematic Perspective of the ETF, SALDS, and Related Infrastructure

network (see Section 1.3.2). Tritium appeared in wells closer to the facility at a later time. The probable reasons for this circumstance are related to hydrogeologic peculiarities beneath the facility, and are discussed in Sections 2.0 and 4.0.

1.2 Objectives and Scope

This document reports the results of all tritium analyses in groundwater as determined from sampling the SALDS tritium-tracking network wells, since 1995, just prior to the beginning of SALDS operations. The document also provides interpretations of these results as they relate to SALDS operation and its effect on groundwater. Also presented are analytical results and interpretations for several additional chemical parameters assigned enforcement limits by ST-4500 in three proximal SALDS wells and one upgradient well. The data include all historical analytical results for these constituents through July 1999. Interpretations and discussions of their significance are included for these parameters where they have a bearing on groundwater protection and SALDS operation. The hydrogeologic framework of the SALDS is presented to provide a coherent conceptual model when linked with groundwater geochemical results. The conceptual model is used as a basis for refining the groundwater monitoring program.

The revised groundwater monitoring program, presented in Section 5.0, supersedes the groundwater monitoring plan of Sections 3.0 and 4.0 of *Ground-Water Screening Evaluation/Monitoring Plan -- 200 Area Effluent Treatment Facility (Project C-018H)* (Davis et al. 1996), but draws upon applicable background information elsewhere in that document. Section 5.0 defines the new schedule, constituent list, and other groundwater-related activities that will accompany the revised permit, which will be implemented in FY 2000.

1.3 Facility Description and Operation

The ETF is located near the northeast corner of the 200 East Area of the Hanford Site (Figure 1.1). Numerous generating facilities produce liquid wastes that are conveyed directly to the ETF or to the Liquid Effluent Retention Facility (LERF) which stores waste for later treatment at the ETF. The treated effluent, essentially pure water that may contain tritium, is then transferred by pipeline to the SALDS disposal drainfield, which is ~500 m north of the 200 West Area, for infiltration into the soil column. The SALDS is also known as the "616A Crib" and "Project C-018H." Sources of wastewater for the ETF include: 242-A Evaporator process condensate from treatment of double-shell tank wastes, UP-1 pump-and-treat project, N-Basin wastewater, 222 S Laboratory wastes, and leachates from the Environmental Remediation Disposal Facility (ERDF) and other disposal trenches. Most of these streams do not contain tritium; the tritium derives primarily from treatment of double-shell tank wastes. Liquid wastes from the UP-1 pump-and-treat project and the 242-A Evaporator are conveyed to the ETF by pipeline (see Figure 1.1). Other streams are trucked to the facility. ETF operation is described in detail by DOE-RL (1993). The treated effluent is monitored in verification tanks prior to discharge to the SALDS.

1.3.1 Effluent Discharge History

The first discharge to the SALDS occurred as a result of the testing of the ETF in late 1994. Another discharge, designed to test the integrity of the drainfield, was released in June 1995. The effluent in these tests consisted of raw (Columbia River) water. Actual operation, with discharges containing tritium, did not begin until December 1995. Figure 1.2 illustrates monthly and cumulative discharge volumes and corresponding inventories of disposed tritium through September 1999.

Following high discharge volumes and tritium quantities in early 1996, there occurred a period of relatively low discharge volume from July 1996 until July 1997. From July 1997 through September 1999, discharge volumes have remained relatively robust, with the peak monthly discharge of ~1.5E+7 L occurring in July 1999. As of the end of September 1999, a total of ~2.7E+8 L of water has been discharged to the SALDS.

Tritium disposal has been sporadic since the early 1996 campaigns. The highest monthly discharge of tritium occurred in May 1996 (57.1 Ci). Several months have seen no tritium discharge at all, including virtually the entire period from May 1998 through March 1999. The total inventory disposed thus far to the SALDS through September 1999 is ~304 Ci. Of this total, 72% was discharged during the first 7 months of operation. The discharged tritium inventories have been substantially less, thus far, than were predicted prior to the onset of operations, but discharged effluent volumes have been proportionate with projections.

1.3.2 History of Groundwater Monitoring and Well Network

The results of groundwater monitoring in the vicinity of SALDS prior to operation, and the initial groundwater monitoring network are described by Davis et al. (1996). Three proximal wells (one upgradient [699-48-77A] and two downgradient [699-48-77C and 699-48-77D]) were the original wells drilled for groundwater monitoring purposes (Figure 1.3). The SALDS groundwater monitoring plan, *Ground-Water Screening Evaluation/Monitoring Plan -- 200 Area Effluent Treatment Facility (Project C-018H)* (Davis et al. 1996) also identified numerous other wells between the SALDS and the Columbia River for the purpose of tritium monitoring only. The more distant wells are considered potential future tritium monitoring sites, but a subset of 23 of these wells in the immediate vicinity of the SALDS (including the three proximal wells) were selected for routine monitoring of tritium in groundwater beginning in 1995. The current network of groundwater monitoring wells, including the tritium tracking wells, is shown in Figure 1.3.

Groundwater monitoring began immediately following the installation of well 699-48-77A in 1992, and wells 699-48-77C and 699-48-77D in 1994. Wells 699-48-77A and 699-48-77D are screened at the water table. Well 699-48-77C is screened ~20 m below the water table. Discharges to the facility beginning in late 1995 produced a slight hydraulic mound in the vicinity of the SALDS, thus compromising the upgradient status of well 699-48-77A (see Section 2.0). To reestablish an upgradient monitoring site, an existing Resource Conservation and Recovery Act (RCRA) monitoring well, 299-W8-1, was selected as a replacement upgradient well in 1997. Also in 1997, two of the original 23 tritium-tracking wells, 299-W6-5 and 299-W7-2, were dropped from the network because of drying and damage to the well

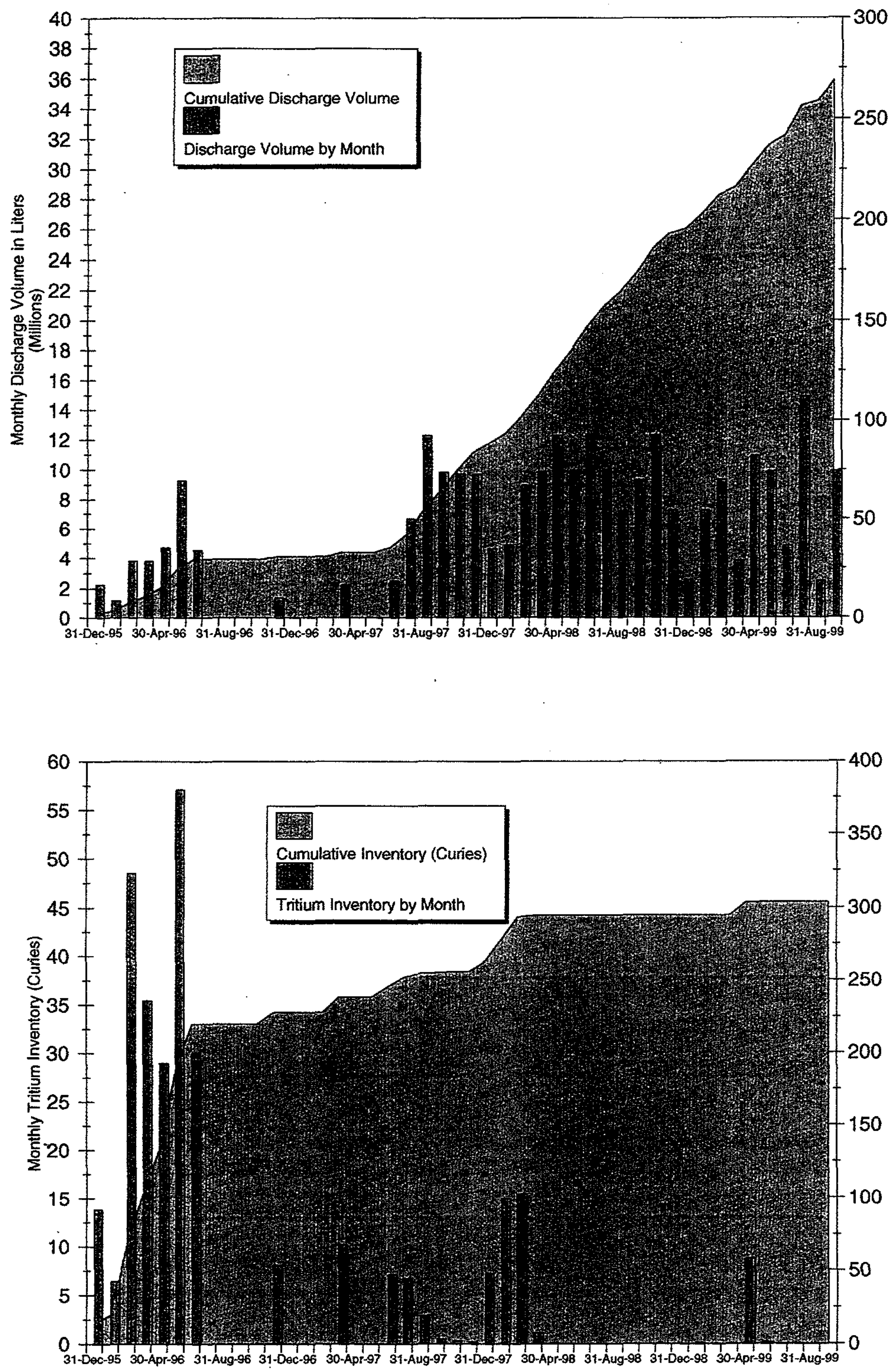


Figure 1.2. Effluent Volume and Tritium Quantities Discharged to the SALDS Through September 1999. Each increment on the horizontal axes equals one month.

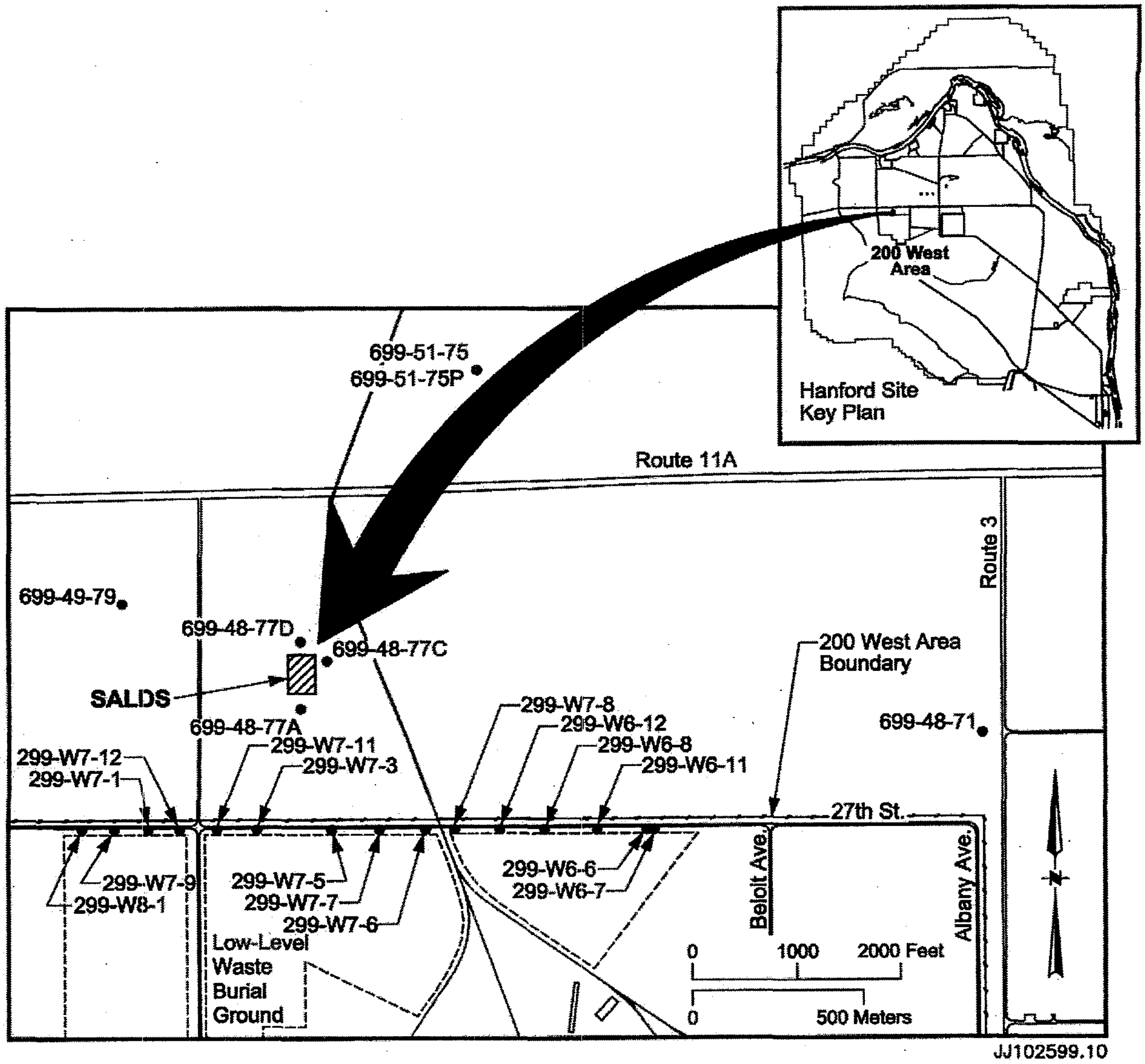


Figure 1.3. Groundwater Monitoring and Tritium-Tracking Well Network for the SALDS

casing, respectively. The spacing of the wells in this area is such that effectiveness of the monitoring network was not materially affected by the loss of these two wells.

The first list of groundwater analytes was derived as part of an evaluation of several potential SALDS locations (Harris and Delaney 1991). This list (see Table A.1 in Appendix A) was applied to well 699-48-77A immediately after it was drilled in 1992 to gather "pre-facility baseline data." The list was applied through June 1993, whereupon a revised constituent list was adopted (Reidel 1993) that was later applied to the other two SALDS proximal wells (699-48-77C and 699-48-77D) drilled in 1994 (see Table A.2 in Appendix A). Both of these early constituent lists were aimed at defining pre-operational groundwater conditions at the SALDS, and preceded the current list found in ST-4500.

The current list of analytical parameters and constituents for groundwater monitoring at the SALDS proximal wells (699-48-77A, 699-48-77C, and 699-48-77D) was established by Davis et al. (1996), and is included in ST-4500 as enforcement limits in groundwater. When the new upgradient well, 299-W8-1, was selected, the same constituent list was applied in this well. All four wells have been sampled quarterly since sampling began at each well. The only change to the original permit constituents list was effected in 1997, when it was discovered that natural soil chemistry was elevating sulfate and a few other parameters in groundwater as the clean effluent infiltrated through the vadose zone (see Section 3.0). The enforcement limit for sulfate was raised from 30,000 to 250,000 μg/L to compensate for this condition. The constituent list with enforcement limits, in use through July 2000, is provided in Table A.3 in Appendix A.

In 1997, the effectiveness of the well network in defining tritium plume development was reevaluated using a groundwater flow and transport model and the anticipated rates of discharge and tritium disposal (Barnett et al. 1997) (see Section 2.0). Minor changes in the monitoring schedule were made based on that report. Sampling frequency for four of the tritium-tracking wells was increased from annual to semiannual, and water level measurement frequency was increased to monthly (from quarterly) in the three proximal SALDS wells.

2.0 Hydrogeology of the SALDS

Details of the hydrogeologic setting of the SALDS are presented by Lindsey and Reidel (1992), Reidel (1993), Reidel and Thornton (1993), with more recent information compiled by Davis et al. (1996). Lindsey et al. (1994) described the stratigraphy and provided detailed geologic cross sections of the Low-Level Burial Grounds (LLBG) in the 200 West Area, immediately south of the SALDS site. The SALDS tritium-tracking network shares 15 wells with the LLBG facility. Hanford Site geology and stratigraphy have been characterized by Myers et al. (1979), DOE (1988), Delaney et al. (1991), Reidel et al. (1992), and Lindsey (1995). Groundwater hydrology of the Hanford Site and the surrounding region is discussed by Gephart et al. (1979), Wurstner et al. (1995), and is most recently summarized by Hartman et al. (2000). Swanson (1994) reports the results of aquifer and permeameter tests at the SALDS site. This section briefly describes salient elements of the hydrogeologic framework of the SALDS as derived from these efforts.

2.1 Geologic and Stratigraphic Framework

Figure 2.1 illustrates general stratigraphic relationships beneath the SALDS, as determined by site-specific investigations. Additional lithologic details are provided in the well logs of Appendix B.

The Miocene Elephant Mountain Member of the Saddle Mountains Formation basalt underlies the sequence of sediments of late Miocene to Holocene age that comprise the vadose zone and uppermost aquifer beneath the Hanford Site. The basalt surface occurs at a depth of ~132 m (433 ft) beneath the SALDS. The surface of the basalt beneath the facility dips to the south at ~3°. Numerous additional basalt flows and sedimentary interbeds between flows underlie the Elephant Mountain Member. These flows and interbeds extend downward several thousand meters and host several confined aquifers.

The late Miocene-to-Pliocene Ringold Formation fluviolacustrine sediments immediately overly the basalt and account for ~84% (~119 m) of thickness of the suprabasalt strata beneath the SALDS. The top of the Ringold occurs approximately 19 m below land surface at this location. The dominant facies of the Ringold Formation beneath the SALDS are fluvial sand and gravel of the upper Ringold and units A and E (corresponding to units 5 and 9, respectively, of Thorne et al. 1994). These two units are elsewhere distinguished by the intervening Ringold lower mud unit. However, at the SALDS location this mud unit is absent, thus making the two similar A and E units difficult to differentiate. The Ringold Formation sediments are variably cemented at this location with calcium carbonate and probably other evaporite minerals (see Section 4.2). The structural trend of these strata appears to be concordant with that of the underlying basalt (i.e., dipping gently south).

The Plio-Pleistocene unit overlies the Ringold Formation, and is ~16 m thick beneath the SALDS. The top of the unit is encountered at only 2 m (6 ft) below the surface in well 699-48-77D, and, like the basalt surface, dips gently to the south. The Plio-Pleistocene unit is typically silt, sand, and local basaltic gravel, with abundant carbonate cement and local caliche layers. Lindsey and Reidel (1992) describe this unit as occurring discontinuously throughout much of the 200 West Area. Lindsey et al. (1994) state that

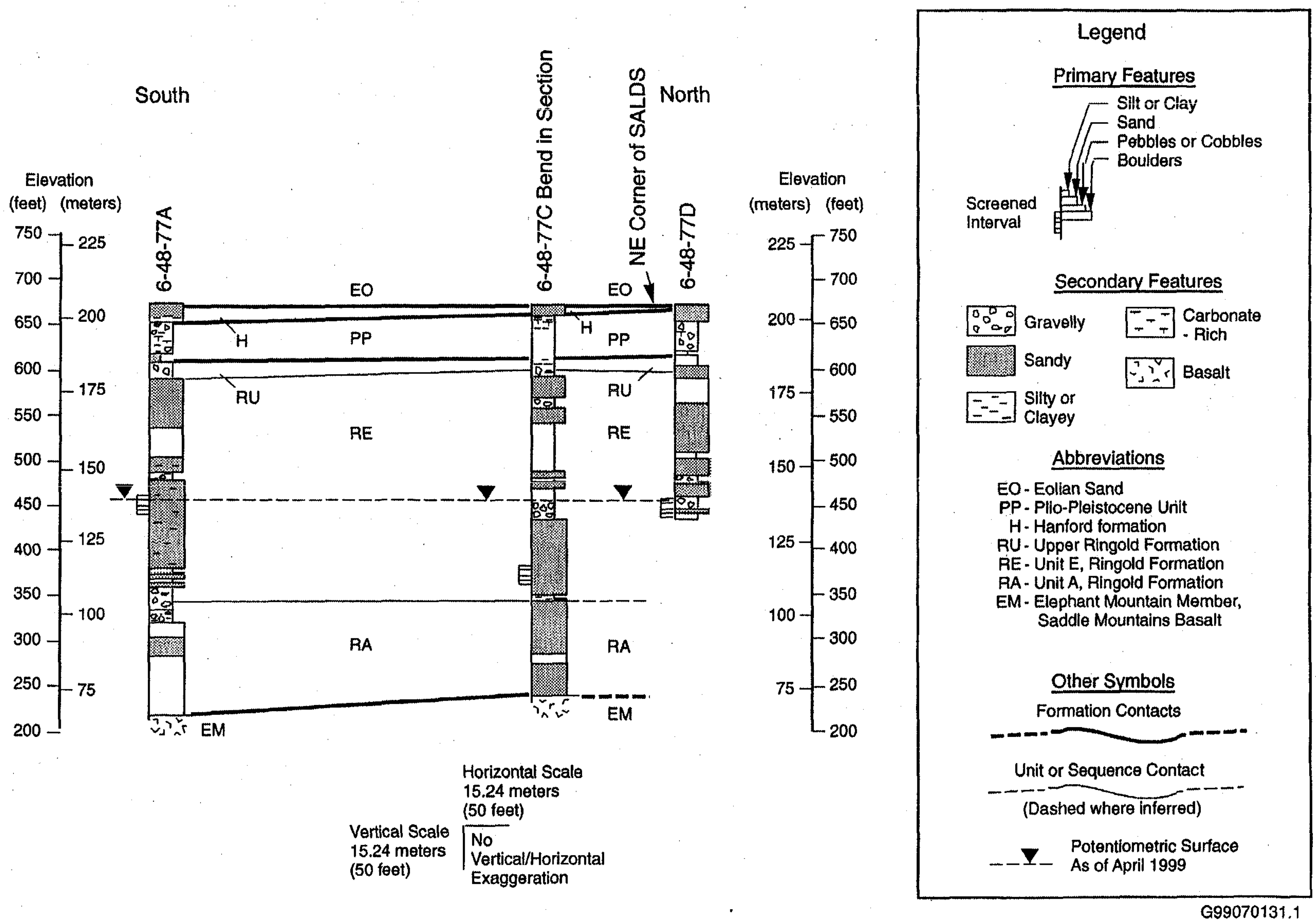


Figure 2.1. Suprabasalt Stratigraphy Beneath the SALDS. See Figure 1.3 for well locations.

it is continuous beneath the LLBG immediately south of the SALDS, but add that considerable variability exists in carbonate cementation and degree of caliche development at this location. The caliche of the Plio-Pleistocene unit is a persistent feature in the 200 West Area, but varies considerably in thickness and degrees of development. From cored intervals of boreholes at the SALDS, Reidel and Thornton (1993) note a lack of "significant" caliche layers or calcrete zones in the Plio-Pleistocene unit, with mostly thin (<0.5 cm) stringers of caliche present. Observations made by Swanson (1994) during the excavation of infiltration test holes near the SALDS also attest to the lateral variability in cementation and permeability of the Plio-Pleistocene unit at this site.

The Hanford formation sediments consists of non-cemented gravel, sand, and silt, which disconformably overlie the Plio-Pleistocene unit in the 200 West Area. In the vicinity of the SALDS, the Hanford formation is encountered at approximately 0.5 m below land surface, and is only 1.4 m thick near the northern edge of the facility, to 6.4 m thick near well 699-48-77A. The Hanford formation is overlain by a thin veneer of dune sand.

2.2 Groundwater Hydrology

The uppermost aquifer beneath the SALDS occurs within the Ringold Formation sand and gravel (units A and E). The current (April 1999) depth to groundwater beneath the SALDS is approximately 68.3 m (224 ft), and the lower boundary of the aquifer is formed by the Elephant Mountain Member Basalt at ~134 m (~433 ft). Thus, the aquifer is approximately 66 m (~210 ft) thick at this location. The water table surface in the vicinity of the SALDS for March 1999 is shown in Figure 2.2.

The saturated zone begins approximately 50 m below the upper contact of the Ringold Formation (within unit E). No identifiable confining layers have been recognized in this aquifer, but pumping tests suggest that it is partially and/or locally confined. Swanson (1994) identified the general locations of two of these layers within the aquifer. The aquifer is shown as divided roughly into three unequal layers because of the semiconfining strata. The confinement may be the result of layers of cementation within the Ringold Formation. The horizontal component of hydraulic gradient in the general vicinity of the SALDS for March 1999 is approximately 0.0018, but is significantly higher very near the drain field because of infiltrating effluent. For instance, the horizontal hydraulic gradient between wells 699-48-77A and 699-48-77D in March 1999 was ~0.004.

Vertically-separated well pairs to the southeast and northeast of the SALDS indicate that there is virtually no measurable vertical gradient within the uppermost aquifer in this area, away from the immediate vicinity of the SALDS. The hydrographs of wells 299-W6-7 and 299-W6-6 (Figure 2.3) illustrate the lack of significant vertical hydraulic potential in this area. Well 299-W6-6 is screened 52 m (172 ft) lower in the aquifer than well 299-W6-7. As expected, proximal SALDS wells (699-48-77A, 699-48-77C, and 699-48-77D) indicate a consistent downward-directed vertical gradient near the facility as a result of SALDS discharges (Figure 2.4). The consistently higher head in well 699-48-77A suggests that infiltration of effluent to groundwater (mounding) from the SALDS is occurring closer to this well than well 699-48-77D. Both 699-48-77A and 699-48-77D are screened at the water table; 699-48-77C is screened ~20 m below the water table.

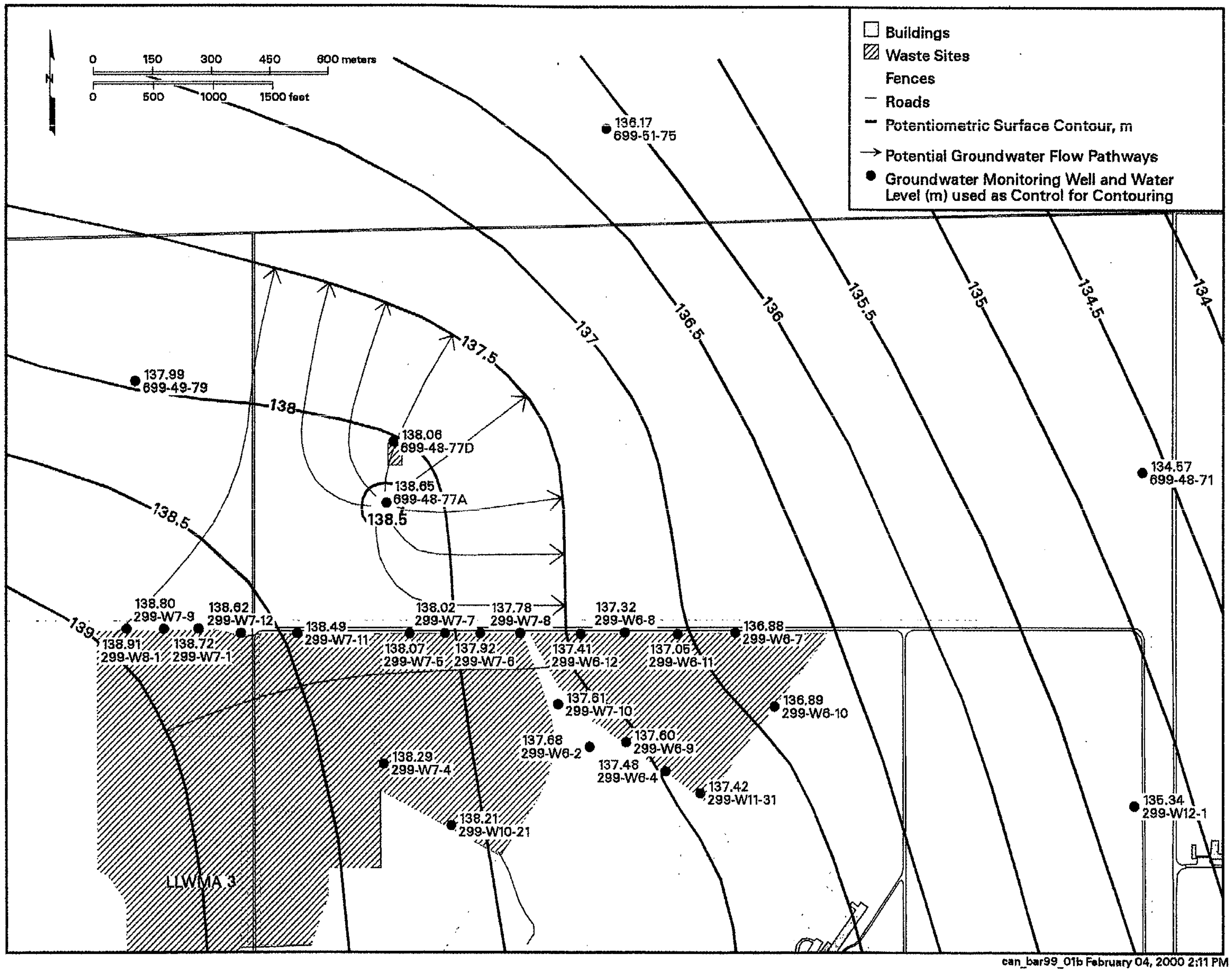


Figure 2.2. Water Table Map and Interpreted Groundwater Flow Directions in the SALDS Area, March 1999

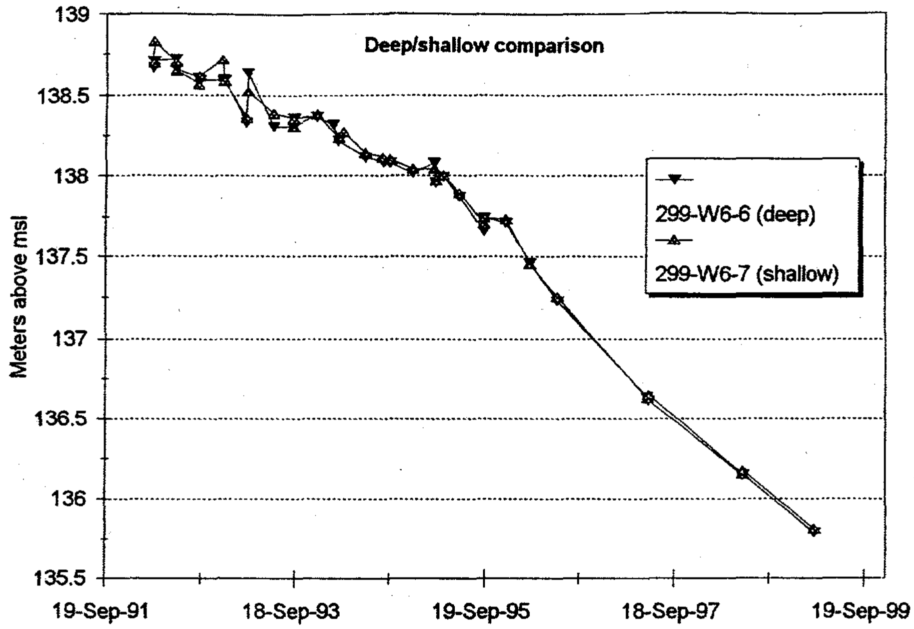


Figure 2.3. Hydrographs of Deep/Shallow Companion Wells in the SALDS Tritium-Tracking Network

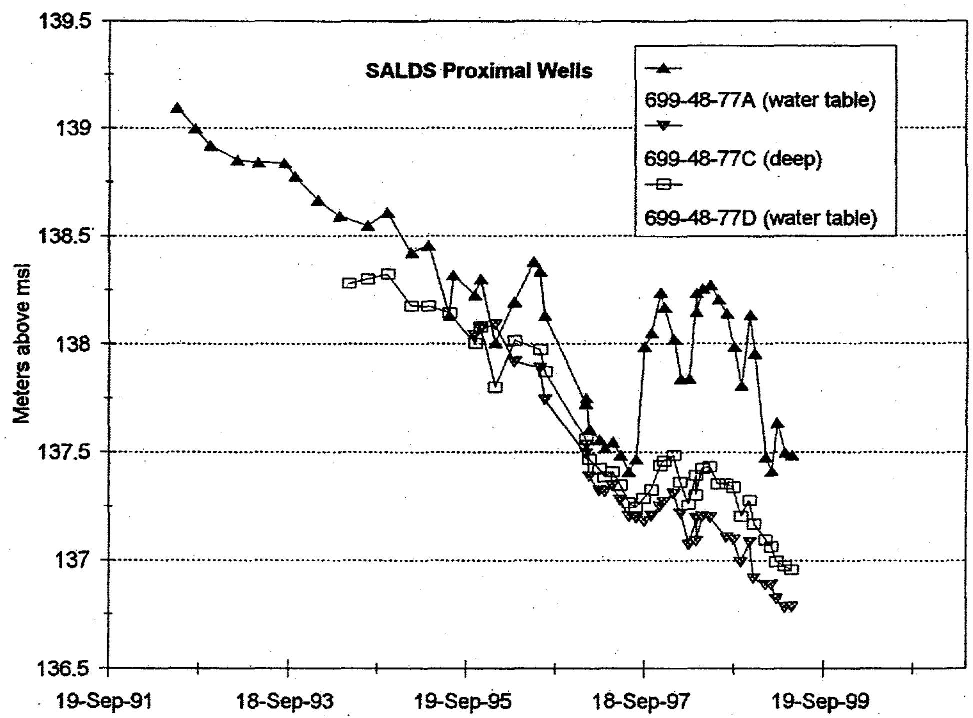


Figure 2.4. Hydrographs of SALDS Proximal Wells

The hydraulic potential between the unconfined (uppermost) aquifer and the confined, upper-basalt aquifers is also directed downward near the SALDS. However, the lack of measurable vertical gradient within the unconfined (uppermost) in the general vicinity of the SALDS (e.g., wells 299-W6-6 and 299-W6-7) suggests that significant discharge from the uppermost aquifer to the upper-basalt aquifers does not occur in this area, despite the potential for downward flow.

Annual-to-monthly water level measurements are made in all 21 wells in the SALDS tritium-tracking network. The composite hydrographs in Appendix C, grouped by their well locations relative to the SALDS, illustrate the results of these measurements over the last several years. The most obvious feature common to all wells in the network is the steady decline in water levels since the late 1980s. This decline is a result of the termination of effluent disposal activities within the 200 West Area over the past two decades. As a result of this, and the beginning of the SALDS operation, water levels in the SALDS proximal wells, most notably well 699-48-77A, are becoming consistently higher than water levels in the rest of the network wells.

Falling groundwater levels in the SALDS area is also limiting the service life of some of the tritium-tracking network wells. Table C.1 (Appendix C) indicates projected service life for SALDS tritium-tracking wells, based on a linear calculation of decline, and using the most recent 1 year of records (ending in May 1999). By this estimate, some wells in the network may have only a few years of service left, such as well 299-W7-9, which is projected to have <3 years left. Most of the wells at risk of going dry are located near the 200 West Area boundary, south of the SALDS. Loss of some of these wells may not significantly reduce network efficiency because of the density of well coverage in this area.

2.2.1 Vadose Zone and Aquifer Hydraulic Characteristics

During the site-evaluation of the SALDS in 1994, two shallow (~6.5 m) boreholes were drilled into the calcareous portion of the Plio-Pleistocene unit near the southwest and southeast corners of the SALDS drainfield for the purpose of conducting infiltration tests. The tests were conducted out of concern for the potential of the Plio-Pleistocene unit to cause excessive lateral diversion of effluent discharged to the SALDS. Three falling-head tests produced infiltration rates ranging from 0.9 $L \cdot day^{-1} \cdot m^{-2}$ at the southeastern corner to 66.8 $L \cdot day^{-1} \cdot m^{-2}$ in the southwest borehole. The only reliable constant-head test, from the southwestern borehole, yielded a hydraulic conductivity of 2.7E-3 $cm \cdot sec^{-1}$. No other in situ tests were conducted in the vadose zone, but laboratory analyses for saturated hydraulic conductivity (K_s) produced values ranging from 1.4E-2 $cm \cdot sec^{-1}$ in the upper, unsaturated portion of the Ringold Formation, to 5.3E-6 $cm \cdot sec^{-1}$ in the Plio-Pleistocene unit at a depth of ~11 m. The average (n=12 samples) laboratory-determined K_s for the Plio-Pleistocene unit was 3.0E-3 $cm \cdot sec^{-1}$, while the average (n=2) for the upper portion of the Ringold was 1.6E-2 $cm \cdot sec^{-1}$ (WHC 1994).

Three constant-rate aquifer tests were conducted at three intervals in well 699-48-77C during the drilling of this well in 1994 (Swanson 1994). Well 699-48-77D was used as an observation well. These tests produced estimates of K_s ranging from ~0.004 $cm \cdot sec^{-1}$ to ~0.042 $cm \cdot sec^{-1}$, with the lower estimate occurring in the upper ~one-third of the aquifer. Storativity was calculated at 0.0016 from one aquifer test within a semi-confining layer in the Ringold Formation, but a storativity value of 0.0005 was found to work best when applied to type curves for analyzing the remaining two aquifer test results. Both of these values are typical of confined aquifer storativity. Three slug tests were also performed in the same test intervals as the pumping tests and yielded comparable results.

2.2.2 Groundwater Flow

A derivative of the Darcy equation was used to obtain the magnitude of groundwater flow near the SALDS facility. The relationship is expressed by

$$\bar{v} = K_s I / n_e$$

where $\bar{v}$ is the horizontal component of average linear flow velocity, K_s is the saturated hydraulic conductivity, I is the horizontal component of hydraulic gradient, and n_e is the effective porosity of the aquifer material. Using the March 1999 regional hydraulic gradient of 0.0018, an assumed n_e of ~0.25 (Graham et al. 1981; Graham et al. 1984; Cole 1997), and the range of K_s from the constant-rate aquifer tests (~0.004 cm · sec^{-1} to ~0.042 cm · sec^{-1}), yields a $\bar{v}$ range of 3.0E-5 cm · sec^{-1} (0.03 m/day) to 3.0E-4 cm · sec^{-1} (~0.3 m/day). Using the gradient for March 1999 between wells 699-48-77A and 699-48-77D (0.004), results in a range for $\bar{v}$ of 6.0E-5 cm · sec^{-1} (0.05 m/day) to 6.7E-4 cm · sec^{-1} (0.6 m/day). Within a very restricted area immediately adjacent to the region of effluent infiltration at the SALDS, flow velocities presumably would be higher still because of the higher hydraulic head. Within and very near the area of infiltration, the greatest component of groundwater flow would be downward (see Section 4.0).

Based on the groundwater contour map for March 1999 (see Figure 2.2), groundwater flow in the general region around the SALDS is dominantly northeast. However, perturbations caused by effluent discharge to the facility produce a "radially" divergent flow close to the SALDS. The flow directions indicated in Figure 2.2 are interpretive in nature. For instance, it is not known how far groundwater flows southwestward from the SALDS before taking an easterly or northeasterly course. It should also be recognized that this figure represents only a *potential* flow field to illustrate probable direction of flow at any point in the field, and that actual translocation of water molecules (or tritium) has not occurred along a path equal to the entire lengths of the flow lines (i.e., lengths of the flow lines are arbitrary).

2.2.3 Comparison of Current Conditions with Numerical Model Predictions

Several numerical simulations of groundwater flow and transport have been conducted for the SALDS since the planning stage of the facility began in 1991. A summary discussion of these models and two relevant vadose-zone flow models is presented by Barnett et al. (1997). Early two-dimensional models (e.g., Golder 1991) used overly robust values for SALDS operation and assumed steady-state conditions. Some of these extra-conservative models predicted that tritium would reach the Columbia River in 100+ years at concentrations near the drinking water standard (DWS) at 20,000 pCi/L. Later, more sophisticated three-dimensional models, such as Chiaramonte et al. (1996), incorporated realistic operating scenarios for the SALDS, terms for tritium decay, and transient flow conditions. These models indicated that the tritium plume generated by SALDS would remain within ~2 km of the SALDS until the plume decayed.

The most recent groundwater numerical model for the SALDS used the three-dimensional Coupled Fluid, Energy, and Solute Transport (CFEST) code (Gupta et al. 1987) to predict hydraulic head and tritium plume extent through the year 2100 (C. R. Cole and S. K. Wurstner in Barnett et al. 1997). In this model, transient flow simulations using CFEST were performed for the period of 1980 through 2100. The SALDS was assumed to receive tritium from 1996 through 2025, and effluent with no tritium through 2034. One-year time steps were used, incorporating estimates of SALDS future discharge volumes and tritium quantities, and actual volumes and quantities through 1996. Model results were illustrated as hydraulic head distributions, lateral tritium plume extent, and vertical distribution of tritium in the vicinity of the SALDS.

Comparison of the model predictions for the year 2000 with actual late 1999 values indicate that the simulations are very close to reality. Figures 2.5 and 2.6 illustrate the predictions for head distribution and tritium concentrations, respectively, for the year 2000 near the SALDS. Hydraulic head at the SALDS in well 699-48-77D appears to be ~1 m lower than predicted by the model (138.0 versus 139.0--compare with Figure 2.2). However, the highest head for the March 1999 potential map (see Figure 2.2) near the SALDS is 138.65 m at well 699-48-77A, which is in virtual agreement with the 139 m value predicted by the model. Also, the actual high point of the SALDS groundwater mound for March 1999 is probably even closer to 139 m—somewhere between well 699-48-77A and the SALDS. Centering of the mound at well 699-48-77A is an artifact of contouring, because this well has the highest water level in the immediate vicinity.

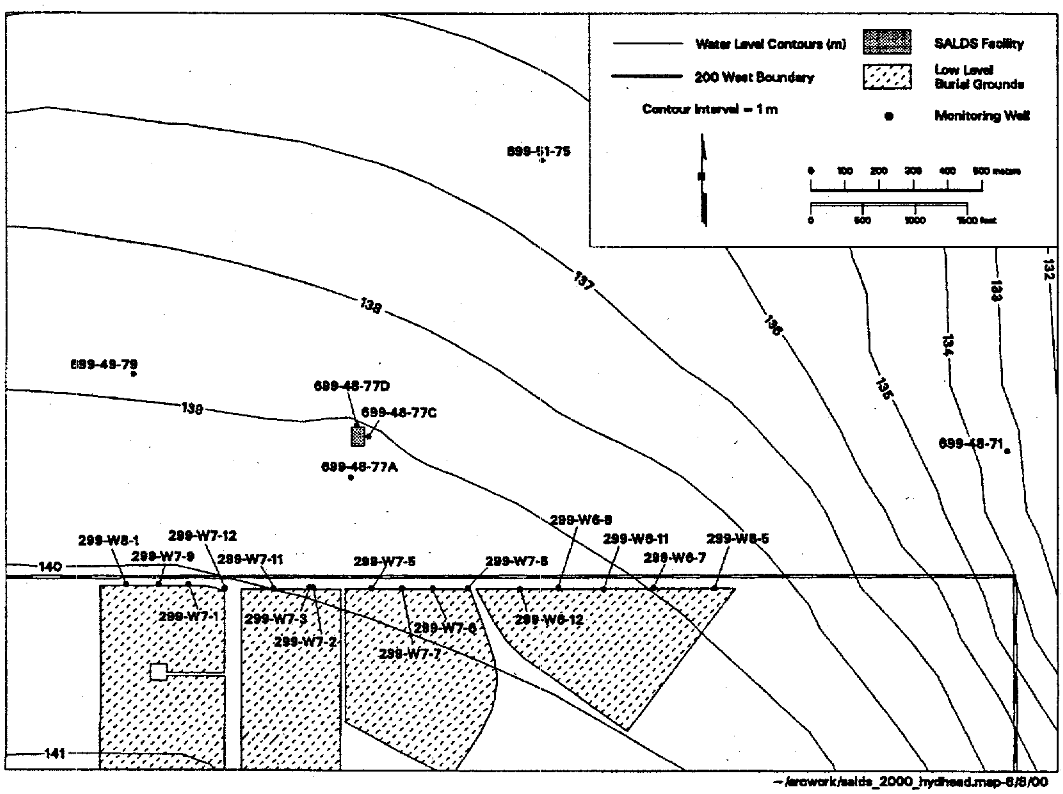


Figure 2.5. Hydraulic Heads Predicted in the Vicinity of SALDS in 2000

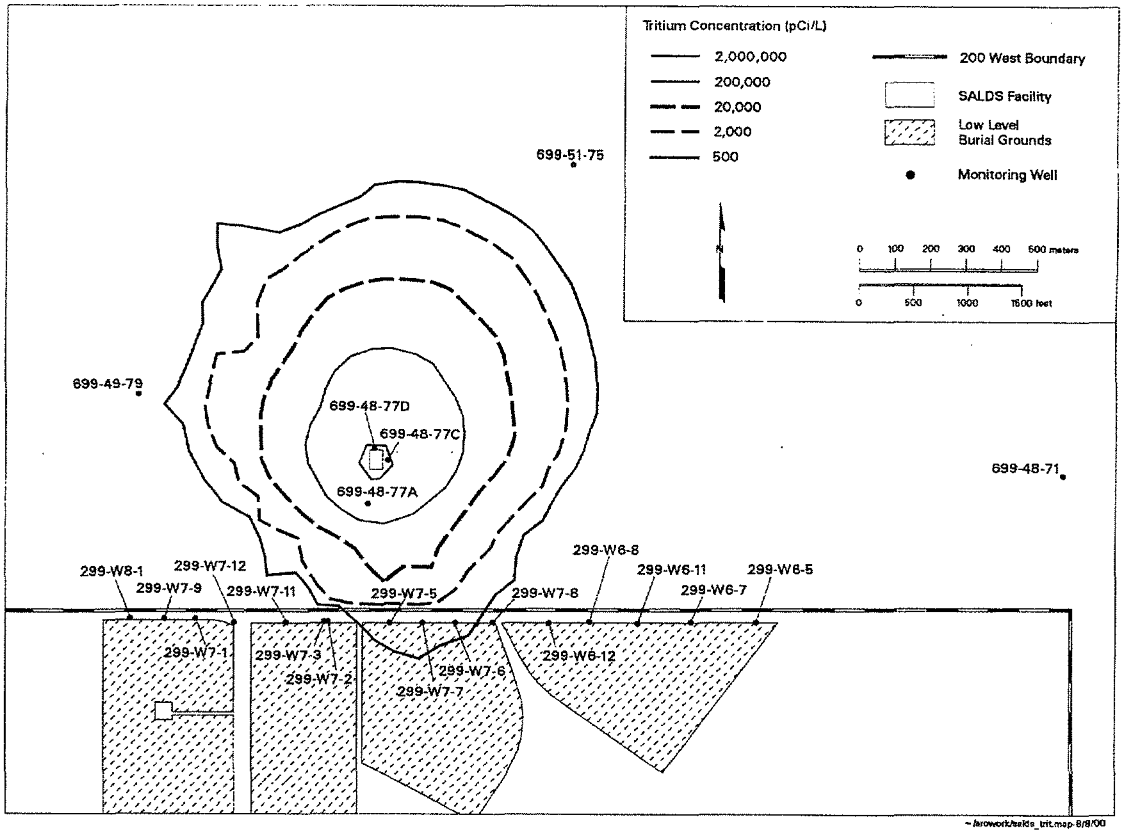


Figure 2.6. Tritium Concentrations Predicted in the Vicinity of SALDS in 2000

The extent of the tritium plume is greater in the simulation than actually observed (e.g., no increases in tritium have been observed in wells 299-W7-5, -W7-6, and -W7-7 [as of April 2000]), although the model predicts concentrations between 500 and 2,000 pCi/L in these wells by year 2000. Also, the model indicates tritium activities of ~20,000 pCi/L reaching nearly to the bottom of the aquifer in the vicinity of SALDS and nearly 200,000 pCi/L at the level at which well 699-48-77C is screened, 37 m above the bottom of the aquifer and ~20 m below the water table (see Barnett et al. 1997). Sampling in July 1999 indicated only 77,000 pCi/L in well 699-48-77C, but results from April 2000 produced results of ~430,000 pCi/L. However, this well produced tritium results of only 8,100 pCi/L as recently as January 1999, and only sporadic, low results in earlier samples. Thus, it is probable that tritium from the SALDS has not penetrated as deeply into the aquifer as quickly as the model predicts. The model does accurately predict the high levels of tritium observed in wells 699-48-77A and 699-48-77D (see Section 3.0).

One of the reasons for the departures between the year 2000 CFEST model predictions and actual observations for tritium distribution in groundwater is the discrepancies between projected and actual values for discharged tritium quantities. While actual versus modeled discharge effluent volumes are virtually identical (238M and 237M liters, respectively, 1997 through 1999), the total quantity of tritium sent to the SALDS through September 1999 (~304 Ci) is less than half of the quantity assumed for the model through 1999 (~649 Ci).

In summary, the CFEST model of Cole and Wurstner (in Barnett et al. 1997) accurately predicts the head distribution in the vicinity of the SALDS. The model appears to overestimate the lateral and, to a lesser degree, the vertical extent of tritium in the groundwater surrounding the SALDS, probably because the quantity of tritium released to the facility has been only one-half of the amount assumed by the model.

3.0 Tritium-Tracking Results and Groundwater Geochemistry

Groundwater sampling and analysis for the SALDS consists of two parts: tritium sampling in 21 wells surrounding the facility, and sampling for a larger list of constituents in the 3 SALDS proximal wells and 1 background well. This section describes the prominent historical analytical results from both of these efforts since the beginning of SALDS monitoring in 1992 through August 1999.

Some of the 21 wells in the tritium-tracking network have been sampled since the 1960s, but only the tritium results since January of 1995 (11 months prior to SALDS operation) are included in this discussion. The SALDS proximal well 699-48-77A was installed in 1992, and wells 699-48-77C and 699-48-77D were emplaced in 1994; analytical results for these wells begin during the years of installation. Well 299-W8-1 was designated as a replacement upgradient/background well for the SALDS in 1997, but groundwater monitoring in this well for the LLBG dates back to its installation in 1988. Because of its importance to historical groundwater conditions upgradient of the SALDS, analytical results since 1988 are examined for this well. The constituent lists and historical aspects of groundwater monitoring are discussed in Section 1.3.2. Evaluation of analytical results from the SALDS proximal and background wells focuses on the list of 16 parameters with groundwater enforcement limits or monitoring requirements found in Section S1.A. of ST-4500 (Washington State Department of Ecology 1995).

3.1 Results of Tritium Monitoring in Groundwater

Appendix D lists all historical results from the 21 wells in the tritium-tracking network from January 1995 through August 1999. Figure 3.1 shows the locations of the tritium-tracking wells, the maximum results for the latest monitoring period (FY 1999), and the trends in tritium activities since the previous year (FY 1998).

Only the three proximal SALDS wells (699-48-77A, 699-48-77C, and 699-48-77D), which are immediately adjacent to the facility, have indicated the effects of tritium disposal at SALDS. Figure 3.2 shows the trends for tritium activities in these three wells for the entire history of monitoring through July 1999.

Wells in the southeast portion of the network (i.e., 299-W6-7, 299-W6-8, 299-W6-11, 299-W6-12, 299-W7-6, and 299-W7-8) reflect the dissipating tritium plume that originated from the northeast portion of the 200 West Area. All wells in this area have shown a generally-downward trend in tritium activities (Figure 3.3), with the exception of well 299-W6-6, which is a deep companion of well 299-W6-7 and has not been affected by the 200 West Area tritium. Some wells, such as 299-W6-8 and 299-W6-11, appear at first to have recent increases in tritium activities, but these fluctuations are within the historical range of counting errors. The August 1999 increase in well 699-W6-11 represents a larger fluctuation from the 1998 result than the historical range, but the 1998 result is suspected of error. Also, the 1999 result is still in line with a continuing downward trend, and at a rate consistent with the historical rate of decline of tritium activities in this well.

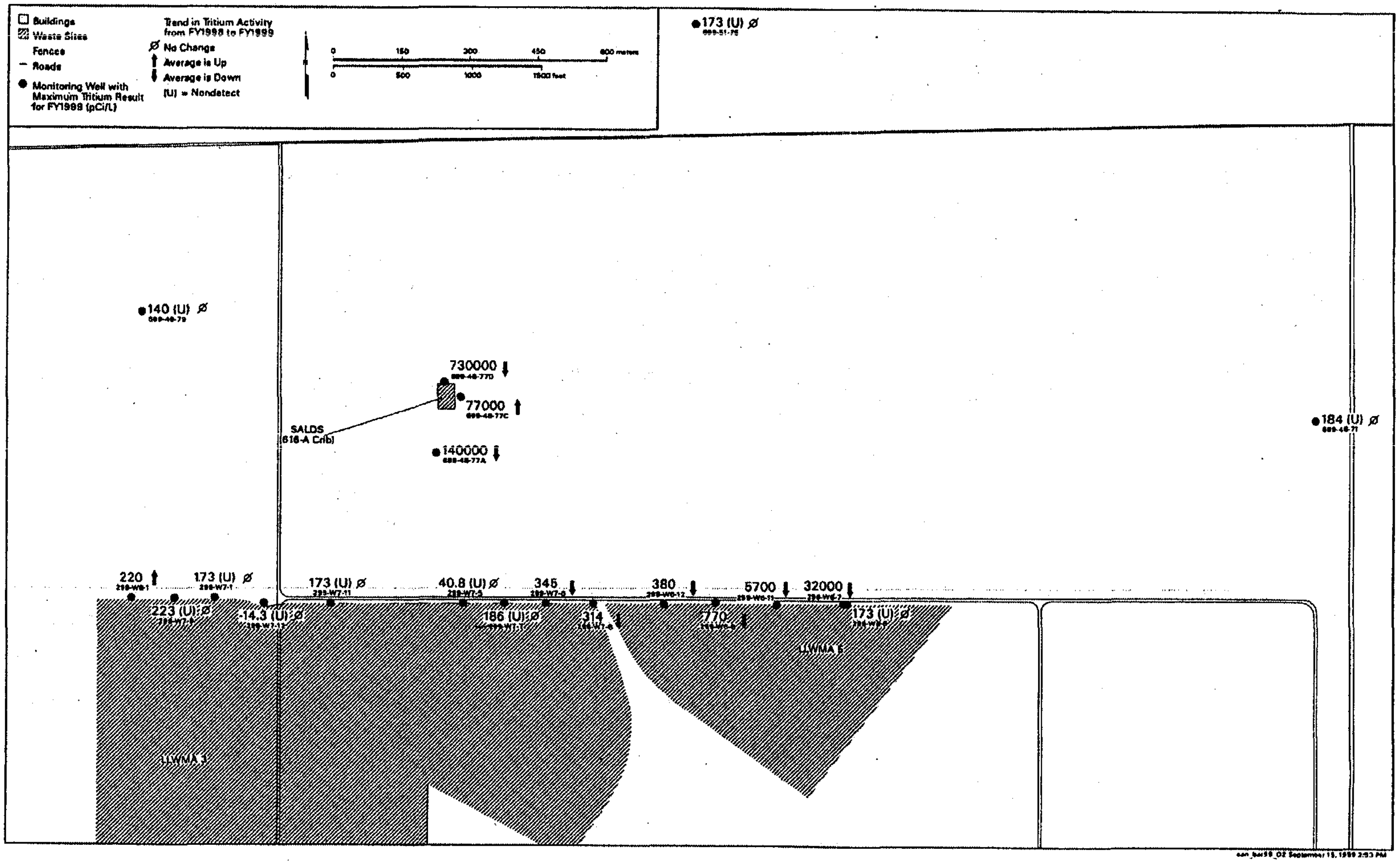


Figure 3.1. Maximum Tritium Activities in Groundwater for the SALDS Tritium-Tracking Well Network for FY 1999, Indicating Change from 1998

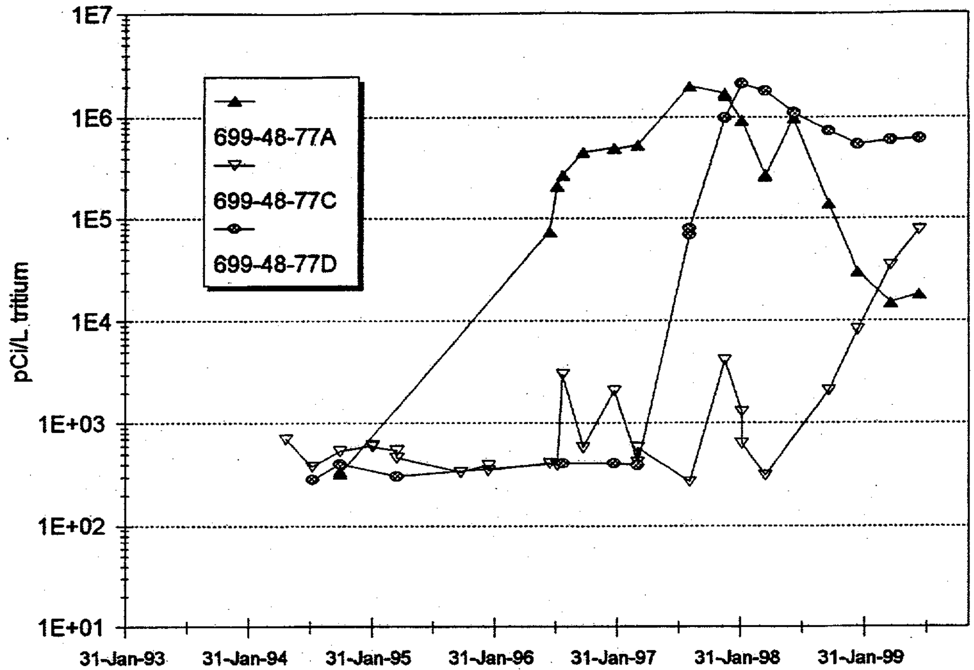


Figure 3.2. Trends of Tritium Activities in SALDS Proximal Wells Through July 1999

Well 299-W8-1, is nearly 1 km away from the facility, and is unaffected by discharges to the SALDS. This well produced one marginally-detectable tritium result of 220 pCi/L (minimum detectable activity [MDA] = 184 pCi/L) in July 1999, but has historically produced no detections since tritium monitoring began in this well in 1988. Three additional tritium results (including a September 1999 result) from this well during FY 1999 were also below detection.

Tritium first appeared in July 1996 in well 699-48-77A, which is the proximal well that is furthest from the SALDS drainfield (~100 m). Tritium activity in this well rose to a maximum of 2.0 E+6 pCi/L in September 1997, and has generally declined since then. The highest tritium activities detected in groundwater at the SALDS thus far is 2.1E+6 pCi/L from well from well 699-48-77D, which is only a few meters north of the facility and screened at the water table. However, tritium did not appear in this well until September 1997, more than a year later than in the more distant well 699-48-77A. The possible reasons for this apparent paradox are discussed in Sections 3.3 and 4.0. Proximal well 699-48-77C is completed deeper within the aquifer beneath the SALDS, and produced detectable tritium results (3,000 pCi/L) as far back as August 1996. Thereafter, detections of tritium were minimal and sporadic until October 1998, when tritium activities began climbing to 7.7E+4 pCi/L in July 1999 and most recently 430,000 pCi/L in April 2000.

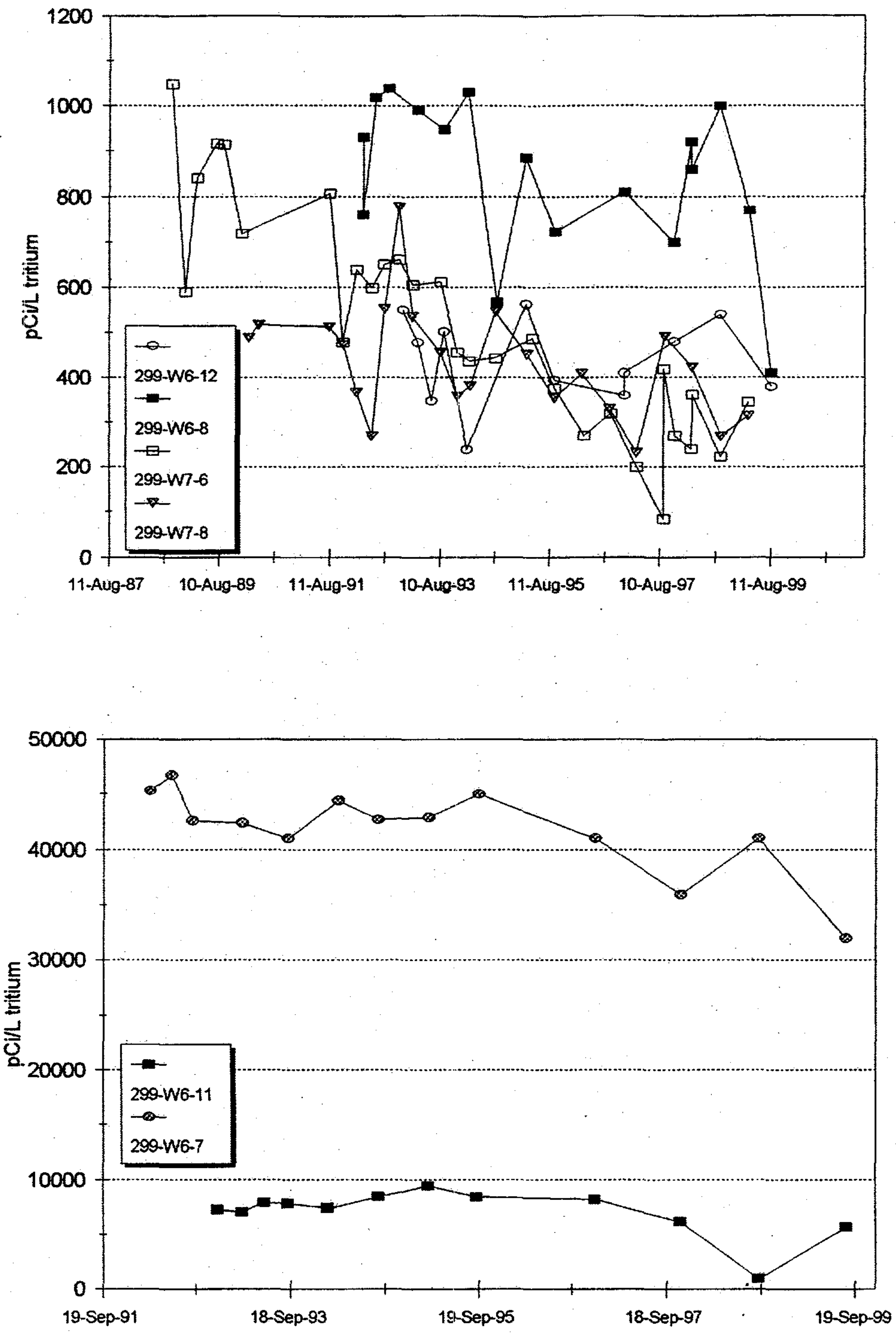


Figure 3.3. Trend Plots for Tritium in Wells in the Southeast Portion of the SALDS Tritium-Tracking Well Network

3.2 Groundwater Geochemical Results

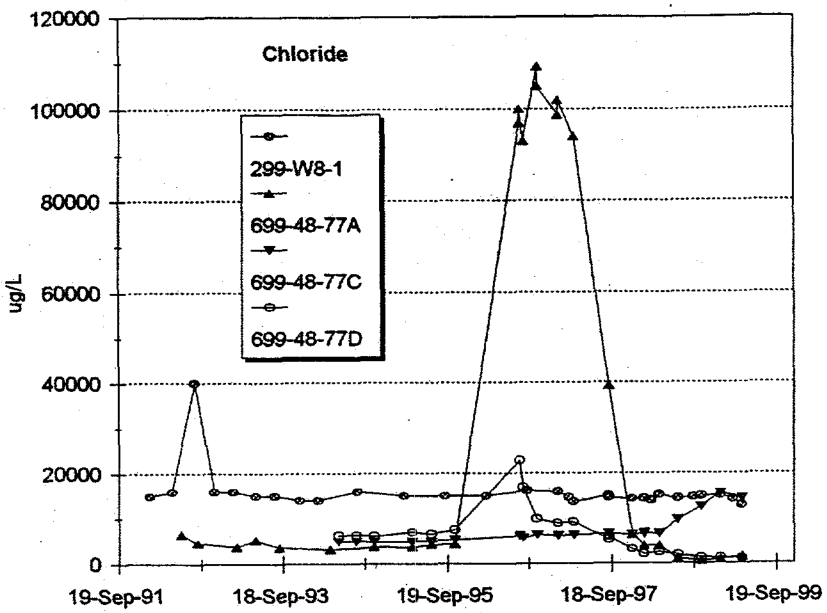
In addition to tritium, the three SALDS proximal wells and background well 299-W8-1 are sampled for a larger list of constituents. Enforcement limits for 16 (including tritium) of these constituents are assigned by ST-4500 for the three proximal wells (699-48-77A, 699-48-77C, and 699-48-77D). These 16 constituents, the corresponding enforcement limits, and the maximum, mean, and standard deviation through July 1999 for each are listed in Tables E.1 through E.4 in Appendix E. Also listed for comparison are Hanford sitewide groundwater background values for each constituent (from Johnson 1993 and DOE/RL 1997).

All analytical results of constituents with permit enforcement limits have historically been below those limits in all three proximal SALDS wells, with the exception of pH and one measurement of total dissolved solids (TDS). Wells 699-48-77A and 699-48-77D slightly exceeded maximum pH limits (8.5) once each in single laboratory measurements during 1994 and 1995, respectively. A laboratory measurement of pH from a sample taken from background well 299-W8-1 also produced a result of 9.08 in October 1998. Replicate measurements taken in the field for all of these samples were in line with historical results, and indicate that the laboratory measurements were not representative, and should not be used for compliance purposes. Loss of CO_2 and other processes during transport or handling may significantly alter the pH of a sample.

In 1996, well 699-48-77A produced a maximum TDS result of 654,000 µg/L, which is well above the permit enforcement limit of 500,000 µg/L. This result occurred in conjunction with elevated concentrations of anions and cations, and is attributed to the dissolution of natural soil components by clean SALDS effluent (see discussion below). The enforcement limit for this parameter has not been exceeded since the 1996 occurrence.

Figures 3.4 through 3.6 illustrate trends for concentrations of specific parameters in the SALDS proximal wells from the beginning of monitoring through July 1999. The increases in each of these constituents is most likely a result of the leaching of natural salts (e.g., gypsum, calcite) by dilute SALDS effluent during infiltration through the vadose zone (see Thornton 1997 and Barnett et al. 1997). During the entire period of SALDS operation (December 1995 to present) these same constituents have been below detections limits in most effluent verification samples (e.g., <200 µg/L sulfate; <1000 µg/L TDS). Well 699-48-77A shows the earliest and most pronounced response. The early appearance of sodium in this well in higher concentrations, prior to SALDS construction, may be the result of dissolved sodium bentonite clay used as a sealant during well construction. Concentration of this element fell off as remnant bentonite was washed out of the well environment over time. A few years later, the influx of SALDS effluent carrying dissolved soil components from the vadose zone (and possibly the remnants of the first source of sodium, i.e., the bentonite scale) resulted in another episode of elevated sodium.

Other parameters showing abrupt increases in concentrations (chloride, conductivity, sulfate, TDS, and dissolved calcium) all correspond to the arrival of elevated tritium in well 699-48-77A (approximately July 1996). Well 699-48-77D also produced abruptly elevated levels of chloride, conductivity, sulfate, and TDS at approximately the same time (July 1996) as occurred in well 699-48-77A, but without



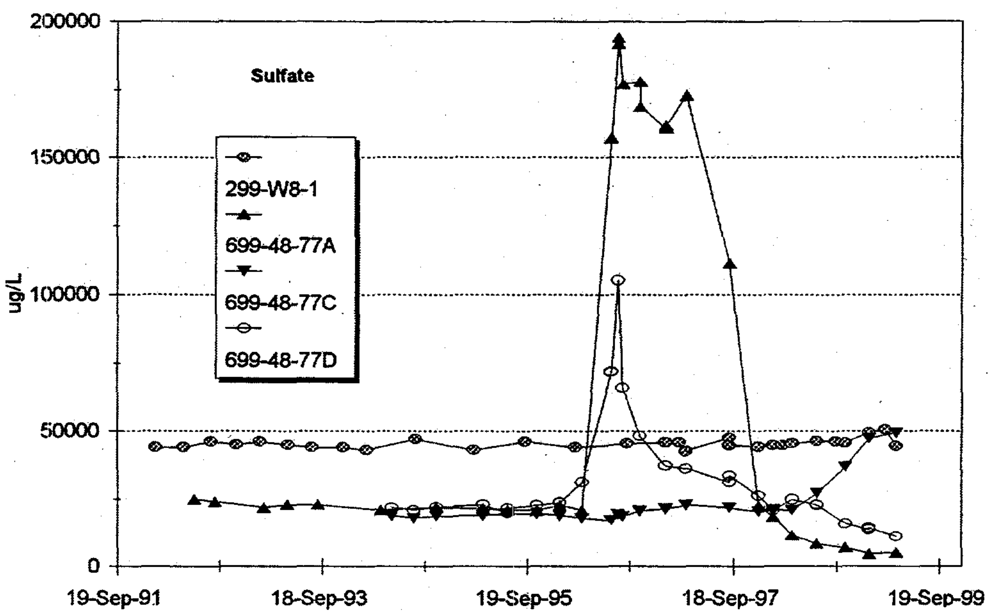


Figure 3.4. Trend Plots for Chloride and Sulfate in SALDS Proximal Wells and Background Well 299-W8-1

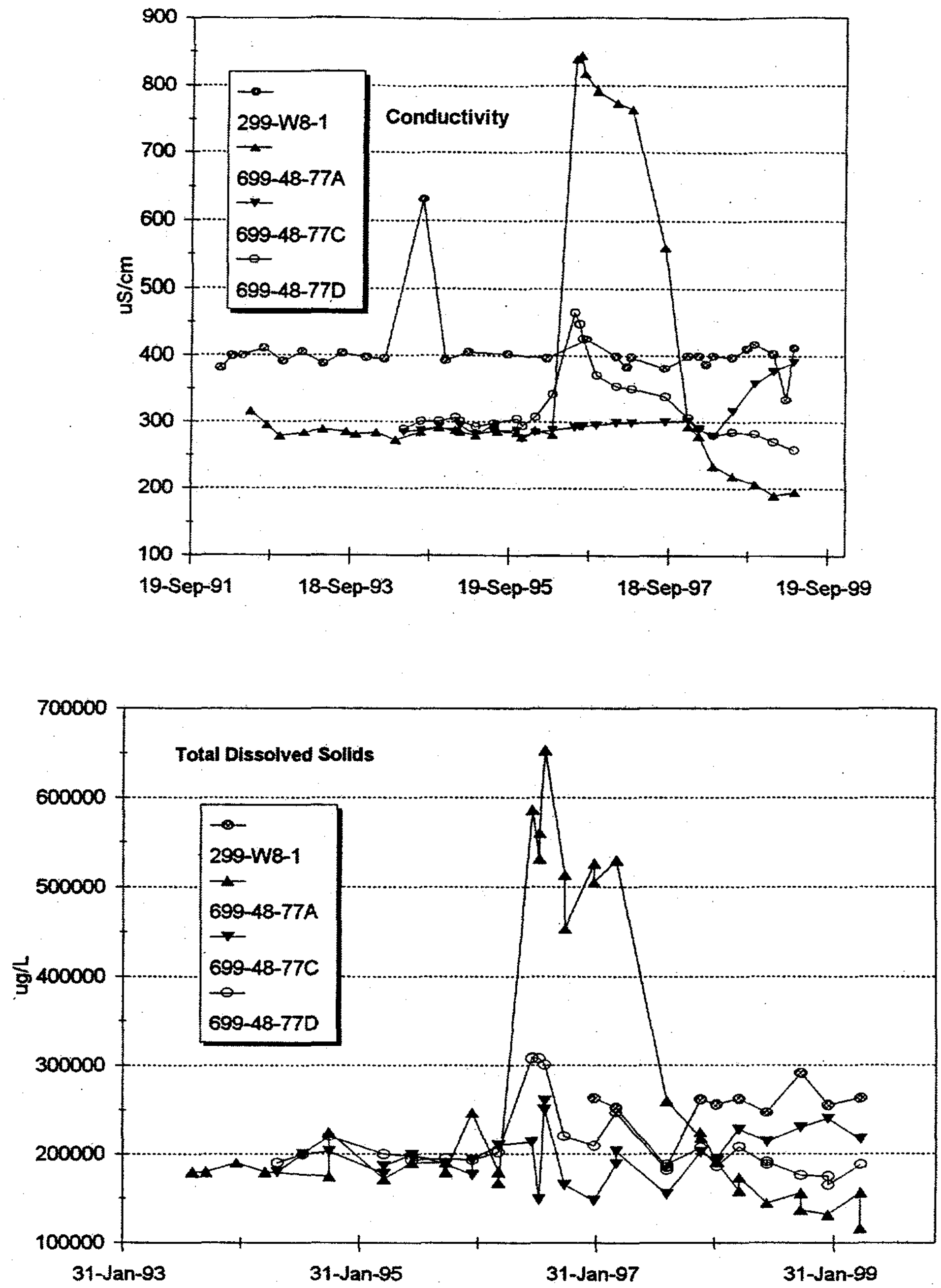
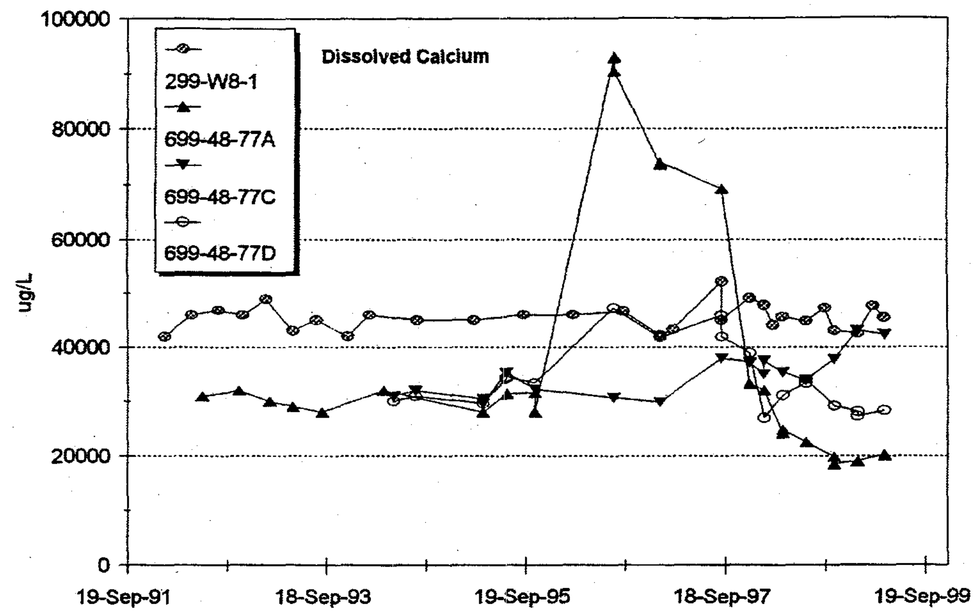


Figure 3.5. Trend Plots for Conductivity and Total Dissolved Solids in SALDS Proximal Wells and Background Well 299-W8-1



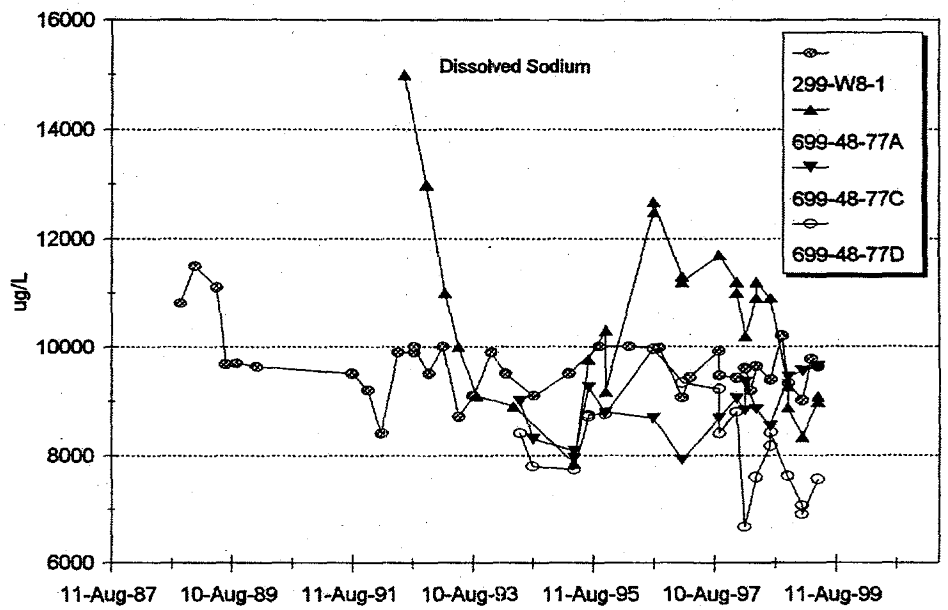


Figure 3.6. Trend Plots for Dissolved Calcium and Sodium for SALDS Proximal Wells and Background Well 299-W8-1

the appearance of tritium. Tritium did not appear in significant activities in well 699-48-77D until September 1997. The probable reasons for this disparity are discussed in Section 3.3.

With few exceptions, average concentrations for constituents with enforcement limits also fell below established Hanford Site background values for these constituents in the SALDS proximal wells. The exceptions include copper, mercury, strontium-90, and tritium, which averaged above at least one of the two sitewide background concentrations (Johnson 1993; DOE-RL 1997). Tritium has exceeded background in all three proximal wells due to the planned disposal of this isotope at the SALDS. Background values have not been calculated for the four organic constituents on the enforcement list.

Average concentrations of copper and mercury were consistently above the most conservative background values for these metals (1.37 μg/L and 0.004 μg/L, respectively) in all three proximal wells, as well as in background well 299-W8-1. The highest averages for both copper (5.23 μg/L) and mercury (0.32 μg/L) occurred in well 699-48-77D.

Strontium-90 results are reported above the DOE-RL (1997) sitewide background of 1.14 pCi/L, particularly in well 699-48-77D. However, an evaluation of the counting errors for strontium-90 suggests that some of these results are actually below detection limits; most of the remaining results barely exceed detection limits.

3.3 Discussion of Results

Concentrations for most constituents in the list of Appendix E are essentially uniform over time and are well within enforcement limits and sitewide background (where background has been calculated). Some exceptions are noted above in Section 3.2. The high standard deviation in constituents such as sulfate, TDS, and tritium in the proximal SALDS wells indicates the incursion of effluent from the SALDS. High standard deviations of some other constituents, such as metals, reflects the generally low concentrations of these. Occasional departures of a few micrograms per liter produce a dramatic rise in measures of variability, but actual concentrations remain very low.

Comparison of the trend plots for tritium in SALDS proximal wells with plots for sulfate, conductivity, and TDS reveals an apparent paradox. The arrival of tritium in well 699-48-77A is also marked by significant increases in sulfate, conductivity, chloride, TDS, calcium, and sodium. As noted, these constituents have been linked to dissolution of natural soil salts by the clean effluent discharged to the SALDS (Thornton 1997; Barnett et al. 1997). Well 699-48-77D also displays an abrupt increase in sulfate, TDS, and conductivity that corresponds in time with the increases in well 699-48-77A. However, tritium does not appear in elevated quantities in well 69-48-77D until late 1997—more than a year after the surge in concentration of the other parameters in this well. A possible explanation is that the early (tritium-free) tests of the SALDS/ETF system (see Section 1.3.1) in late 1994 to early 1995 involved small discharges of short duration. These may have been of insufficient volume to reach groundwater at well 699-48-77A, and may have remained impounded near the Hanford/Plio-Pleistocene contact due to the contrasts in hydraulic conductivity between these units (see Section 2.0). Later, when tritium discharges began in December 1995, the earlier discharges may have been virtually overtaken by the larger, tritium-bearing discharges in the vicinity of well 699-48-77A, and then forced downward due to the added hydraulic head. The same discharges in December 1995 would have applied additional hydraulic head to the early tritium-free effluent (with dissolved soil salts) already migrating toward well 699-48-77D within the ambient groundwater flow field.

Strontium-90 is reported slightly above detection limits in SALDS proximal wells and upgradient well 299-W8-1 sporadically. Most results above detection have been low (maximum = 7.1 in well 699-48-77C in December 1997) and, in some cases, within a few percent of counting error, near MDA, or sitewide background (see Appendix D). Because of the timing and locations of detections, it is unlikely that this constituent could have originated from the SALDS. Well 299-W8-1 produced detections of strontium-90 in late 1991 well before SALDS construction. Also, wells 699-48-77C and 699-48-77D produced detections of this isotope well in advance of other, more mobile constituents demonstrably resulting from SALDS discharges. Interestingly, well 699-48-77A, which responds most readily to SALDS discharge events, has produced only one detectable result for strontium-90, while wells 699-48-77C and 699-48-77D have produced 4 and 6 results, respectively. Evaluation of the counting errors for these analyses suggest that the results may be marginally detectable or even below detection. If the results are valid, it may be that discharges from the SALDS, which reach well 699-48-77A most easily and quickly, have a dilutive effect on existing groundwater, thus preventing frequent detections of trace constituents in ambient groundwater. Wells 699-48-77C and 699-48-77D have not been as dramatically affected by SALDS discharges until recently. Hence, remnants of preexisting groundwater constituents would be more easily detected.

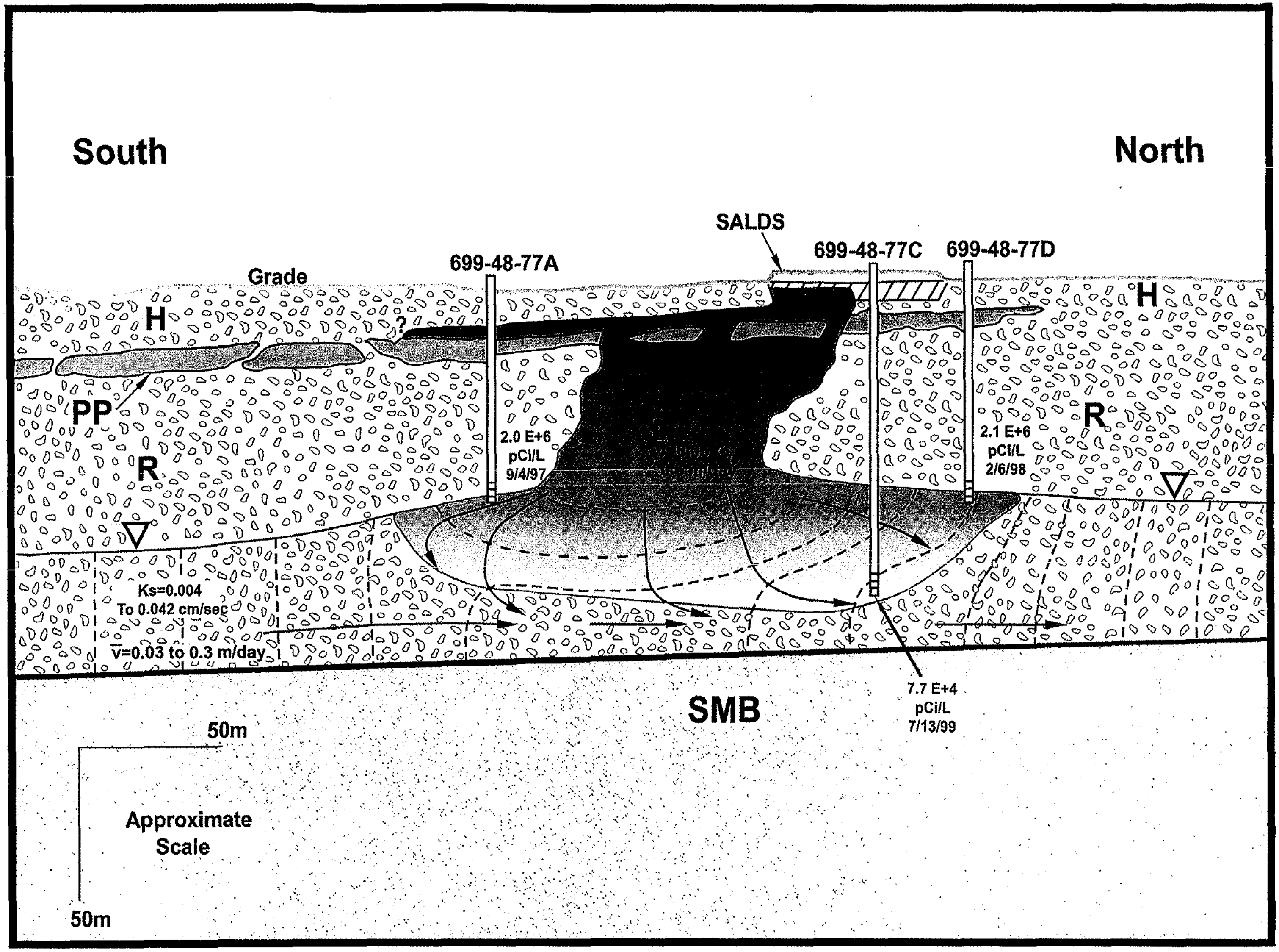
4.0 Conceptual Model

Drilling, hydrologic testing, and media analyses during construction of the SALDS and the proximal groundwater monitoring wells, and subsequent results of groundwater monitoring over the past ~7 years have provided abundant information with which to construct a concept of the SALDS physical setting and response to operation. Figure 4.1 illustrates schematically the effects of disposal on the subsurface at the SALDS and other features that have direct bearing on flow and transport of SALDS effluent in the vadose zone and uppermost aquifer. This model is prefaced on the information presented in previous sections of the document, the salient points of which are discussed below. These points are then synthesized to derive the model parameters. The model represents a scenario which will explain observations and measurements from testing and monitoring, and is used as a basis from which to formulate an effective groundwater monitoring plan.

4.1 Hydrogeology

Well 699-48-77A was installed as an upgradient well to the SALDS facility, but within 7 months of the beginning of facility operation this well was the first to respond to the discharges. All three wells in the proximity of SALDS produced a discernable hydraulic response to the first discharges, but well 699-48-77A responded far more intensely, suggesting a closer proximity and more direct connection to the point of effluent infiltration, despite its more remote location from the SALDS. This well has consistently maintained a higher hydraulic head, up to ~0.75 m higher, than the other two SALDS proximal wells. As Figure 4.1 indicates, effluent from the SALDS is probably entering groundwater at a point somewhere between well 699-48-77A and the SALDS. Water level measurements taken regularly in piezometers in the SALDS drainfield indicate that effluent is infiltrating mostly through the southern portion of the facility. The discharges create a local groundwater mound in the vicinity of this infiltration point, but groundwater flow resumes a northeasterly trend a short distance from the facility. Likewise, downward flow potential is enhanced in the vicinity of the effluent entry point. The effects of the head increase are transmitted throughout the thickness of the aquifer beneath the SALDS, but actual transport of effluent is more limited, and flow is maintained in a north/northeasterly trend near the bottom of the aquifer. This is suggested by the arrival times and distribution of tritium in SALDS proximal wells (see Section 4.2) and hydraulic head difference represented between wells 699-48-77C and 699-48-77D.

Travel time through the vadose zone to the well screen at well 699-48-77A was from ~5 to 8 months under the hydraulic head produced by the first routine discharges; the 3-month uncertainty is due to a quarterly sampling schedule. A period of relative inactivity (little to no discharge) at the SALDS occurred from July 1996 through June 1997 (see Figure 1.2). This was followed by a substantial increase in discharges in July 1997. The hydrograph of well 699-48-77A (Figure 2.4) indicates a dramatic decrease in hydraulic head around September 1996 (which may have begun even earlier), with a sudden rise in September of 1997. If these discharge/head-response events are correlatable, it would suggest a response time of only ~2 months in well 699-48-77A to these discharge events. This is strictly a hydraulic response to SALDS discharges and does not imply that effluent has migrated to the well. The hydraulic response time would be highly dependent on available head (i.e., the magnitude and duration of the discharge



ZTLC0064

Figure 4.1. Schematic Diagram of SALDS Operation and the Effects on the Uppermost Aquifer. Dashed lines are equipotentials; arrows indicate potential groundwater flow directions; H = Hanford formation; PP = Plio Pleistocene unit; R = Undifferentiated Ringold Formation; SMB = Saddle Mountains Basalt. Tritium results shown near the well screens are maximum activities observed as of July 1999.

event). As indicated in Figure 4.1, average linear flow velocity would naturally be greater at locations closer to the apex of the groundwater mound, where the point of infiltration adjoins the water table.

The average linear flow velocity of groundwater in the aquifer in the vicinity of SALDS depends on proximity to the small groundwater mound generated by the facility, the magnitude of which is in turn dependent on the facility's discharge schedule. As noted in Section 2.2.2, groundwater velocity very near the point of infiltration may be several times greater than it is a short distance away. Figure 4.1 depicts the higher flow rates (estimated at 0.05 to 0.6 m/day), based on the hydraulic gradient between wells 699-48-77A and 699-48-77D, which incorporates the zone of effluent infiltration. Immediately beneath the zone of infiltration the gradient is higher still, with a significant downward vertical component. A relatively short distance away from the facility, however, the hydraulic gradient falls off quickly, producing groundwater flow rates of only ~0.03 to 0.3 m/day.

4.2 Geochemistry

Tritium from SALDS operation was first observed in groundwater in well 699-48-77A in the July 1996 sample from this well. This means that tritium may have reached the well anytime between the April and July sampling events in 1996. Because tritium travels virtually in unity with water, it is assumed this represents the first observation of effluent from the SALDS. Hence, the length of time for the effluent to travel through the vadose zone to the water table is a maximum of 8 months; this would assume a point of infiltration at immediately above well 699-48-77A. More likely, the effluent reached the water table somewhere between the SALDS and this well, based on travel times calculated for groundwater flow and subsequent observations in the other SALDS wells.

Elevated levels of sulfate, TDS, and other constituents (see Section 3.0), derived principally from the Plio-Pleistocene evaporite unit, arrived at well 699-48-77A at the same time of the first tritium observation - approximately July 1996. However, elevated sulfate and other soil-derived constituents were detected in well 699-48-77D at the same time (July 1996) as in well 699-48-77A, *but without tritium.* This apparent paradox can be explained by the scenario presented in Figure 4.1. Early test discharges of clean water (without tritium) were discharged to the SALDS during late 1994 and early 1995 as part of engineering tests of the ETF/SALDS system (see Sections 1.3.1 and 3.0). The volumes of these tests were of lesser magnitude than subsequent discharges when operations began in late 1995. Thus, the effluent from these tests may have reached the water table in only scant quantities and under low head conditions somewhere between the SALDS and well 699-48-77A. The dissolved soil components (sulfate, etc.) moved north/northeast toward well 699-48-77D with the natural groundwater flow. Later, when operations began, with large volumes of effluent containing tritium, the additional head drove the dissolved soil salts from the test discharges more rapidly toward both wells. Because of the nearness of the infiltration point to well 699-48-77A, and the limited volume of the test discharges, the tritium-bearing discharges essentially overtook and combined with the soil salts signature from the test discharges, thus appearing as one event in well 699-48-77A. At the same time, the dissolved soil salts from the first discharges (without tritium) were driven more rapidly toward well 699-48-77D by the increased head of the tritium-bearing discharges and arrived there, coincidentally (within a three-month margin of error), at nearly the same time as the tritium and soil salts arrived together in well 699-48-77A.

More than a year later, tritium from the first operational discharges reached well 699-48-77D. For this sequence to occur would require that the point of infiltration be located somewhere between the SALDS and well 699-48-77A.

4.3 Discussion

Based on accumulated hydrologic and hydrogeochemical data, effluent from the SALDS is evidently creating a limited groundwater mound a short distance south of the facility, somewhere between the drainfield and well 699-48-77A in a north-south direction. The amount of east-west offset (if any) of the point of infiltration from the drainfield to well 699-48-77A is unknown, but cannot be appreciable if estimates of groundwater flow rates (Section 2.2.2) are reconciled with observations. Tritium was discharged to the SALDS beginning in December 1995, and was first observed in downgradient well 699-48-77D in September 1997. If a point halfway between well 699-48-77A and the southern edge of the SALDS is assumed for the point of infiltration, then the effluent discharged in December 1995 would have taken approximately 1.5 years to travel ~108 m to well 699-48-77D. If it is assumed that travel through the vadose zone consumed ~0.5 year (Lu et al. 1993; Barnett et al. 1997), then approximately 1 year would have been required for transport of tritium over the 108-meter distance. Thus, a rate of ~0.3 m/day is calculated for groundwater flow velocity in the direction of well 699-48-77D. This rate agrees reasonably well with the 0.6 m/day estimated by Darcy equation calculations in Section 2.2.2 for the higher groundwater flow rates near the SALDS. It should be recognized however, that the SALDS wells are sampled on a quarterly basis, and prior to the September 1997 sampling event, well 699-48-77D had not been sampled since April of 1997. This represents a potential 5-month discrepancy in the above travel-time estimate. If the five months are deducted from the travel time, a groundwater flow rate of ~0.5 m/day is calculated, which is even closer to the 0.6 m/day Darcy calculation for flow near the SALDS.

Hydraulic gradient decreases within a short distance from the facility as the influence of the limited groundwater mound diminishes, and thus results in a potentially lower groundwater flow rate (assuming that the hydraulic properties of the sediments are similar). As presented in Section 2.2.2, the estimate for groundwater flow rates outside the immediate influence of SALDS discharges is 0.03 to 0.3 m/day. If this range of flow rates is used to calculate travel time in a straight line from well 69-48-77D to the next downgradient well, 699-51-75 (699-51-75 is ~940 meters away, nearly directly downgradient of the SALDS—see Figure 2.2), groundwater would take from ~8.6 to 86 years to reach well 699-51-75 from well 699-48-77D. In comparison, numerical models of Cole and Wurstner (Barnett et al. 1997) estimated that tritium (at ~500 pCi/L) will reach well 699-51-75 in 2005, or about 8 years after reaching well 699-48-77D. However, as noted in Section 2.2.3, the numerical model assumed twice the tritium inventory that has actually been discharged thus far in the life of the facility. Hence, because of dilution and decay, tritium activities at observable levels (i.e., distinguishable from background) may require substantially more than 8 years to reach well 699-51-75. Likewise, the numerical model also predicts that tritium would be observed (at ~500 pCi/L) first in wells 299-W7-5, 299-W7-6, and 299-W7-7 sometime in 2000. The arrival of tritium at these wells may be slightly delayed as a result of the reduced tritium inventory in actual discharges. However, this is problematic because most of the tritium was discharged at the beginning of SALDS operations, and the actual discharge volumes (i.e., driving forces) have been almost exactly what the model assumed.

The extent to which remnants of the effluent flows to the south along the Plio-Pleistocene unit (see query in Figure 4.1 above Plio-Pleistocene) is unknown, but cannot be significant because of the discontinuous nature of the Plio-Pleistocene caliche as observed in test holes, and by virtue of the relatively rapid and intense response of well 699-48-77A to effluent discharges.

Effluent moves downward rapidly in the region of infiltration between the SALDS and well 699-48-77A, but, due to lack of sufficient head, probably does not reach the bottom of the aquifer. Also, because of a lack of vertical gradient within the aquifer away from the influence of the SALDS, it is expected that the greatest opportunity for detecting tritium migration will be near the water table rather than deeper in the aquifer, either in wells 699-51-75, 699-49-79, or wells immediately south of SALDS along the 200 West Area boundary (e.g., 299-W7-3, 299-W7-5, 299-W7-11).

As of the end of September 1999, ~2.7E+5 m^3 of effluent have been discharged to the SALDS. If we assume an average effective porosity of 0.2, then a saturated volume of soil equal to ~1.35E+6 m^3, or 110.5 m on a side, is needed to contain this volume of effluent. If the aquifer is ~66 m thick at the SALDS location (a conservative value, since it does not include mounding and a variably-saturated vadose zone), and were composed entirely of effluent, the area thus encompassed would be ~20,450 m^2. Or, assuming that the effluent spread evenly in all directions from the point of infiltration, and to a depth of 66 m, a circular surface area with a radius of ~81 m would be encompassed. Realistically, based on the observations of tritium occurrence near the facility in well 699-48-77C, it is highly unlikely that the effluent has displaced preexisting groundwater to the base of the aquifer. Furthermore, the effects of the Plio-Pleistocene stratum and Ringold semi-confining layers (see Section 2.1) have probably aided additional lateral spreading of effluent in the vadose and saturated zones beneath the SALDS. Preferential movement to the south in the vadose zone is already suspected as a mechanism for translocating the point of infiltration to groundwater. Factors of dispersion are also not accounted for in this estimate. Hence, the area of lateral spreading is undoubtedly somewhat greater, and the calculated area would be considered a minimum. Nevertheless, the estimate does illustrate the generally limited dimensions of the sediment volume that is thus far needed to contain SALDS discharges.

4.4 Conclusions

From the above discussions, it can be surmised that:

- Effluent from the SALDS drainfield is diverted laterally in the vadose zone by a relatively impermeable, but discontinuous evaporite horizon (the Plio-Pleistocene unit), such that effluent enters the aquifer at a location north of the SALDS, between the SALDS and well 699-48-77A (as viewed in a north-south plane).

- The effluent will dilute in the groundwater and spread "radially" away from the small groundwater mound for a limited distance before returning to a northeasterly direction of flow.

- Arrival times of tritium in network wells outside of the SALDS proximal wells will occur later than predicted by the numerical model because of the reduce tritium inventory in actual discharges.

- The arrival of tritium at wells outside of the SALDS proximal wells may occur within the next year at one or more of the wells near the 200 West Area boundary, depending on the intensity of SALDS operations. Arrival of tritium at downgradient well 699-51-75 will occur in >5 years (i.e., later than 2005).

- The interplay between hydrostratigraphic features, SALDS discharge schedule, and tritium inventories will ultimately determine which well(s) will be affected next and the timing of these events.

- Well 299-W8-1, which has been used as a background water quality well is no longer a legitimate monitoring point for groundwater quality comparisons for the SALDS. The hydrologic changes brought about by SALDS operation have altered flowpaths in this region, such that groundwater at well 299-W8-1 no longer flows past the SALDS site.

Although well 699-51-75 is almost directly downgradient of the SALDS (Figure 2.2), it is at a considerable distance from the facility compared to the proximal wells. Simply because of this distance, it would be prudent to monitor the deep piezometer companion to this well, 699-51-75P, in case vertical migration has occurred between the SALDS and this well site. Wells at the 200 West Area boundary projected to detect tritium in 2000 are currently monitored on a semiannual schedule in anticipation of the arrival of the tritium plume. Well 299-W8-1 is no longer a valid monitoring point for upgradient groundwater quality. However, this well should still be sampled for tritium on an annual basis to ensure the full extent of SALDS effluent is not overlooked. SALDS proximal wells alone should be sampled for permit-regulated constituents (including tritium). Historical records from upgradient wells (near 200 West Area) could be useful in resolving minor detections of various constituents, but increasingly, the mound at the SALDS is forcing preexisting groundwater away from the facility. Thus, only remnant quantities of historical groundwater constituents remain beneath the SALDS.

5.0 Groundwater Monitoring Program

The groundwater monitoring plan presented in this section is prefaced on experience and data collected thus far from groundwater monitoring at the SALDS. The changes made in this plan from the original plan of Davis et al. (1996) are relatively minor, and include an elimination of constituents that are no longer considered appropriate for groundwater quality evaluation at the SALDS, based on historical monitoring of effluent and groundwater. Additional changes from current monitoring practices (see Section 1 and Davis et al. 1996, Barnett et al. 1997) include: an increase in the frequency of measurement of tritium activities in some tritium-tracking wells; the elimination of a well as an upgradient monitoring site; and the addition of a deep tritium-monitoring point in the uppermost aquifer downgradient of the SALDS.

5.1 Monitoring Objectives and Scope

The primary objectives of this groundwater monitoring plan remain largely identical with those of the initial plan of Davis et al. (1996), generally, to determine the effects on groundwater, both chemical and radiological (from tritium), of SALDS operation. The specific objectives of the 1996 plan were to:

- determine if groundwater quality has changed from pre-operational conditions
- evaluate any potential impact the SALDS may have on groundwater quality in the uppermost aquifer
- demonstrate compliance with ST-4500 (Ecology 2000) and enforcement limits
- track the migration of tritium in the aquifer as it enters groundwater from SALDS operations.

Because much more is now known about the effects of SALDS operation on the groundwater, some of the approaches to addressing these objectives, and the relative importance of each, have changed. It is already demonstrated that groundwater quality has changed from pre-operational conditions, but to what degree it has changed remains an ongoing issue. That the SALDS has impacted groundwater quality near the facility is no longer in question, but how this has occurred, its longer term effects, and what further impacts may be expected in the future are still of prime concern. Compliance with the permit conditions and comparison of groundwater results with enforcement limits will remain unchanged as a primary objective, although the permit requirements themselves may change. Tracking the migration in groundwater of tritium originating from the SALDS will continue to be the main objective of the monitoring program. Tritium is the only constituent deliberately discharged to the facility. Because of its radiological nature and virtually non-retarded movement in groundwater, it is, therefore, of special interest not only as a contaminant, but as a metric of the maximum extent of SALDS influence in the groundwater.

Additional objectives, which may be viewed as subsets of the primary groundwater monitoring objectives, include the correlation of discharge events to observations in groundwater. Also, tracking the movement of the tritium plume generated by SALDS will include the comparison of actual observations with numerical model predictions.

5.2 Monitoring Well Network

The monitoring well network for tritium tracking and chemical monitoring (proximal wells) will remain essentially the same, but with one addition—the deep piezometer 699-51-75P (Figure 1.3) will be added to the tritium-tracking portion of the network to monitor the deep portion of the aquifer at this location. Table 5.1 shows all 22 wells to be used in the SALDS network. Because of declining water levels, some wells in the network may have only a few years of service left (see Section 2.2 and Appendix C). However, the estimated well life is based on standard sampling procedures using a dedicated pump. Well life could be extended, if for tritium sampling only, by using alternative sampling methods, such as bailing. If wells are taken out of service because of drying or other circumstances, those wells will be evaluated for their importance to the network. If network coverage is compromised by the loss of a well, so as to significantly decrease monitoring efficiency, replacement or deepening of the well will be considered. Construction details for all wells in the SALDS tritium-tracking network are presented in Appendix E.

Well 299-W8-1 was selected to replace well 699-48-77A as the "upgradient" or background well in 1997 when discharges to the SALDS formed a slight groundwater mound beneath the facility and disqualified well 699-48-77A as an upgradient location (see Section 1.3.2). This same phenomenon has also compromised the "upgradient" status of well 299-W8-1 (see Section 2.2). The SALDS proximal wells are no longer in the flow path of groundwater passing the location of well 299-W8-1, hence, this well is not effective as an upgradient or background groundwater quality well. In fact, as long as discharges continue to the SALDS at historical or higher rates and a hydraulic mound is maintained, no well will provide an adequate or representative "upgradient" location for the facility. For this reason, well 299-W8-1 will be discontinued as a background water quality well for SALDS, and will be retained for tritium analyses only. Wells 699-48-77A, 699-48-77C, and 699-48-77D, in the immediate vicinity of the SALDS, will be retained for monitoring groundwater quality, in addition to tritium, as described below. The analytical results from these three wells will be compared with permit enforcement limits for compliance purposes.

5.3 Sampling and Analysis Plan

This section describes all activities pertaining to the collection, analysis, interpretation, and reporting of groundwater data from the 22 wells in the SALDS tritium-tracking network. Where possible, these efforts will be coordinated with other Hanford Site groundwater programs to maintain maximum technical and resource efficiency. Sampling and analysis for SALDS will conform to protocols in the *Implementation Guidance for the Groundwater Quality Standards* (Washington State Department of Ecology 1996).

5.3.1 Sampling Schedule

Table 5.1 lists the SALDS network wells with corresponding sample frequency and nominal month(s) of sampling. Sampling for the proximal SALDS wells will remain on a quarterly frequency. All wells will be sampled for tritium in January, with semiannually-scheduled tritium-tracking wells sampled in

Table 5.1. Sampling Schedule for SALDS Wells

Well	Sample Frequency/ Months(a)	Other Facilities/ Programs	Comments
299-W6-6	A/January	Surv-3	Deep companion to W6-7 (screen 418 to 429 ft)
299-W6-7	A/January	Surv-3	Shallow companion to W6-6 (screen 246 to 267 ft)
299-W6-8	A/January		
299-W6-11	A/January		
299-W6-12	A/January	Surv-3	
299-W7-1	A/January	LLBG	
299-W7-11	S/January, July	LLBG	
299-W7-12	A/January	LLBG	
299-W7-3	S/January, July	LLBG	Screened near bottom of aquifer
299-W7-5	S/January, July	LLBG	
299-W7-6	S/January, July	LLBG	
299-W7-7	S/January, July	LLBG	
299-W7-8	A/January	LLBG	
299-W7-9	A/January	LLBG	
299-W8-1	A/January	LLBG	
699-48-71	A/January	Surv-3	
699-48-77A	Q/January, April, July, October	Surv-3	Sampled for additional constituents (plus tritium)
699-48-77C	Q/January, April, July, October		Sampled for additional constituents (plus tritium)
699-48-77D	Q/January, April, July, October		Sampled for additional constituents (plus tritium)
699-49-79	A/January	Surv-3	
699-51-75	S/January, July	Surv-3	
699-51-75P	A/January		Deep companion to 699-51-75 (piezometer)

(a) Actual months of sampling may vary slightly due to program coordination, but frequency is maintained.
A = Annual.
S = Semiannual.
Q = Quarterly.

Other Programs Using Wells
Surv-3 = Sitewide surveillance triennial sampling.
LLBG = Low-Level Burial Grounds.

January and July. Six wells (299-W7-3, 299-W7-11, 299-W7-7, 299-W7-5, 299-W7-6, and 699-51-75) will be sampled semiannually for tritium because of the greater likelihood, as indicated by numerical modeling, that these wells would detect tritium from SALDS before other wells in the network. The three proximal SALDS wells will remain on a quarterly sampling schedule, but the former upgradient well 299-W8-1 is reduced to annual frequency for tritium sampling only (see Section 5.3.2).

5.3.2 Constituents List

Tritium analyses will be conducted for all 22 wells in the network according to the schedule in Table 5.1. Analyses for additional constituents will be conducted for the three SALDS proximal wells on a quarterly-to-annual basis, depending on parameter. Table 5.2 lists the parameters for the proximal wells and frequencies for each.

Table 5.2. Constituent List for SALDS Proximal Wells (699-48-77A, 699-48-77C, and 699-48-77D)

Constituent (μg/L unless noted)	Enforcement Limit	Frequency	Method[a]
Acetone	160	Q	SW-846 8260
Benzene	5	Q	SW-846 8260
Chloroform	6.2	Q	SW-846 8260
Tetrahydrofuran	100	Q	SW-846 8260
Alkalinity (field)[b]	NA	Q	Field[c]
Cadmium, total	10	Q	EPA-600, 200.8
Conductivity (field μS/cm)	MR	Q	Field[c]
Copper, total	70	Q	EPA-600, 200.8
Dissolved Oxygen (field)[b] (mg/L)	NA	Q	Field[c]
Field pH (pH units)[b]	6.5 - 8.5	Q	Field[c]
Gross Alpha (pCi/L)	MR	Q	Laboratory specific
Gross Beta(pCi/L)	MR	Q	Laboratory specific
Laboratory pH (pH units)	NA	A	EPA-600, 150.1
Lead (total)	50	Q	EPA-600, 200.8
Mercury (total)	2	Q	EPA-600, 200.8
Strontium-90 (pCi/L)	MR	Q	Laboratory specific
Sulfate	250,000	Q	EPA-600, 300.0
Temperature (field)[b] (°C)	MR	Q	Field[c]
Total Dissolved Solids	500,000	Q	EPA-600, 160.1
Tritium (pCi/L)	MR	Q	Laboratory specific
Turbidity (NTU)[b]	NA	Q	Field[c]
Water-level measurement (m)	MR	Monthly	Field[c]

(a) Methods with equal or greater sensitivity may be substituted when appropriate.
(b) The average of four sequential measurements after readings have stabilized.
(c) Field methods are determined by company-specific procedures, based on EPA methods, and by instrument manuals.
MR = Constituent is not assigned an enforcement limit, but is subject to routine monitoring and reporting.
NA = Recommended by Implementation Guidance for Groundwater Quality Standards (Ecology 1996) or required for consistency with Hanford Groundwater Monitoring Project.
A = Annual.
Q = Quarterly.

The list of constituents in Table 5.2 is similar to the previous list for these wells in the first SALDS permit, with some exceptions. Ammonia, which was rarely detected in SALDS groundwater analyses (see Appendix D), is eliminated. Metal analyses will be performed for both filtered and unfiltered samples. Sample pH has historically been determined in the laboratory by a single measurement. Experience from other Hanford Site groundwater programs indicate that replicate field measurements of pH are typically more reliable and consistent than single laboratory measurements from the same sampling event. The effects of transport and storage may occasionally have deleterious effects on the samples, such as loss of CO_2, which may cause elevated pH results. Henceforth, averaged quadruplicate measurements of pH, taken in the field after readings have stabilized, will be used as the determinant of this property for future comparisons, instead of single laboratory measurements. Laboratory pH measurements will be continued annually for comparison with field readings, to determine sample changes during handling.

Replicate field measurements of dissolved oxygen (DO) will also be made during each sampling event to ensure that the samples taken represent geochemical conditions in the aquifer, and to establish a baseline chemical signature for the well. As with pH and conductivity, DO measurements will be taken in succession until readings stabilize prior to sampling, then the final four readings recorded. Levels of DO will also be measured and recorded prior to sampling in all tritium-tracking wells, according to the schedule in Table 5.1.

5.3.3 Water Level Measurements

Water level measurements will be taken in each well in the network in conjunction with every sampling event (annual to quarterly basis—see Table 5.1). In addition, water levels will be measured monthly in the SALDS proximal wells, 699-48-77, 699-48-77C, and 699-48-77D. Monthly measurements taken in these wells will allow a more accurate assessment of the hydraulic response of the groundwater system to SALDS discharges. All water level measurements will be taken prior to purging and sampling of wells.

5.3.4 Quality Assurance and Control

Provisions for groundwater sampling, analysis, and data validation procedures and criteria are governed by the *Liquid Waste Processing Facilities Quality Assurance Project Plan* (QAPjP) (Olson 1997). Analyses are performed by an accredited laboratory as authorized by WAC 173-50, *Accreditation of Environmental Laboratories* (Ecology 1990), and are a reflection of *Test Methods for Evaluating Solid Wastes, Physical/Chemical Methods* (U.S. EPA 1986). Additional or alternative procedures/methods are compliant with SW-846, Chapter 10. Details of analytical methods are described in *Standard Methods for the Examination of Water and Wastewater* (Eaton et al. 1995). Procedures for field analyses are specified in the subcontractor's or manufacturer's manuals.

5.3.5 Well Purging and Sample Collection

Prior to sample collection, each well will be purged of one well volume of groundwater. Following purging, a sample may be collected when field parameters (pH, conductivity, temperature, turbidity) have stabilized. Pumping rates for purging and sampling should be sufficiently low such that sample turbidity is kept to a minimum. Based on development results and prior sampling experience, pumping rates for sampling and purging should not exceed 5 L/min (1.3 gal/min) in wells 699-48-77A and 699-48-77C, and should be ≤42 L/min (11 gal/min) in well 699-48-77D. Turbidity must be ≤5.0 NTU prior to sample collection in these wells. The pumping/purging rates are not as critical in wells sampled for tritium only, but turbidity should be below 10 NTU prior to sampling. If these turbidity criteria cannot be achieved, field personnel will contact the project scientist in charge of data interpretation or the project engineer in charge of data validation. Readings for dissolved oxygen will also be monitored for stability prior to sampling.

Groundwater purged from the SALDS tritium-tracking wells within the 200 West Area boundary falls under containment criteria in DOE-RL (1990) and is not discharged to ground surface. Wells in the SALDS network outside the 200 West Area boundaries currently do not require containment. If future analyses indicate containment is necessary, procedures for containment and disposal will follow *Strategy for Handling and Disposal of Purgewater at the Hanford Site* (DOE-RL 1990).

5.4 Groundwater Flow Determination and Modeling

Groundwater elevations in the three SALDS wells will continue to be measured monthly and at the time of sample collection. Water level measurements in other SALDS tritium-tracking wells will be made at the time of sampling. Determination of groundwater flow rate and direction will be made annually, at minimum, for the purpose of ensuring adequate understanding of hydrologic conditions in the aquifer in the vicinity of the SALDS. Groundwater flow rate will be determined using the average linear flow equation derived from the Darcy relationship, as presented in Section 2.2.2 of this document. Contouring and interpretation of the water table will occur once annually, at minimum, and the direction of groundwater flow will be estimated by the mapping of hydraulic head in the aquifer beneath and in the vicinity of the SALDS.

The CFEST-based numerical groundwater model by Cole and Wurstner (in Barnett et al. 1997) or an equivalent model will be reapplied using actual discharge volumes and tritium quantity since 1996, and will incorporate revised estimates for future operation of SALDS. The model will be reapplied upon the occurrence of one or more of the following:

1. once during the 2000-2005 permit cycle (5 years)

2. in the event that elevated tritium appears in a well at a time significantly sooner than the model predicts

3. within six (6) months of detection of the SALDS tritium plume in a monitoring well where tritium has not been previously detected

4. detection of tritium at a location not forecasted by the model.

The reporting format for the groundwater/tritium-plume numerical model will include hydrogeologic information and historical background discussion necessary to understand the application of the model. The report will also include a description of the model code used, an illustration of the modeled domain, and all input parameters and assumptions made in running the model.

Model results will be illustrated in both cross-sectional and plan views across an area large enough to reveal the entire extent of plume travel. Map (plan) illustrations of hydraulic head derived by the model will accompany the predicted plume illustrations. The illustrations will be sequenced in five- (5) year increments, at minimum, from the time of the modeling effort, until the time that the SALDS tritium plume is predicted to decay to below 500 pCi/L (approximately the current MDA for high-level analyses) at all locations (see Barnett et al. 1997). Contour intervals for the plume maps will be selected based on the range of tritium concentrations in the data sets. A comprehensive table of tritium results for all tritium-tracking wells in the well network will be included in an appendix to the report.

5.5 Data Management, Evaluation, and Reporting

Groundwater analytical results will be received from the laboratory on electronic medium or hard copy. (Field parameters will be submitted in hardcopy). These data are entered directly into the Liquid Effluent Monitoring Information System (LEMIS) and are then validated by the Data Manager at Liquid Waste Processing Facilities. After an initial inspection and qualification, these data are copied in whole to the Hanford Environmental Information System (HEIS).

Groundwater data are evaluated using application-specific databases such as the Data Viewer and Evaluator (DAVE), which allows trend analyses and other comparisons and screening. The project scientist will evaluate the data (hydrologic and geochemical) for each analytical period (annual to quarterly) for trend departures, anomalous or erroneous data, or unprecedented results. This evaluation is used to assess the potential vulnerability of groundwater to SALDS operation, or to detect the influence in the aquifer of other sources that may interfere with the SALDS groundwater interpretations.

Groundwater analytical results will be evaluated quarterly, at minimum to screen for anomalous results, unexpected trends, or exceedences in DWS. Requests for Data Review (RDR) are used by PNNL to more closely examine anomalous groundwater analytical results or results suspected of error. All such results will be subject to RDRs. All results will also be reviewed and reported annually as described below.

LWPF publishes quarterly Discharge Monitoring Reports (DMR) that contain all analytical results for both effluent and groundwater for the SALDS. Groundwater analytical data will continue to be reported on a quarterly basis, as they become available, in the DMR. A tritium-tracking and groundwater monitoring report will be produced annually, detailing all tritium results from the tritium-tracking network and non-tritium results for enforcement parameters at the three SALDS proximal wells. This report will include a discussion of departures from historical trends in analytical results and pertinent hydrogeological information (see Section 5.4). A summary of SALDS groundwater monitoring results is also published annually by the PNNL Groundwater Project in the Hanford Site Groundwater Monitoring annual report (e.g., Hartman 2000).

5.6 Statistical Evaluation of Data

Basic measures of central tendency and variability will be applied annually to the groundwater analytical data, such as presented in Appendix D. Aside from these, no other routine statistical analyses will be performed. Contingency statistical analyses may include the application of control charts for constituents of particular interest (e.g., conductivity) should trending suggest a departure from historical values.

5.7 Contingencies

If effluent monitoring requirements change significantly, groundwater monitoring requirements will be revised, as needed, to reflect discharge parameters.

The network of wells for tracking the tritium in groundwater emanating from the SALDS is currently adequate for the necessary levels of assurance of determining impact of operations on the uppermost aquifer and the Columbia River. Additional groundwater monitoring locations would be considered in the event that unexpected detections of tritium occur in the current network, or if numerical modeling results indicate a need for additional coverage, such that tritium could move undetected beyond the bounds of the current network.

In the event that numerical modeling results indicate that concentrations of tritium in groundwater will exceed the surface water standard for tritium at the Columbia River during the life of the tritium plume, a list of contingency measures to mitigate or further evaluate potential impacts will be submitted to Ecology.

6.0 References

Barnett DB and CJ Chou. 1998. *Groundwater monitoring Plan for the Hanford Site 216-B-3 Pond RCRA facility*. PNNL-11903. Pacific Northwest National Laboratory, Richland, Washington.

Barnett DB, MP Bergeron, CR Cole, MD Freshley, and SK Wurstner. 1997. *Tritium monitoring in groundwater and evaluation of model predictions for the Hanford Site 200 Area Effluent Treatment Facility*. PNNL-11665, Pacific Northwest National Laboratory, Richland, Washington.

Chiaramonte GR, CW Denslow, AJ Knepp, RD Landon, and S Panday. 1996. *Hanford sitewide groundwater remediation strategy - groundwater contaminant predictions*. BHI-00469, Rev. 0, Bechtel Hanford, Inc., Richland, Washington.

Cole CR, SK Wurstner, MP Bergeron, MD Williams, and PD Thorne. 1997. *Three-dimensional analyses of future groundwater flow conditions and contaminant plume transport in the Hanford Site unconfined system: FY 1996 and 1997 status report*. PNNL-11801, Pacific Northwest National Laboratory, Richland, Washington.

Davis JD, DB Barnett, CJ Chou, and PB Freeman. 1996. *Ground-water screening evaluation/monitoring plan -- 200 Area Effluent Treatment Facility (Project C-018H)*. WHC-SD-C018H-PLN-004, Rev. 1, Westinghouse Hanford Company, Richland, Washington.

Delaney CD, KA Lindsey, and SP Reidel. 1991. *Geology and hydrology of the Hanford Site: A standardized text for use in Westinghouse Hanford Company documents and reports*. WHC-SD-ER-TI-003, Rev. 0, Westinghouse Hanford Company, Richland, Washington.

Eaton AD, LS Clesceri, and AE Greenberg. 1995. *Standard methods for the examination of water and wastewater*. American Public Health Association, Washington, D.C.

Gephart RE, RC Arnett, RG Baca, LS Leonhart, and FA Spane. 1979. *Hydrologic studies within the Columbia Plateau, Washington: An integration of current knowledge*. RHO-BWI-ST-5, Rockwell Hanford Operations, Richland, Washington.

Golder Associates, Inc. 1991. *Ground-water mounding and plume migration analyses for candidate soil column disposal sites, Hanford Site, Washington*. WHC-MR-0276, Westinghouse Hanford Company, Richland, Washington.

Graham MJ, MD Hall, SR Strait, and WR Brown. 1981. *Hydrology of the separations area*. RHO-ST-42, Rockwell Hanford Operations, Richland, Washington.

Graham MJ, GV Last, and KR Fecht. 1984. *An assessment of aquifer intercommuncation in the B Pond-Gable Mountain pond area of the Hanford Site*. RHO-RE-ST-12P, Hanford Operations, Richland, Washington.

Gupta SK, CR Cole, CT Kincaid, and AM Monti. 1987. *Coupled fluid, energy, and solute transport (CFEST) model: Formulation and user's manual.* BMI/ONWI-660, Battelle Memorial Institute, Columbus, Ohio.

Harris SF and CD Delaney. 1991. *Groundwater quality characterization at three candidate sites for the C-018H Soil Column Disposal Facility.* WHC-SD-EN-ES-013, Rev. 0, Westinghouse Hanford Company, Richland, Washington.

Hartman MJ, LF Morasch, and WD Webber (eds.). 2000. *Hanford Site groundwater monitoring for fiscal year 1998.* PNNL-12086, Pacific Northwest National Laboratory, Richland, Washington.

Johnson VG. 1993. *Westinghouse Hanford Company operational groundwater status report, 1990-1992.* WHC-EP-0595, Westinghouse Hanford Company, Richland, Washington.

Lindsey KA. 1995. *Miocene- to Pliocene-aged suprabasalt sediments of the Hanford Site, south-central Washington.* BHI-00184, Rev. 0, Bechtel Hanford Company, Richland, Washington.

Lindsey KA and SP Reidel. 1992. *Suprabasalt geology of soil column disposal candidate site number 1: A preliminary evaluation of the site geology and recommendations for number of boreholes.* WHC-MR-0291, Westinghouse Hanford Company, Richland, Washington.

Lindsey KA, JL Slate, GK Jaeger, KJ Swett, and RB Mercer. 1994. *Geologic setting of the low-level burial grounds.* WHC-SD-EN-TI-290, Rev. 0, Westinghouse Hanford Company, Richland, Washington.

Myers CW, SM Price, JA Caggiano, MP Cochran, WJ Czimer, NJ Davidson, RC Edwards, KR Fecht, GE Holmes, MG Jones, JR Kunk, RD Landon, RK Ledgerwood, JT Lillie, PE Long, TH Mitchell, EH Price, SP Reidel, and AM Tallman. 1979. *Geologic studies of the Columbia Plateau: A status report.* RHO-BWI-ST-4, Rockwell Hanford Operations, Richland, Washington.

Olson PM. 1997. *Liquid waste processing facilities quality assurance project plan.* WHC-SD-LEF-QAPP-002, Waste Management Federal Services Hanford, Richland, Washington.

Reidel SP. 1993. *Ground-water monitoring plan for the proposed State-Approved Land Disposal Site.* WHC-SD-C018H-PLN-004, Rev. 0, Westinghouse Hanford Company, Richland, Washington.

Reidel SP and EC Thornton. 1993. *Characterization report, C-018H disposal siting evaluation.* WHC-SD-C018H-RPT-001, Rev. 0, Westinghouse Hanford Company, Richland, Washington.

Reidel SP, KA Lindsey, and KR Fecht. 1992. *Field trip guide to the Hanford Site.* WHC-MR-0391, Westinghouse Hanford Company, Richland, Washington.

Swanson. 1994. *1994 characterization report for the proposed State-Approved Land Disposal Site.* WHC-SD-C018H-RPT-003, Rev. 0, Westinghouse Hanford Company, Richland, Washington.

Thorne PD, MA Chamness, VR Vermeul, QC MacDonald, and SE Schubert. 1994. *Three-dimensional conceptual model for the Hanford Site unconfined aquifer system: FY 1994 status report*. PNL-10195, Pacific Northwest National Laboratory, Richland, Washington.

Thornton EC. 1997. *Origin of increased sulfate in groundwater at the ETF Disposal Site*. PNNL-11633, Pacific Northwest National Laboratory, Richland, Washington.

U.S. Department of Energy, Richland Operations Office (DOE-RL). 1990. *Strategy for handling and disposal of purgewater at the Hanford Site*. Letter No. 90-ERB-076, U.S. Department of Energy, Richland Operations Office, Richland, Washington.

U.S. Department of Energy, Richland Operations Office (DOE-RL). 1993. *State waste discharge permit application for the 200 Area Effluent Treatment Facility and the State-Approved Land Disposal Site*. DOE/RL-93-44, U.S. Department of Energy, Richland Operations Office, Richland, Washington.

U.S. Department of Energy, Richland Operations Office (DOE-RL). 1997. *Hanford Site background: Part 3, Groundwater background*. DOE/RL-96-61, Richland, Washington.

U.S. Environmental Protection Agency (EPA). 1986. *Test methods for evaluating solid wastes, physical/ chemical methods, 3rd ed*. Office of Solid Waste and Emergency Response, Washington, D.C.

Washington State Department of Ecology (Ecology). 1990. *Accreditation of environmental laboratories*. WAC 173-50, Olympia, Washington.

Washington State Department of Ecology (Ecology). 1995. *State waste discharge permit no. ST-4500*. Issued June 26, 1995. Olympia, Washington.

Washington State Department of Ecology (Ecology). 1996. *Implementation guidance for the ground water quality standards*, Publication #96-02. Olympia, Washington.

Washington State Department of Ecology (Ecology). 2000. *State waste discharge permit no. ST-4500*. Issued August, 2000. Olympia, Washington.

Westinghouse Hanford Company (WHC). 1994. *Project C-018H borehole data package*. WHC-SD-EN-DP-092, Rev 0, Richland, Washington.

Wurstner SK, PD Thorne, MA Chamness, MD Freshley, and MD Williams. 1995. *Development of a three-dimensional ground-water model of the Hanford Site unconfined aquifer system, FY 1995 status report*. PNL-10886, Pacific Northwest Laboratory, Richland, Washington.

Appendix A

Constituent Lists for SALDS Groundwater Monitoring

Appendix A

Constituent Lists for SALDS Groundwater Monitoring

The following tables show the lists of constituents sought for SALDS groundwater monitoring from 1992 through July 2000. Tables A.1 and A.2 are the constituent lists used prior to the issuance of ST-4500 (see Section 1.3.2). Table A.3 is the constituent list derived by Davis et al. 1996, which was observed through July 2000. The constituent list and sampling schedule for the new groundwater monitoring plan is presented in Section 5.0 in the main body of the document.

Table A.1. Constituent List Applied to SALDS Groundwater Monitoring, 1992-1993

Constituent Name		
Contamination Indicator Parameters		
Conductivity, field	Total organic carbon	Total organic halogen
pH, field		
Drinking Water Parameters		
Alpha-BHC	Arsenic	Arsenic, filtered
Barium	Barium, filtered	Beta-BHC
Cadmium	Cadmium, filtered	Chromium
Chromium, filtered	Delta-BHC	Endrin
Fluoride	Gross alpha	Gross beta
Lead	Lead, filtered	Mercury
Mercury, filtered	Methoxychlor	Selenium
Selenium, filtered	Silver	Silver, filtered
Toxaphene	Gamma-BHC (lindane)	
Groundwater Quality Parameters		
Chloride	Iron	Iron, filtered
Manganese	Manganese, filtered	Phenol
Sodium	Sodium, filtered	Sulfate
Site-Specific and Other Constituents		
1,1,1-Trichloroethane	1,1,2-Trichloroethane	1,1-Dichloroethane
1,2-Dichloroethane	1,4-Dichlorobenzene	1-Butanol
2-Methylphenol	4,4'-DDD	4,4'-DDE
4,4'-DDT	4-Methyl-2-pentanone	4-Methylphenol
Acetone	Aldrin	Antimony
Antimony, filtered	Benzene	Beryllium
Beryllium, filtered	Bromide	Calcium
Calcium, filtered	Carbon tetrachloride	Chlordane
Chloroform	Cobalt	Cobalt, filtered
Coliforms, membrane filter	Copper	Copper, filtered
Cyanide	Decane	Dieldrin
Dodecane	Endosulfan I	Endosulfan II
Endosulfan sulfate	Endrin aldehyde	Heptachlor
Heptachlor epoxide	Hydrazine	Iodine-129, low detection
Magnesium	Magnesium, filtered	Methyl ethyl ketone
Methylene chloride	Naphthalene	Nickel

Table A.1. (contd)

Constituent Name		
***Site-Specific and Other Constituents** (contd)*		
Nickel, filtered	Nitrate	Nitrite
Pentachlorophenol	Phosphate	Potassium
Potassium, filtered	Temperature, field	Tetrachloroethane
Tetradecane	Tetrahydrofuran	Tin
Tin, filtered	Toluene	Tributyl phosphate
Trichloroethene	Tritium	Vanadium
Vanadium, filtered	Vinyl chloride	Xylenes (total)
Zinc	Zinc, filtered	m-Cresol
trans-1,2-Dichloroethylene		

Table A.2. Constituent List Applied to SALDS Groundwater Monitoring, 1993-1995

Constituent Name		
Interim Primary Drinking Water Standards		
Arsenic	Barium	Cadmium
Chromium	Fluoride	Lead
Mercury	Nitrate (as NO_3)	Selenium
Silver	Endrin	Lindane
Methoxychlor	Toxaphene	2,4-D
2,4,5-TP Silvex	Radium	Gross alpha
Gross beta	Turbidity (surface water only)	Coliform bacteria
Groundwater Quality Parameters		
Chloride	Iron	Manganese
Phenols	Sodium	Sulfate
Groundwater Contamination Indicator Parameters		
pH	Specific conductance	Total organic carbon
Total organic halogen		

Table A.3. Constituent List for SALDS Proximal Wells, 1995 Through July 2000

Constituent	Highest Allowable Concentration[a]	Method
Acetone	160	8260
Ammonia	1,100	EPA 350.3, 350.1
Benzene	5	8260
Cadmium, total	10	7131A, 200.8
Chloroform	6.2	8260
Copper, total	70	6010 ICP, 200.7, 200.8
Lead, total	50	7421, 200.8
Mercury, total	2	7470, 7471
pH, pH units	6.5 - 8.5	150.1 (lab), 9040A
Sulfate	250,000	300 IC, 9056
Tetrahydrofuran	100	8260
Total dissolved solids	500,000	160.1
Gross alpha	(pCi/L)[b]	Laboratory specific
Gross beta	(pCi/L)[b]	Laboratory specific
Strontium-90	(pCi/L)[b]	Laboratory specific
Tritium	(pCi/L)[b]	Laboratory specific

(a) All concentrations in μg/L unless noted.
(b) Not assigned a permit enforcement limit but are subject to measurement and reporting as required by the permit.

Appendix B

Construction Details and Lithologic Logs for Wells in the SALDS Tritium-Tracking Network

Appendix B

Construction Details and Lithologic Logs for Wells in the SALDS Tritium-Tracking Network

The following records illustrate lithologic and construction details for all wells in the SALDS tritium-tracking groundwater monitoring network. Logs for the SALDS proximal wells (699-48-77A, C, D) provide considerably greater detail than those for the older wells in the network. Wells 699-51-75 and 699-51-75P comprise a dual-completion well, with 75P consisting of a 2-inch piezometer open at approximately 7 m below the screened interval of, and centralized within well 699-51-75.

Project: W-017H/C-018H RCRA GROUNDWATER MONITORING WELL INSTALLATION		**Well No:** 699-48-77A	Page 1 of 6
		Total Depth: 457.70	Static Water Level: 215.40
Date Started: 1-21-92	Date Completed: 5-19-92	Surface Elevation: 672.25	Casing Elevation: 674.72
Location: NORTH OF 200 WEST		Northing: 137969.02	Easting: 566413.57
Prepared By: DJ ANDERSON/C WRIGHT		Hanford N: 47602.70	Hanford W: 77020.00
Drilling Co: JENSEN	Driller: D PERKINS	Drill Meth: CABLE TOOL	Drill Equip: SPEED STAR 60

Screen: 20.3' OF 4" DIAM 10-SLOT T-304 STAINLESS STEEL CONTINUOUS WIREWRAP W/ENDCAP SET FROM 212.4' TO 232.7'

Filter Pack: 20-40 MESH SILICA SAND FROM 206.7' TO 237.1'

Permanent Casing: 4" DIAMETER TYPE 304 SCHEDULE 5 STAINLESS STEEL WITH CENTRALIZERS SET TO 212.4'

Comments: SPECTRA GAMMA LOG WAS PERFORMED.

Elev'n (Feet) / Depth (Feet)	Remarks/ Materials Used	Well Construction (Inches)	Drill Method	Sample	Graphic Lithologic Log	Gross Gamma Log	% CaCO3 / % Moist	Misc XRF = F XRD = D

Elevations: 670, 660, 650, 640, 630, 620, 610, 600. Depths: 10, 20, 30, 40, 50, 60, 70.

Remarks/Materials Used:

- CEMENT (0.0' TO 8.0')
- 16" TEMPORARY CARBON STEEL CASING SET AT 19.71'
- 8-20 MESH BENTONITE CRUMBLES (8.0' TO 199.1')

Drill Method: CB

Graphic Lithologic Log:

0-1.5' Slightly silty sandy GRAVEL
EOLIAN/HANFORD CONTACT AT 1.5'
1.5-3' Slightly gravelly SAND
3-5' Sandy GRAVEL
5-10' Slightly silty sandy GRAVEL

10-20' Silty sandy GRAVEL
Minor cementation with white leach type staining (10-15')

Non-CaCO3 cementation at 18.9'
20-22.5' Silty gravelly SAND

HANFORD/PLIO-PLEISTOCENE CONTACT AT 22.5'
22.5-45' Slightly silty, slightly gravelly SAND
Silt lens (22.5-22.8')
Silt lens (24.5-25.5')

Caliche lens (29-29.4')
Possible caliche stringers (30-35')

Cemented sand (32.6-32.8')

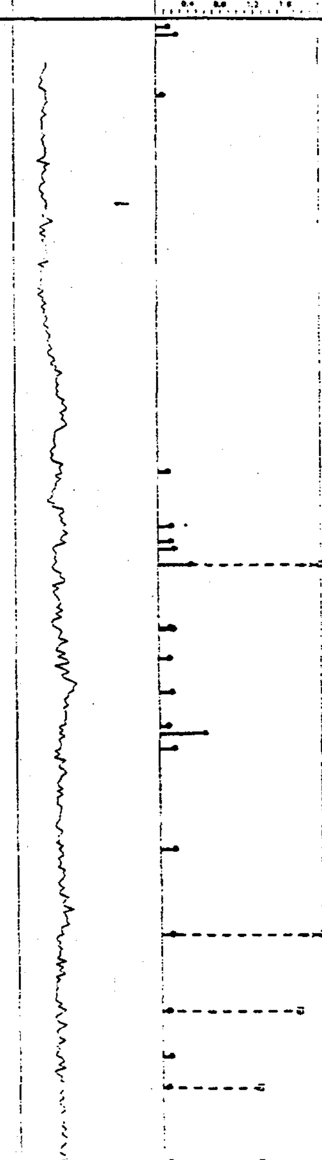
Caliche (35.3-35.8')

Cemented sand (37.9-38')

Silt lens (42-42.5')
Possible silt stringers (42-45')

45-50' Slightly silty SAND
Silt lens at 46.5'
Possible silt stringers at 47.5'

50-55' Slightly silty, slightly gravelly SAND
Very loose sand
Silt at 52'
Caliche at 53.5'
Cemented sand (54-54.3')
55-63.6' Sandy SILT
Silt lens at 58'
Cemented sand below silt
60-65' Slightly silty, sandy GRAVEL
Caliche (60.3-60.5')
Minor CaCO3 cementation (63-63.9')
PLIO-PLEISTOCENE/UPPER RINGOLD CONTACT AT 65'
65-82.5' Slightly silty, slightly gravelly SAND

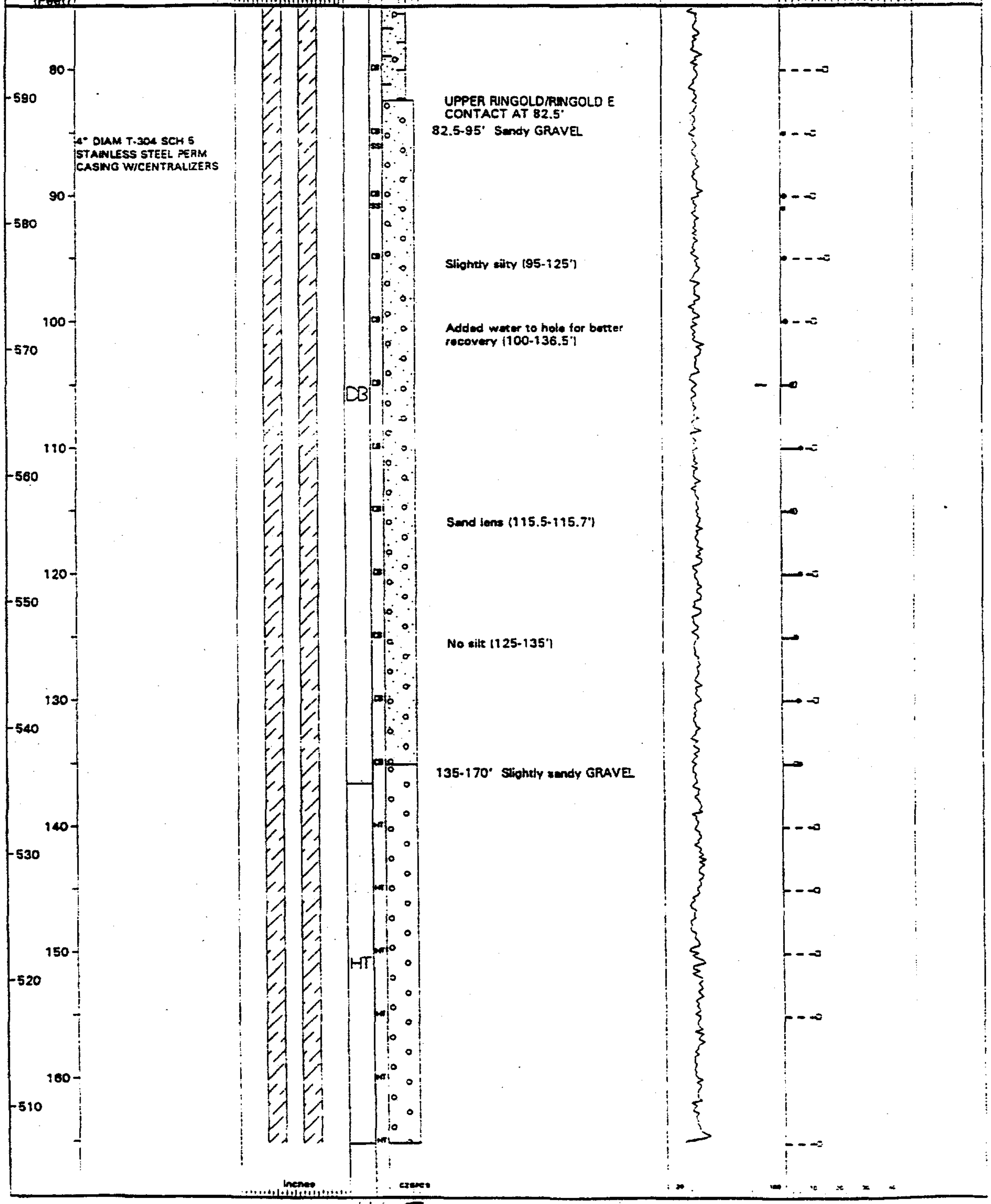


Misc: F F F F F F F F F F F F F F F F F F F F

Reviewed By: Kent D. Reynolds / KDR Date: FEB. [illegible]

Project: W-017H/C-018H RCRA GROUNDWATER MONITORING WELL INSTALLATION	Well No: 699-48-77A	Page 2 of 6

Elev'n (Feet) Depth (Feet)	Remarks/ Materials Used	Well Construction (Inches)	Drill Method	Sample	Graphic Lithologic Log	Gross Gamma Log	% CaCO3 / % Moist	Misc XRF = F XRD = D

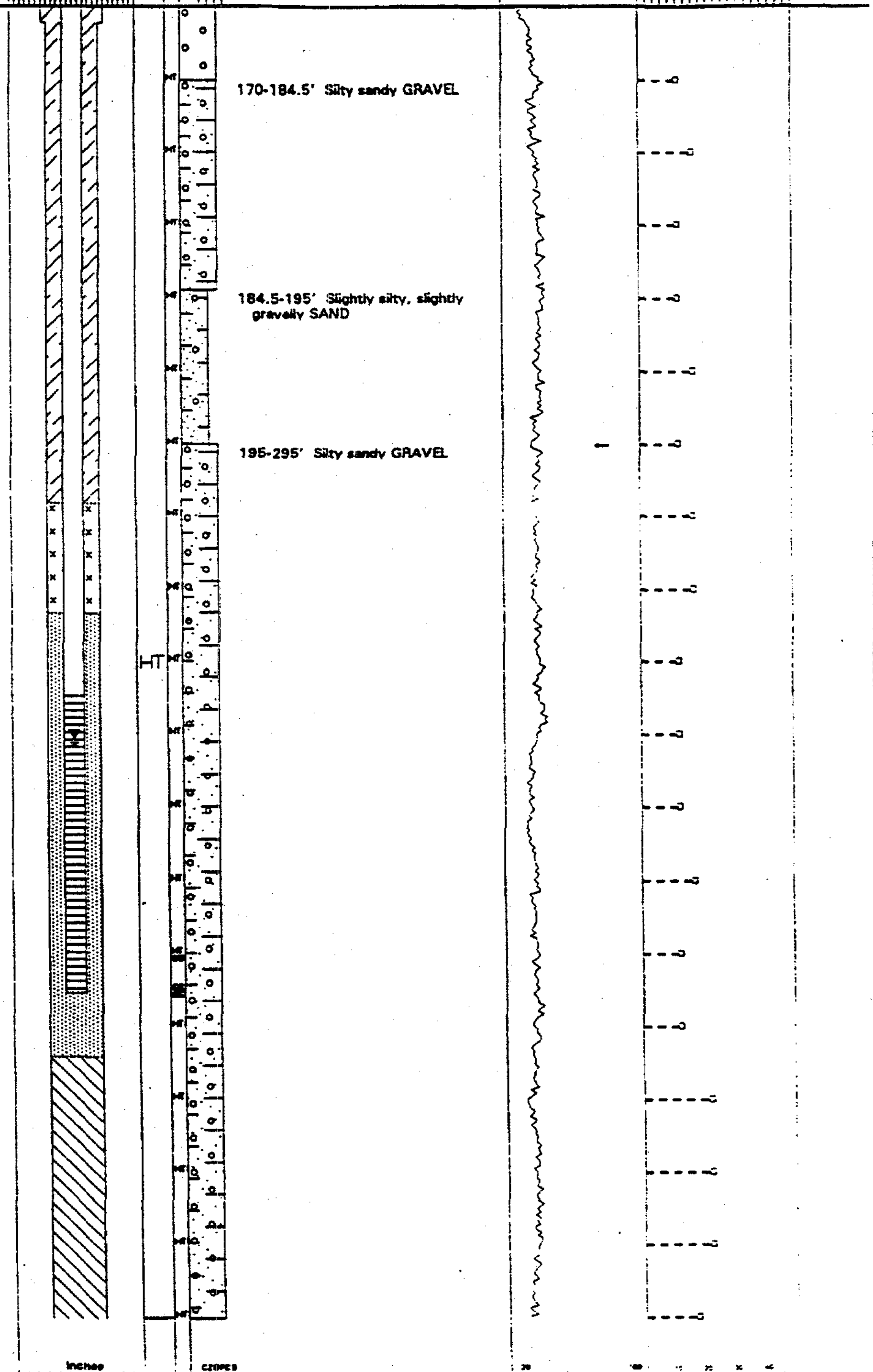


Reviewed By: Kent D. Reynolds //KDR

Date: FEB. 1 2 1993

Project: W-017H/C-018H RCRA GROUNDWATER MONITORING WELL INSTALLATION	Well No: 699-48-77A	Page 3 of 6

Elev'n (Feet) / Depth (Feet)	Remarks/ Materials Used	Well Construction	Drill Method	Sample	Graphic Lithologic Log	Gross Gamma Log	% CaCO3 / % Moist	Misc XRF = F XRD = D



Depth: 170, 180, 190, 200, 210, 220, 230, 240, 250

Elev'n: 500, 490, 480, 470, 460, 450, 440, 430, 420

12" TEMPORARY CARBON STEEL CASING SET AT 166.14'

3/8" BENTONITE PELLETS (199.1' TO 206.7')

20-40 MESH SILICA SAND FILTER PACK (206.7' TO 237.1')

STATIC WATER LEVEL AT 215.4' (5-4-92)

4" DIAM 10-SLOT T-304 STAINLESS STEEL CONTINUOUS WIREWRAP SCREEN WITH ENDCAP (212.4' TO 232.7')

3/4" BENTONITE CHUNKS (237.1' TO 457.1')

170-184.5' Silty sandy GRAVEL

184.5-195' Slightly silty, slightly gravelly SAND

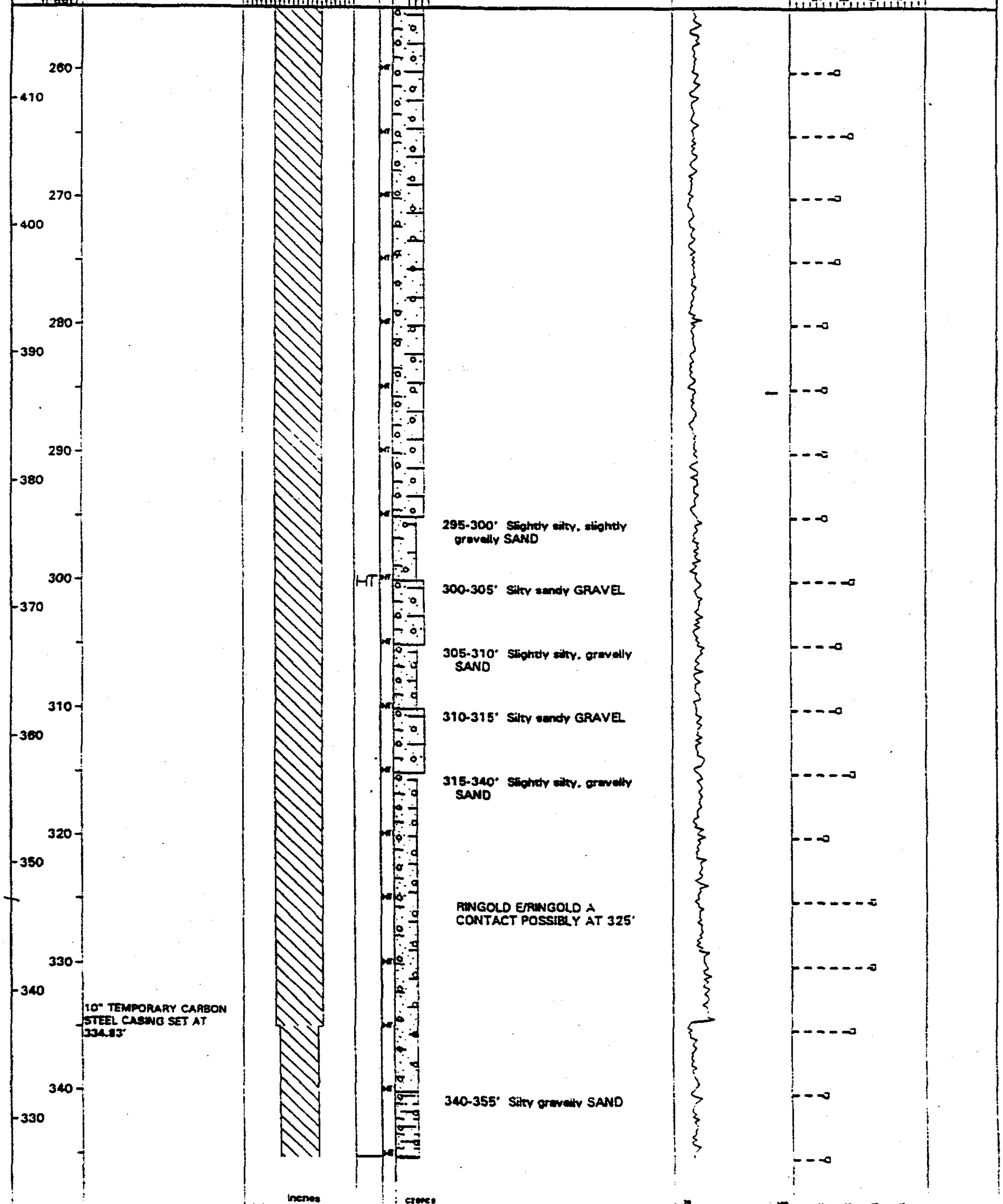
195-295' Silty sandy GRAVEL

Drill Method: HT

Reviewed By: Kent D. Reynolds / KDR Date: FEB ... 1993

Project: W-017H/C-018H RCRA GROUNDWATER MONITORING WELL INSTALLATION | **Well No:** 699-48-77A |

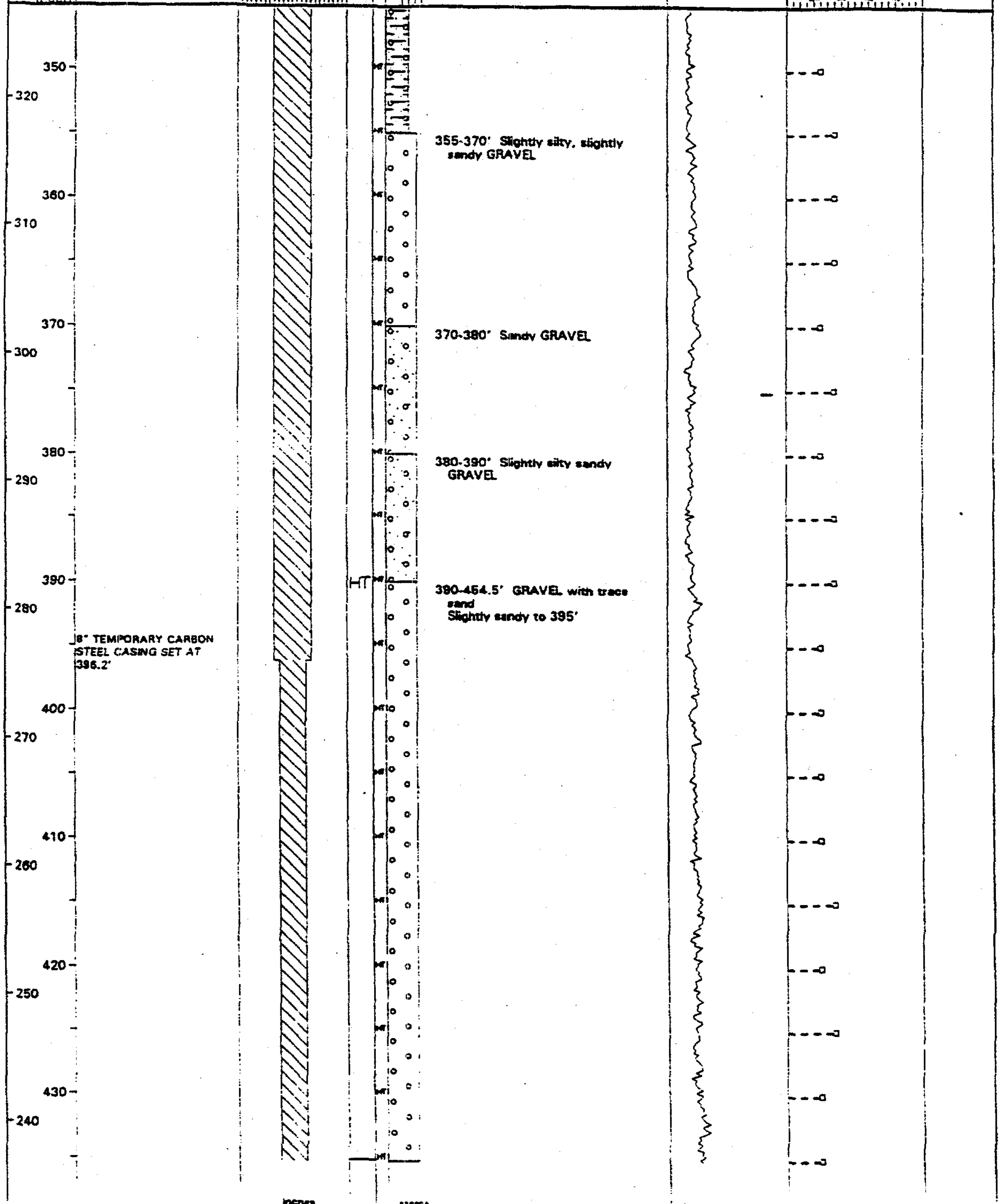
Elev'n (Feet) / Depth (Feet) | Remarks/ Materials Used | Well Construction (Inches) | Drill Method | Sample | Graphic Lithologic Log | Gross Gamma Log | % CaCO3 / % Moist | Misc XRF = F XRD = D



Reviewed By: Kent D. Reynolds //KDR Date: FEB. 2 1993

Project: W-017H/C-018H RCRA GROUNDWATER MONITORING WELL INSTALLATION | **Well No:** 699-48-77A

Elev'n (Feet) / Depth (Feet)	Remarks/ Materials Used	Well Construction (Inches)	Drill Method	Sample	Graphic Lithologic Log	Gross Gamma Log	% CaCO3 / % Moist	Misc XRF = F XRD = D

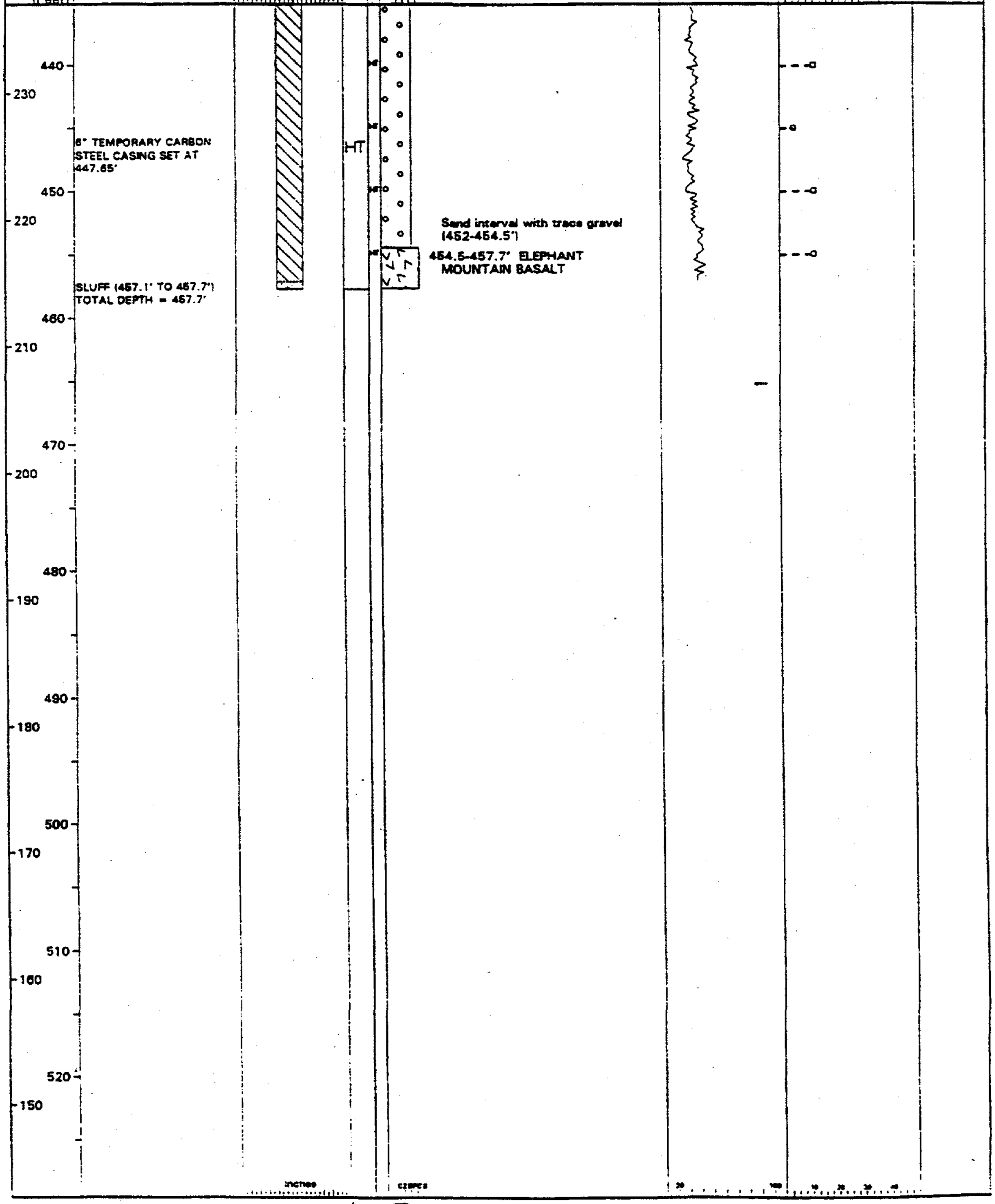


Reviewed By: Kent D. Reynolds / KDR

Date: FEB. ' _ 1993

Project: W-017H/C-018H RCRA GROUNDWATER MONITORING WELL INSTALLATION | **Well No:** 699-48-77A |

Elev'n (Feet) / Depth (Feet)	Remarks/ Materials Used	Well Construction (Inches)	Drill Method	Sample	Graphic Lithologic Log	Gross Gamma Log	% CaCO3 / % Moist	Misc XRF = F XRD = D



Reviewed By: Kent D. Reynolds / KDR

Date: FEB. 12 1993

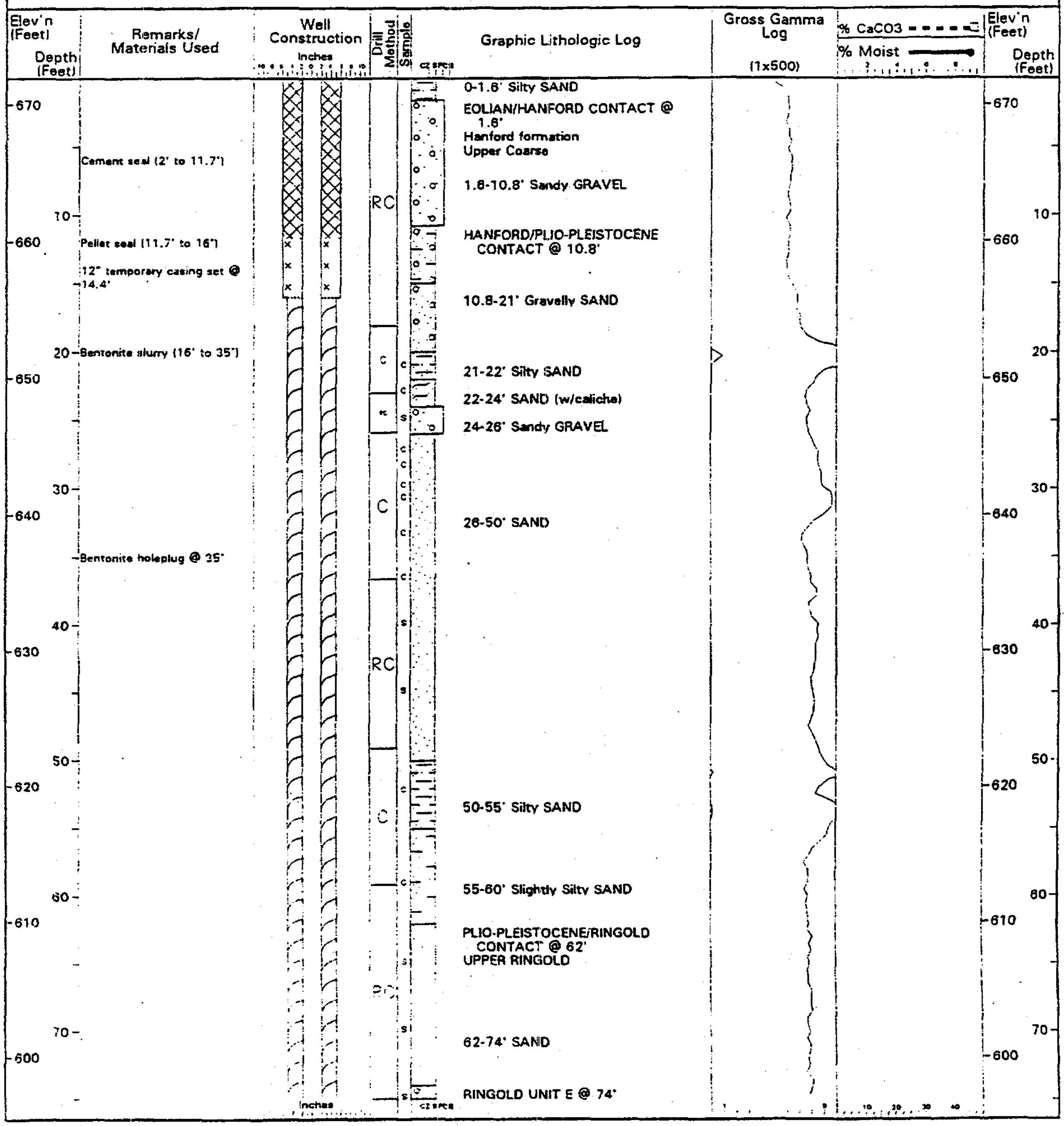
Project: W-017H/C-018H RCRA GROUNDWATER MONITORING WELL INSTALLATION		**Well No:** 699-48-77C	Page 1 of 6
		Total Depth: 437.20	Static Water Level: 216.94
Date Started: 1-31-94	Date Completed: 5-11-94	Surface Elevation: 671.91	Casing Elevation: 674.28
Location: C018H		Northing: 138086.80	Easting: 566468.95
Prepared By: Templeton/Flinn		Hanford N: 47989.32	Hanford W: 76836.16
Drilling Co: PC Exploration	Driller: D KETTLE	Drill Meth: Air Rotary	Drill Equip: Top Drive

Screen: 4" 20 slot SS screen set at 290 to 310 ft bgs.

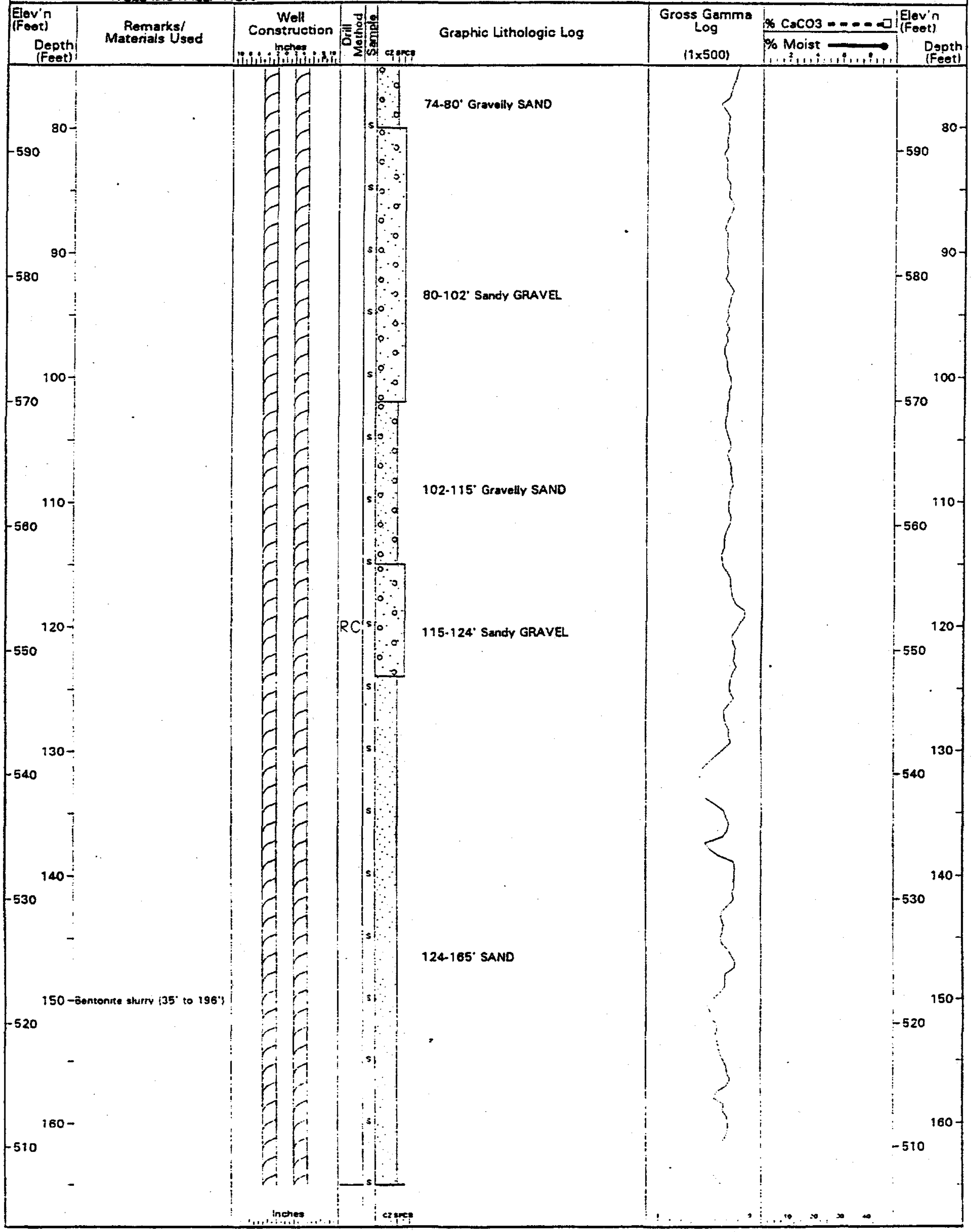
Filter Pack: 10-20 sand set at 286.6 to 310 ft bgs

Permanent Casing: 4" SS set from 3.1 ft above grade to 290 ft bgs

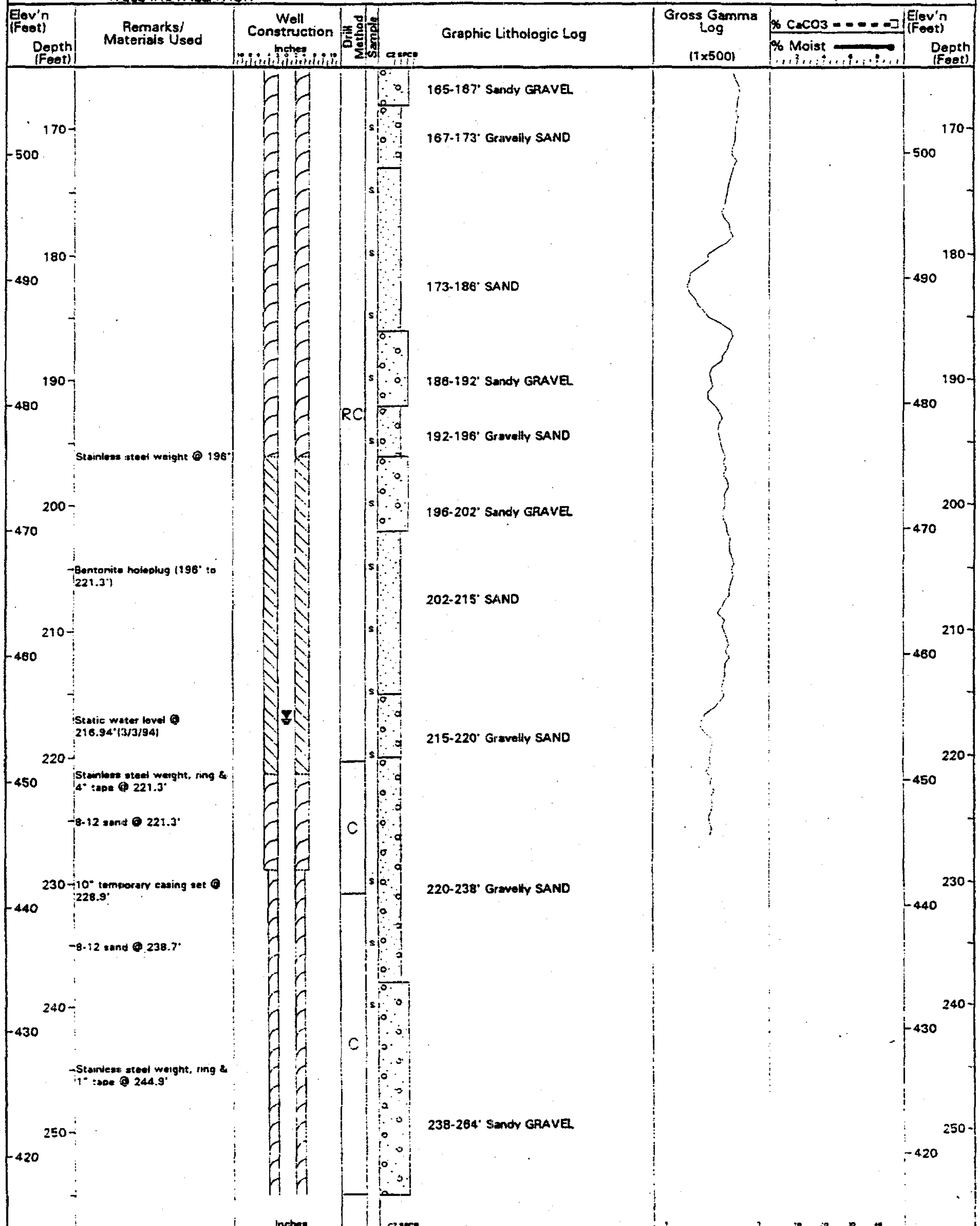
Comments: FIRST WELL COMPLETION ABANDONED. WELL REDRILLED TO 314.4' AND COMPLETED TO SURFACE.



Project: W-017H/C-018H RCRA GROUNDWATER MONITORING WELL INSTALLATION | **Well No:** 699-48-77C |

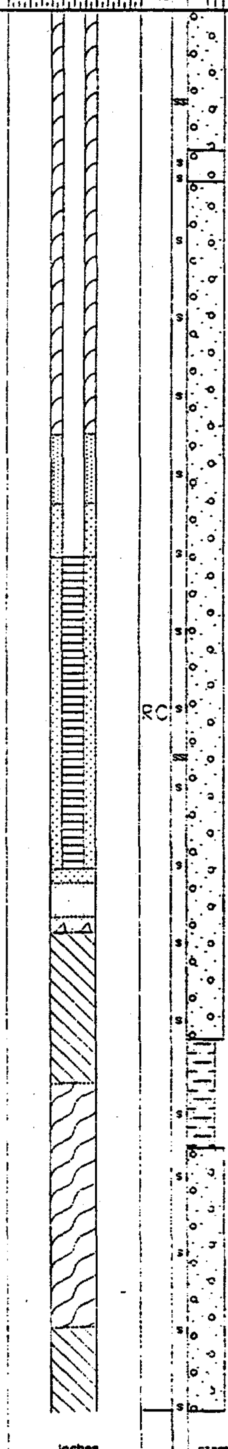


Project: W-017H/C-018H RCRA GROUNDWATER MONITORING WELL INSTALLATION | **Well No:** 699-48-77C |



Project: W-017H/C-018H RCRA GROUNDWATER MONITORING WELL INSTALLATION | **Well No:** 699-48-77C |

Elev'n (Feet) / Depth (Feet)	Remarks/ Materials Used	Well Construction (inches)	Drill Method	Sample	Graphic Lithologic Log	Gross Gamma Log (1x500)	% CaCO3 / % Moist	Elev'n (Feet) / Depth (Feet)
260 / 410	Bentonite slurry (221.3' to 282.2')							260 / 410
					264-266' GRAVEL			
	Stainless steel weight, ring & 4" tape @ 267.3'							
270 / 400								270 / 400
280 / 390								280 / 390
	20-40 sand (282.2' to 286.6')							
290 / 380	10-20 sand (286.6' to 310.9')							290 / 380
300 / 370			RC					300 / 370
					266-321' Sandy GRAVEL			
	20 slot stainless screen (290' to 310')							
310 / 360								310 / 360
	8-12 sand (310.9' to 313.1')							
	Caved formation (313.1' to 314.1')							
320 / 350	Bentonite holeplug (314.1' to 323.8')							320 / 350
					321-328' Silty SAND			
330 / 340								330 / 340
	Cement grout (323.8' to 339.8')							
340 / 330								340 / 330



Elev'n (Feet) / Depth (Feet)	Remarks/ Materials Used	Well Construction (Inches)	Drill Method	Sample	Graphic Lithologic Log	Gross Gamma Log (1x500)	% CaCO3 / % Moist	Elev'n (Feet) / Depth (Feet)
350 / 320				s				350 / 320
				s	328-370' Sandy GRAVEL			
360 / 310				s				360 / 310
370 / 300				s	370-375' GRAVEL			370 / 300
380 / 290	Bentonite holeplug (339.6' to 384.3')			s	375-386' Sandy GRAVEL			380 / 290
390 / 280	8-12 sand (384.3' to 399.1')		RC	s	386-397' GRAVEL			390 / 280
400 / 270	Caved formation (399.1' to 400.5')			s				400 / 270
410 / 260				s				410 / 260
420 / 250				s	397-433' Sandy GRAVEL			420 / 250
430 / 240	8-12 sand (400.5' to 437.2')			s	RINGOLD/SADDLE MOUNTAIN BASALT CONTACT @ 433'			430 / 240

Elev'n (Feet) / Depth (Feet)	Remarks/ Materials Used	Well Construction (Inches)	Drill Method	Sample	Graphic Lithologic Log	Gross Gamma Log (1x500)	% CaCO3 / % Moist	Elev'n (Feet) / Depth (Feet)
	8" temporary casing set @ 437.2' TD @ 437.2'				ELEPHANT MOUNTAIN MEMBER			
440 / 230								440 / 230
450 / 220								450 / 220
460 / 210								460 / 210
470 / 200								470 / 200
480 / 190								480 / 190
490 / 180								490 / 180
500 / 170								500 / 170
510 / 160								510 / 160
520 / 150								520 / 150

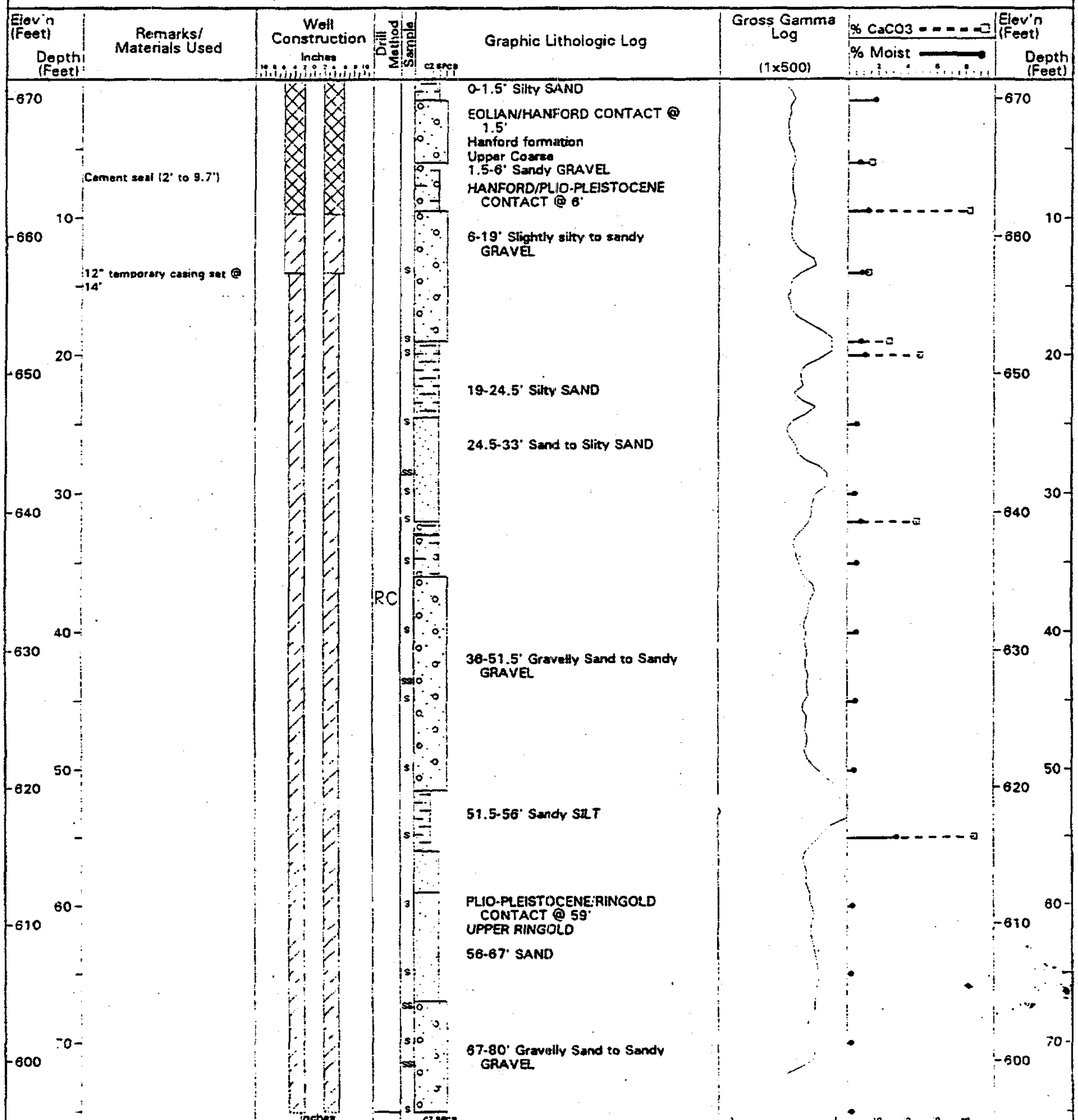
Project: W-017H/C-018H RCRA GROUNDWATER MONITORING WELL INSTALLATION	**Well No:** 699-48-77D — Page 1 of 3
	Total Depth: 237.70 — Static Water Level: 217.10
Date Started: 1-11-94 — Date Completed: 1-31-94	Surface Elevation: 671.37 — Casing Elevation: 673.87
Location: C018H	Northing: 138119.27 — Easting: 566433.30
Prepared By: Templeton	Hanford N: 48096.14 — Hanford W: 76952.88
Drilling Co: PC Exploration — Driller: D KETTLE	Drill Meth: Reverse Circulation — Drill Equip:

Screen: 4" 10 slot SS screen set at 214.7 to 234.7 ft bgs

Filter Pack: 20-40 Sand pack set at 211.6 to 236.1 ft bgs

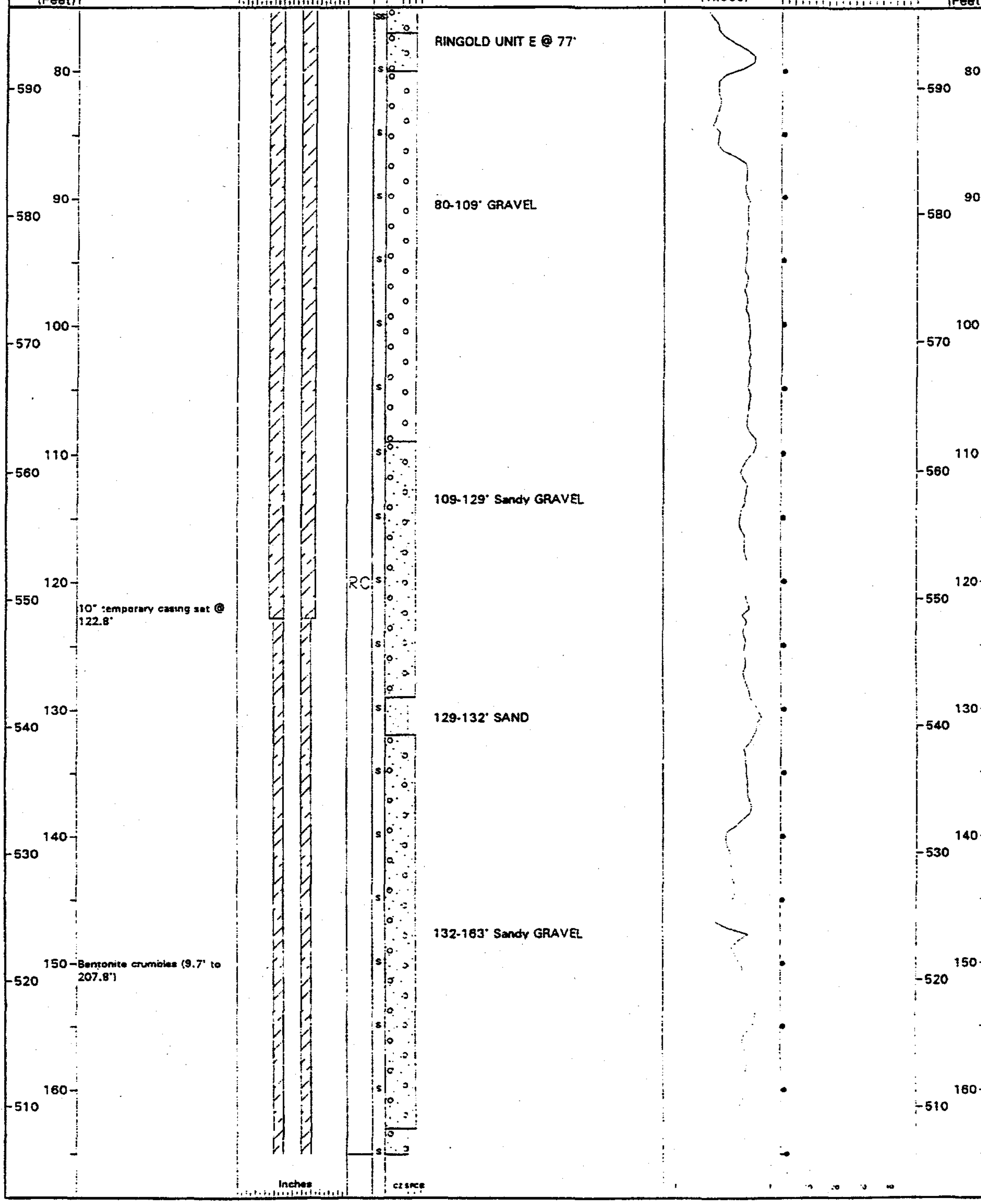
Permanent Casing: 4" 304 SS set from 3.0 ft above grade to 214.7 ft bgs

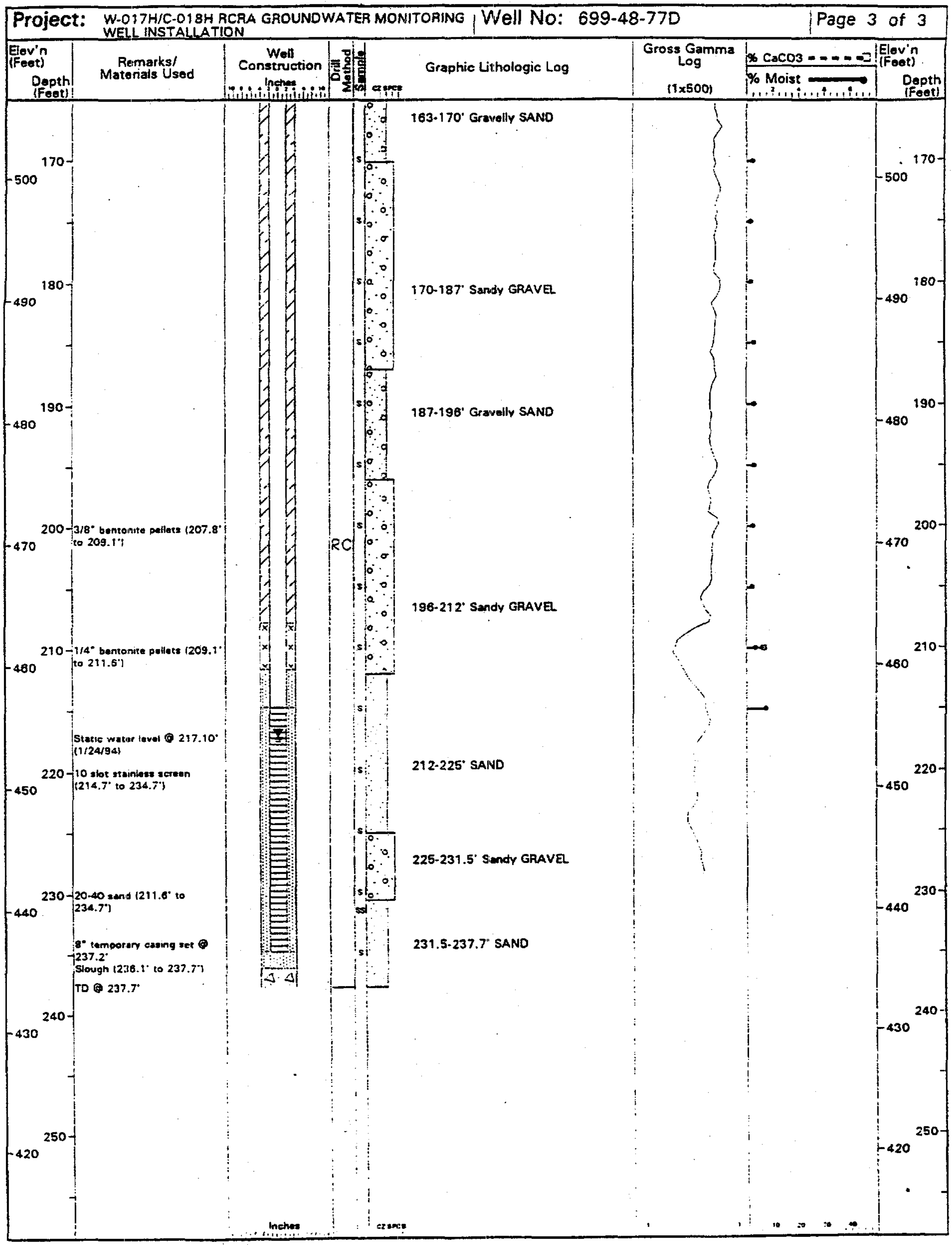
Comments:



Project: W-017H/C-018H RCRA GROUNDWATER MONITORING WELL INSTALLATION | **Well No:** 699-48-77D | Page 2 of 3

Elev'n (Feet) / Depth (Feet)	Remarks/ Materials Used	Well Construction (Inches)	Drill Method	Sample	Graphic Lithologic Log	Gross Gamma Log (1x500)	% CaCO3 / % Moist	Elev'n (Feet) / Depth (Feet)





Project: W-017H/C-018H RCRA GROUNDWATER MONITORING WELL INSTALLATION
Well No: 699-48-77D
Page 3 of 3
Elev'n (Feet)
Depth (Feet)
Remarks/ Materials Used
Well Construction
Inches
Drill Method
Sample
Graphic Lithologic Log
Gross Gamma Log
(1x500)
% CaCO3
% Moist
163-170' Gravelly SAND
170-187' Sandy GRAVEL
187-196' Gravelly SAND
196-212' Sandy GRAVEL
212-225' SAND
225-231.5' Sandy GRAVEL
231.5-237.7' SAND
RC
3/8" bentonite pellets (207.8' to 209.1')
1/4" bentonite pellets (209.1' to 211.6')
Static water level @ 217.10' (1/24/94)
10 slot stainless screen (214.7' to 234.7')
20-40 sand (211.6' to 234.7')
8" temporary casing set @ 237.2'
Slough (236.1' to 237.7')
TD @ 237.7'
170
180
190
200
210
220
230
240
250
500
490
480
470
460
450
440
430
420

WELL CONSTRUCTION AND COMPLETION SUMMARY

Drilling Method: Cable tool
Drilling Fluid Used: 200 W Water Supply
Driller's Name: Multiple
Drilling Company: Jensen Drilling Co
Date Started: 13Aug91

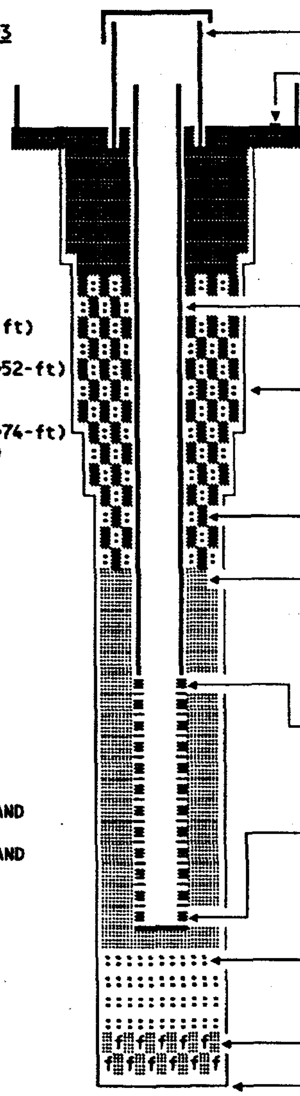
Sample Method: Drive barrel Hard tool
Additives Used: Not documented
WA State Lic Nr: Not documented
Company Location: Not documented
Date Complete: 24Oct91

WELL NUMBER: 299-W6-6
TEMPORARY WELL NO: W6-MW8
Hanford Coordinates: N/S N 46,511.4 E/W W 74,052.5
State NAD83 137,638.72m 567,318.74m
Coordinates: N 451,623 E 2,221,153
Start Card #: Not documented T____ R____ S______
Elevation Ground surface (ft): 706.82 (Brass cap)

Depth to water: 257.0-ft Dec91
(Ground surface) 253.0-ft 11Mar93

GENERALIZED STRATIGRAPHY
Geologist's Log
Sl=slightly

0↔5: Not documented
5↔10: Very sandy GRAVEL
10↔20: Gravelly SAND
20↔25: Very gravelly SAND
25↔30: Sandy GRAVEL
30↔36.5: Silty SAND
36.5↔40: Sandy GRAVEL
40↔50: Gravelly SAND
(Possible CALICHE @ 46↔47-ft)
50↔60: Sl gravelly SAND
(Calcareous sandy SILT, 50↔52-ft)
60↔70: SAND
70↔85: Sl gravelly SAND
(Calcareous sandy SILT, 73↔74-ft)
85↔90: Sl silty sl gravelly SAND
90↔95: Silty SAND
95↔100: SAND
100↔110: Sl gravelly SAND
110↔120: Silty sandy GRAVEL
120↔135: Sandy GRAVEL
135↔140: Silty sandy GRAVEL
140↔150: GRAVEL
150↔175: Silty sandy GRAVEL
175↔200: Sandy GRAVEL
200↔270: Silty sandy GRAVEL
270↔285: Sandy GRAVEL
285↔320: Silty sandy GRAVEL
320↔325: GRAVEL
325↔330: Silty sandy GRAVEL
330↔340: Gravelly SAND
340↔355: Silty sandy GRAVEL
355↔375: Sl silty↔sl gravelly SAND
375↔380: Silty sandy GRAVEL
380↔400: Sl silty sl gravelly SAND
400↔415: SANDS-GRAVELS
415↔435: SAND
435↔440: SANDS-GRAVELS
440↔472: SANDS



Elevation of reference point: (top of casing) [709.99-ft]
Height of reference point above ground surface [3.17-ft]
Depth of surface seal [2.0↔20.7-ft]
Type of surface seal: Pre-mix concrete
4x4-ft x 6-in surface pad
4 equidistant protective posts
Cement grout 2.0↔20.7-ft
I.D. of riser pipe: [4-in]
Type of riser pipe: Stainless steel
Diameter of borehole,
0↔18.1-ft, 17-in nominal
18.1↔169.8-ft, 13-in nominal
168.8↔340.4-ft, 11-in nominal
340.4↔472.0-ft, 9-in nominal
Type of filler, 20.7↔406.7-ft Bentonite slurry
Depth top of sand pack: [406.7-ft]
8↔12-mesh, 406.7↔408.4-ft
20↔40-mesh, 408.4↔416.8-ft
10↔20-mesh, 416.8↔429.5-ft
8↔12-mesh, 429.5↔435.9-ft
Depth top of screen: [418.6-ft]
4-in, #20-slot, continous wrap
304 stainless steel
Depth bottom of screen: [429.3-ft]
Enviroplug coarse bentonite hole plug, 435.9↔462.9-ft
Fill, 462.9↔472.0-ft
Depth to bottom of borehole: [472.0-ft]

Drawing By: RKL/2W06-06.ASB Date: 15Apr93

Reference: ______________________

SUMMARY OF CONSTRUCTION DATA AND FIELD OBSERVATIONS
RESOURCE PROTECTION WELL - 299-W6-6

WELL DESIGNATION	:	299-W6-6
CERCLA UNIT	:	200 Aggregate Area Management Study
RCRA FACILITY	:	LLBG
HANFORD COORDINATES	:	N 46,511.4 W 74,052.5 [200W-20May92]
LAMBERT COORDINATES	:	N 451,623 E 2,221,153 [HANCONV]
		N 137,638.72m E 567,318.74m [NAD83-20May92]
DATE DRILLED	:	Oct91
DEPTH DRILLED (GS)	:	472.0-ft
MEASURED DEPTH (GS)	:	Not documented
DEPTH TO WATER (GS)	:	257.0-ft, Dec91;
		253.0-ft, 11Mar93
CASING DIAMETER	:	4-in stainless steel, +1.0↔418.6-ft;
		6-in stainless steel, +3.17↔~0.5-ft
ELEV TOP CASING	:	709.99-ft, [NGVD'29-20May92]
ELEV GROUND SURFACE	:	706.82-ft, Brass cap [NGVD'29-20May92]
PERFORATED INTERVAL	:	Not applicable
SCREENED INTERVAL	:	418.6↔429.3-ft, 4-in #20-slot stainless steel;
COMMENTS	:	FIELD INSPECTION,
		OTHER:
AVAILABLE LOGS	:	Geologist
TV SCAN COMMENTS	:	Not applicable
DATE EVALUATED	:	Not applicable
EVAL RECOMMENDATION	:	Not applicable
LISTED USE	:	LLBG Quarterly water level measurement, 18Mar↔11Mar93
		Not on water sample schedule
PUMP TYPE	:	Hydrostar
MAINTENANCE	:	

WELL CONSTRUCTION AND COMPLETION SUMMARY

Drilling Method: Cable tool
Drilling Fluid Used: 200 W Water Supply
Driller's Name: D. Kruger/B. Peters
Drilling Company: Kaiser Engineers
Date Started: 14May91

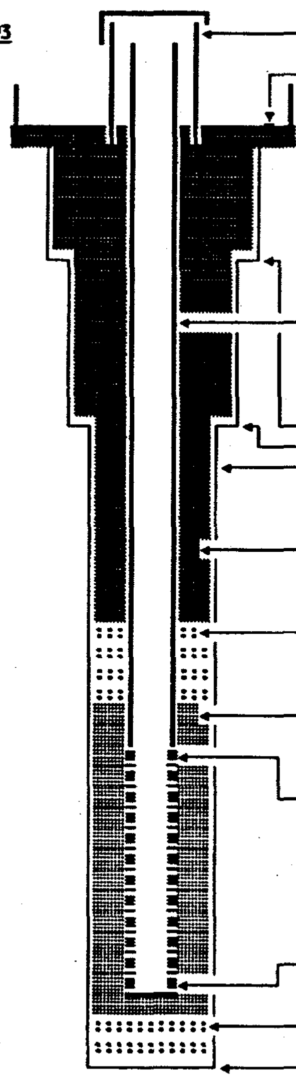
Sample Method: Drive barrel Hard tool
Additives Used: Not documented
WA State Lic Nr: Not documented
Company Location: Hanford
Date Complete: 17Jul91

WELL NUMBER: 299-W6-7
TEMPORARY WELL NO: ______
Hanford Coordinates: N/S N 46,511.6 E/W W 74,076.9
State NAD 83 Coordinates: N 137,638.8m 451,623 E 567,311.3m 2,221,129
Start Card #: Not documented T____ R____ S______
Elevation Ground surface (ft): 706.85 (Brass cap)

Depth to water: 254.7-ft Jul91
(Ground surface) 252.9-ft 11Mar93

GENERALIZED STRATIGRAPHY
Geologist's Log
Sl=slightly

0-22: Sandy GRAVEL
22-27: Sl silty SAND
27-40: Gravelly SAND, cemented
40-45: SAND
45-65: Gravelly SAND
65-70: SAND
70-75: Sandy GRAVEL
75-106: SAND, w/interfingered calcium cemented zones
106-276.2: Sandy GRAVEL



Elevation of reference point: (top of casing) [710.28-ft]
Height of reference point above ground surface [3.43-ft]
Depth of surface seal [1.9-21.6-ft]
Type of surface seal: Pre-mix concrete
4x4-ft x 6-in surface pad to 3.4-ft
4 equidistant protective posts
Cement grout, 1.9-20.6-ft

I.D. of riser pipe: [4-in]
Type of riser pipe: Stainless steel

Diameter of borehole,
0-19.7-ft, 13-in nominal
19.7-155.4-ft, 11-in nominal
155.4-276.2-ft, 9-in nominal

Type of filler, 20.6-238.9-ft
8-20-mesh, bentonite crumbles

Depth top of seal: [238.9-ft]
Type of seal:
1/4-1/2-in bentonite pellets

Depth top of sand pack: [242.3-ft]
20-40-mesh silica sand

Depth top of screen: [246.5-ft]
4-in, #10-slot, stainless steel

Depth bottom of screen [267.2-ft]

Bentonite hole plug, 268.1-276.2-ft

Depth to bottom of borehole: [276.2-ft]

Drawing By: RKL/2W06-07.ASB Date: 15Apr93
Reference: ______

SUMMARY OF CONSTRUCTION DATA AND FIELD OBSERVATIONS
RESOURCE PROTECTION WELL - 299-W6-7

WELL DESIGNATION	:	299-W6-7
CERCLA UNIT	:	200 Aggregate Area Management Study
RCRA FACILITY	:	LLBG
HANFORD COORDINATES	:	N 46,511.6 W 74,076.9 [200W-20May92]
LAMBERT COORDINATES	:	N 451,623 E 2,221,129 [HANCONV] N 137,638.8m E 567,311.3m [NAD83-20May92]
DATE DRILLED	:	Jul91
DEPTH DRILLED (GS)	:	276.2-ft
MEASURED DEPTH (GS)	:	Not documented
DEPTH TO WATER (GS)	:	254.7-ft, Jul91; 252.9-ft, 11Mar93
CASING DIAMETER	:	4-in stainless steel, +0.9↔246.5-ft; 6-in stainless steel, +3.43↔~0.5-ft
ELEV TOP CASING	:	710.28-ft, [NGVD'29-20May92]
ELEV GROUND SURFACE	:	706.85-ft, Brass cap [NGVD'29-20May92]
PERFORATED INTERVAL	:	Not applicable
SCREENED INTERVAL	:	246.5↔267.2-ft, 4-in #10-slot stainless steel;
COMMENTS	:	FIELD INSPECTION, OTHER:
AVAILABLE LOGS	:	Geologist
TV SCAN COMMENTS	:	Not applicable
DATE EVALUATED	:	Not applicable
EVAL RECOMMENDATION	:	Not applicable
LISTED USE	:	LLBG Quarterly water level measurement, 18Mar↔11Mar93 Not on water sample schedule
PUMP TYPE	:	Hydrostar, intake @ 263.6-ft (GS)
MAINTENANCE	:	

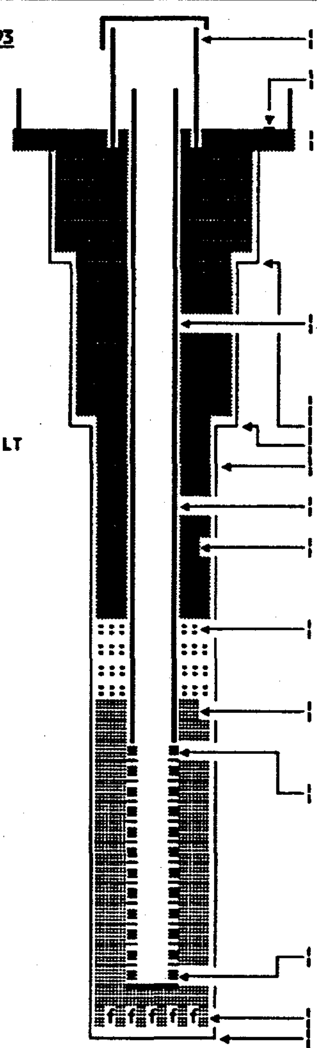
WELL CONSTRUCTION AND COMPLETION SUMMARY

Drilling Method: Cable tool	Sample Method: Drive barrel Hard tool	WELL NUMBER: 299-W6-8 TEMPORARY WELL NO:
Drilling Fluid Used: 200 W Water Supply	Additives Used: Not documented	Hanford Coordinates: N/S N 46,514.0 E/W W 75,003.8
Driller's Name: M. Wrasper	WA State Lic Nr: Not documented	State NAD 83 Coordinates: N 137,638.8m 451,623 E 567,028.8m 2,220,202
Drilling Company: Kaiser Engineers	Company Location: Hanford	Start Card #: Not documented T___ R___ S___
Date Started: 30Apr91	Date Complete: 26Aug91	Elevation Ground surface (ft): 691.34 (Brass cap)

Depth to water: 233.6-ft Jun91
(Ground surface) 235.9-ft 11Mar93

GENERALIZED STRATIGRAPHY Geologist's Log
Sl=slightly

0-10: Sandy GRAVEL
10-20: Sandy GRAVEL
20-22.5: Silty sandy GRAVEL
22.5-25: Sl silty SAND
(CALICHE @ 23-23.5-ft)
25-30: Gravelly silty SAND
30-35: Sl gravelly SAND
35-40: Sandy GRAVEL
40-45: Gravelly SAND
45-60: Sl gravelly SAND
60-65: SAND
65-70: Sl gravelly SAND
70-75: Silty gravelly SAND
75-80: Silty SAND
80-85: CALICHE, cemented SAND/SILT
85-90: Sl gravelly SAND
90-95: Gravelly SAND
95-160: Sandy GRAVEL
160-165: Sl sandy GRAVEL
165-190: Sandy GRAVEL
190-199.5: Gravelly SAND
199.5-200.2: SAND
200.2-218: Sandy GRAVEL
218-219.5: SAND
219.5-225: Gravelly SAND
225-240: Sandy GRAVEL
240-245: Sl gravelly SAND
245-249.5: Gravelly SAND
249.5-252: Sandy GRAVEL



Elevation of reference point: (top of casing) [694.73-ft]
Height of reference point above ground surface [3.39-ft]
Depth of surface seal [1.8-21.0-ft]
Type of surface seal: Pre-mix concrete
4x4-ft x 6-in surface pad to 1.8-ft
4 equidistant protective posts
Cement grout, 1.8-21.0-ft
I.D. of riser pipe: [4-in]
Type of riser pipe: Stainless steel
Diameter of borehole,
0-19.9-ft, 13-in nominal
19.9-161.9-ft, 11-in nominal
161.9-251.7-ft, 9-in nominal
Casing partially collapsed during competion
Type of filler, 21.0-222.1-ft
8-20-mesh, bentonite crumbles
Depth top of seal: [222.1-ft]
Type of seal:
1/4-3/8-in bentonite pellets
Depth top of sand pack: [225.9-ft]
20-40-mesh silica sand
Depth top of screen: [229.9-ft]
4-in, #10-slot, stainless steel
Depth bottom of screen [250.6-ft]
Fill, 251-252-ft
Depth to bottom of borehole: [252.0-ft]

Drawing By: RKL/2W06-08.ASB Date: 15Apr93
Reference:

SUMMARY OF CONSTRUCTION DATA AND FIELD OBSERVATIONS
RESOURCE PROTECTION WELL - 299-W6-8

WELL DESIGNATION	:	299-W6-8
CERCLA UNIT	:	200 Aggregate Area Management Study
RCRA FACILITY	:	LLBG
HANFORD COORDINATES	:	N 46,514.0 W 75,003.8 [200w-20May92]
LAMBERT COORDINATES	:	N 451,623 E 2,220,202 [HANCONV] N 137,638.8m E 567,028.8m [NAD83-20May92]
DATE DRILLED	:	Aug91
DEPTH DRILLED (GS)	:	252.0-ft
MEASURED DEPTH (GS)	:	Not documented
DEPTH TO WATER (GS)	:	233.6-ft, Jul91; 235.9-ft, 11Mar93
CASING DIAMETER	:	4-in stainless steel, +0.9↔229.9-ft; 6-in stainless steel, +3.5↔"0.5-ft
ELEV TOP CASING	:	694.73-ft, [NGVD'29-20May92]
ELEV GROUND SURFACE	:	691.34-ft, Brass cap [NGVD'29-20May92]
PERFORATED INTERVAL	:	Not applicable
SCREENED INTERVAL	:	229.9↔250.6-ft, 4-in #10-slot stainless steel;
COMMENTS	:	FIELD INSPECTION, OTHER: Developed by Hydrostar, casing collapsed during completion.
AVAILABLE LOGS	:	Geologist
TV SCAN COMMENTS	:	Not applicable
DATE EVALUATED	:	Not applicable
EVAL RECOMMENDATION	:	Not applicable
LISTED USE	:	LLBG Quarterly water level measurement, 18Mar↔11Mar93 Not on water sample schedule
PUMP TYPE	:	Hydrostar, intake @ 249.9-ft (GS)
MAINTENANCE	:	

WELL CONSTRUCTION AND COMPLETION SUMMARY

Drilling Method: ODEX air rotary
Drilling Fluid Used: None
Driller's Name: J. Jensen/D. Mingo
Drilling Company: Jensen Drilling
Date Started: 14Jan92

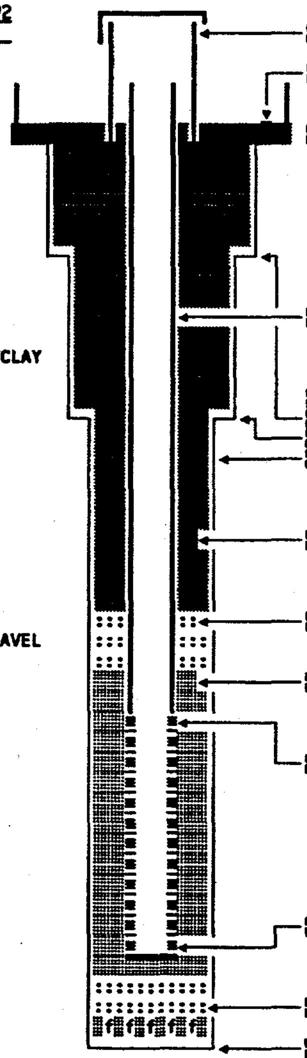
Sample Method: Backhoe to 20-ft Air returns
Additives Used: Not documented
WA State Lic Nr: Not documented
Company Location: Not documented
Date Complete: 21May92

WELL NUMBER: 299-W6-11
TEMPORARY WELL NO: W6-MW #10A
Hanford Coordinates: N/S N 46,500.4 E/W W 74,564.0
State NAD 83 Coordinates: N 137,634.97m 451,611 E 567,162.86m 2,220,642
Start Card #: Not documented T____ R____ S______
Elevation Ground surface (ft): 700.04 (Brass cap)

Depth to water: 243.9-ft 21May92
(Ground surface)

GENERALIZED STRATIGRAPHY
Geologist's Log
Sl=slightly

0-5: Not documented
5-15: Silty sandy GRAVEL
15-25: Sandy GRAVEL
25-37: SAND
37-44: Sandy pebbly GRAVEL
44-59: Sl silty SAND
59-67: Sandy SILT
67-74: No sample recovered
74-81: SAND
81-90: Sl gravelly SAND
81-87: CALICHE zone w/SAND/SILT/CLAY
87-96: SAND
96-100: GRAVEL
100-140: Cobble to pebble GRAVEL
140-185: Pebble to cobble GRAVEL
185-196: Pebble GRAVEL
196-201: SAND
201-214: Pebble GRAVEL
214-215.5: SAND
215.5-221: Pebble to pebble cobble GRAVEL
221-224: Pebble cobble GRAVEL
224-241.5: Cobble to pebble cobble GRAVEL
241.5-242.6: Pebble to cobble GRAVEL
242.6-245: Pebble to pebble cobble GRAVEL
245-247: SAND
247-260: Pebble cobble GRAVEL
260-280: Pebble to pebble cobble GRAVEL



Elevation of reference point: (top of casing) [702.86-ft]
Height of reference point above ground surface [2.82-ft]
Depth of surface seal [4.3-9.6-ft]
Type of surface seal: Pre-mix concrete 4x4-ft x 6-in surface pad to 4.3-ft 4 equidistant protective posts Cement grout, 4.3-9.6-ft
I.D. of riser pipe: [4-in]
Type of riser pipe: Stainless steel
Diameter of borehole,
0-20.0-ft, 13-in nominal
20.0-97.5-ft, 11-in nominal
97.5-280.0-ft, 9-in nominal
Type of filler, 9.6-237.4-ft Bentonite crumbles
Depth top of seal: [242.1-ft]
Type of seal: Bentonite hole plug
Depth top of sand pack: [246.4-ft]
20-40-mesh silica sand
Depth top of screen: [250.9-ft]
4-in, #10-slot, continous wrap T-304 stainless steel
Depth bottom of screen [271.2-ft]
Bentonite hole plug, 273.9-278.2-ft
Depth to bottom of borehole: [280.3-ft]

Drawing By: RKL/2W06-11.ASB Date: 06Jul93
Reference: WHC-SD-EN-DP-049

SUMMARY OF CONSTRUCTION DATA AND FIELD OBSERVATIONS
RESOURCE PROTECTION WELL - 299-W6-11

WELL DESIGNATION	:	299-W6-11
CERCLA UNIT	:	200 Aggregate Area Management Study
RCRA FACILITY	:	LLBG/WMA-5
HANFORD COORDINATES	:	N 46,500.4 W 74,564.0 [200W-07Aug92]
LAMBERT COORDINATES	:	N 451,611 E 2,220,642 [HANCONV]
		N 137,634.97m E 567,162.86m [NAD83-07Aug92]
DATE DRILLED	:	May92
DEPTH DRILLED (GS)	:	280.3-ft
MEASURED DEPTH (GS)	:	Not documented
DEPTH TO WATER (GS)	:	243.9-ft, 21May92;
CASING DIAMETER	:	4-in stainless steel, +0.9~250.9-ft;
		6-in stainless steel, +2.8~⁻0.5-ft
ELEV TOP CASING	:	702.86-ft, [NGVD'29-07Aug92]
ELEV GROUND SURFACE	:	700.04-ft, Brass cap [NGVD'29-07Aug92]
PERFORATED INTERVAL	:	Not applicable
SCREENED INTERVAL	:	250.9~271.2-ft, 4-in #10-slot stainless steel;
COMMENTS	:	FIELD INSPECTION,
		OTHER:
AVAILABLE LOGS	:	Geologist
TV SCAN COMMENTS	:	Not applicable
DATE EVALUATED	:	Not applicable
EVAL RECOMMENDATION	:	Not applicable
LISTED USE	:	
PUMP TYPE	:	Hydrostar, intake @ 269.2-ft (GS)
MAINTENANCE	:	

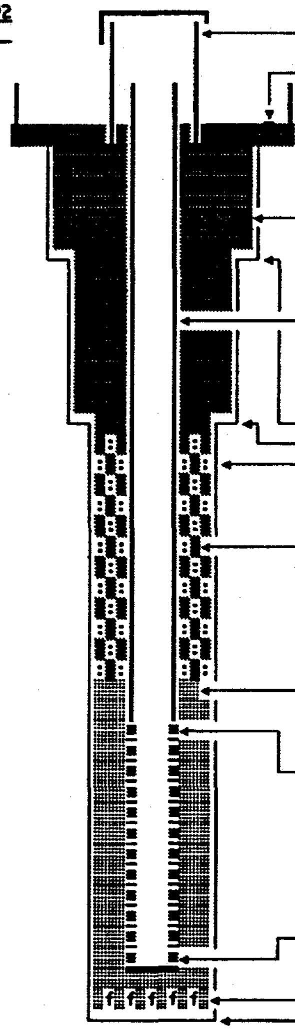
WELL CONSTRUCTION AND COMPLETION SUMMARY

Drilling Method: ODEX air rotary	Sample Method: Backhoe to 20-ft Air returns	WELL NUMBER: 299-W6-12 TEMPORARY WELL NO: W6-MW #13A
Drilling Fluid Used: None	Additives Used: Not documented	Hanford Coordinates: N/S N 46,503.5 E/W W 75,374.3
Driller's Name: S. MacKinnon J. Jensen/D. Mingo	WA State Lic Nr: Not documented	State NAD 83 Coordinates: N 137,635.30m 451,612 E 566,915.91m 2,219,832
Drilling Company: Jensen Drilling	Company Location: Not documented	Start Card #: Not documented T___ R___ S___
Date Started: 15Jan92	Date Complete: 13May92	Elevation Ground surface (ft): 689.64 (Brass cap)

Depth to water: 230.7-ft 07May92
(Ground surface)

GENERALIZED STRATIGRAPHY Geologist's Log
Sl=slightly

0–5: Not documented
5–15: Silty sandy GRAVEL
15–20: Sandy GRAVEL
20–22: Sl silty SAND
22–45: Sandy GRAVEL
45–60: SAND
60–72: Silty SAND
72–81: Sandy SILT
81–85: SAND
85–117: Sandy GRAVEL
117–123: SAND
123–125: GRAVEL
125–126: SILTY interbed
126–187: GRAVEL
187–196: SAND
196–200: Sandy GRAVEL
200–205: Gravelly SAND
205–231: Sandy GRAVEL
231–237: Sl sandy SILT
237–259.3: GRAVEL



Elevation of reference point: (top of casing) [692.51-ft]
Height of reference point above ground surface [2.87-ft]
Depth of surface seal [3.0–10.0-ft]
Type of surface seal: Pre-mix concrete 4x4-ft x 6-in surface pad to 3.0-ft 4 equidistant protective posts Cement grout, 3.0–10.0-ft
8–20 mesh bentonite crumbles, 10.0–93.4-ft
I.D. of riser pipe: [4-in]
Type of riser pipe: Stainless steel
Diameter of borehole,
0–20.0-ft, 13-in nominal
20.0–92.9-ft, 11-in nominal
92.9–257.3-ft, 9-in nominal
Bentonite slurry seal, 93.4–237.9-ft
Depth top of sand pack: 20–40-mesh silica sand [237.9-ft]
Depth top of screen: 4-in, #10-slot, continous wrap T-304 stainless steel with 0.3-ft end cap [241.3-ft]
Depth bottom of screen [257.3-ft]
Fill, 258.6–259.3-ft
Depth to bottom of borehole: [259.3-ft]

Drawing By: RKL/2W06-12.ASB Date: 06Jul93

Reference: WHC-SD-EN-DP-049

SUMMARY OF CONSTRUCTION DATA AND FIELD OBSERVATIONS
RESOURCE PROTECTION WELL - 299-W6-12

WELL DESIGNATION	:	299-W6-12
CERCLA UNIT	:	200 Aggregate Area Management Study
RCRA FACILITY	:	LLBG/WMA-5
HANFORD COORDINATES	:	N 46,503.4 W 75,374.3 [200W-07Aug92]
LAMBERT COORDINATES	:	N 451,612 E 2,219,832 [HANCONV] N 137,635.30m E 566,915.91m [NAD83-07Aug92]
DATE DRILLED	:	May92
DEPTH DRILLED (GS)	:	259.3-ft
MEASURED DEPTH (GS)	:	Not documented
DEPTH TO WATER (GS)	:	230.7-ft, 21May92;
CASING DIAMETER	:	4-in stainless steel, +0.9~241.3-ft; 6-in stainless steel, +2.9~¯0.5-ft
ELEV TOP CASING	:	692.51-ft, [NGVD'29-07Aug92]
ELEV GROUND SURFACE	:	689.64-ft, Brass cap [NGVD'29-07Aug92]
PERFORATED INTERVAL	:	Not applicable
SCREENED INTERVAL	:	241.3~257.3-ft, 4-in #10-slot stainless steel;
COMMENTS	:	FIELD INSPECTION, OTHER:
AVAILABLE LOGS	:	Geologist
TV SCAN COMMENTS	:	Not applicable
DATE EVALUATED	:	Not applicable
EVAL RECOMMENDATION	:	Not applicable
LISTED USE	:	
PUMP TYPE	:	Hydrostar, intake @ 256.6-ft (GS)
MAINTENANCE	:	

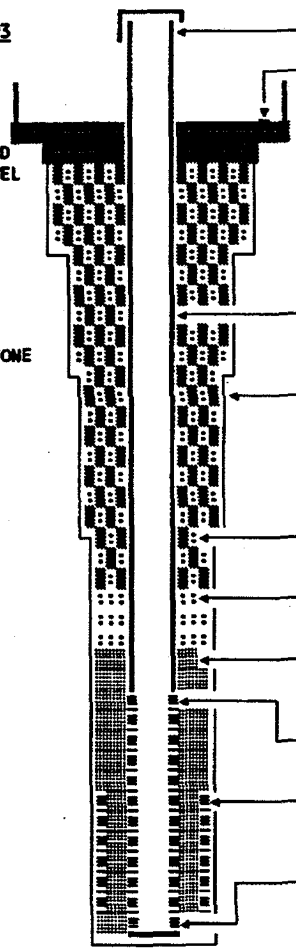
WELL CONSTRUCTION AND COMPLETION SUMMARY

Drilling Method: Cable tool	Sample Method: Drive barrel Hard tool	WELL NUMBER: 299-W7-1 TEMPORARY WELL NO: None
Drilling Fluid Used: 200 W Water Supply	Additives Used: Not documented	Hanford Coordinates: N/S N 46,551 E/W W 78,601
Driller's Name: W. Moomaw	WA State Lic Nr: Not documented	State Coordinates: N 451,622 E 2,217,821
Drilling Company: Onwego Drilling Co	Company Location: Kennewick, WA	Start Card #: Not documented T___ R___ S___
Date Started: 01Jun87	Date Complete: 30Jul87	Elevation Ground surface (ft): 688.55 (Brass cap)

Depth to water: 226.0-ft Jul87
(Ground surface) 229.9-ft 24Mar93

GENERALIZED STRATIGRAPHY   Geologist's Log

5→6: Slightly silty gravelly SAND
10→11: Slightly silty sandy GRAVEL
14→30: Silty sandy GRAVEL
30→64: Sandy GRAVEL
64→73: Silty SAND
73→79: Sandy silty CALICHE
79→82: CALICHE and SAND
82→99: Silty SAND
99→130: Coarse SAND
130→135: Slightly gravelly SAND
135→139: SAND w/calcareous MUDSTONE and CLAY layers
139→142: SAND
142→190: Silty sandy GRAVEL
190→194: Gravelly SAND
194→244: Silty sandy GRAVEL
244→245: Gravelly silty SAND



Elevation of reference point: (top of casing) [690.71-ft]

Height of reference point above ground surface [2.16-ft]

Depth of surface seal [0→20-ft]

Type of surface seal: Pre-mix concrete
4x4-ft x 6-in surface pad to 3.0-ft
4 equidistant protective posts
Volclay grout 3→212-ft

I.D. of riser pipe: [4-in]
Type of riser pipe: Stainless steel

Diameter of borehole,
0→10-ft, 17-in nominal
10→63.4-ft, 13-in nominal
63.4→157.1-ft, 11-in nominal
157.1→245-ft, 9-in nominal

Type of filler, 3→217-ft
Volclay grout

Depth top of seal: [212.0-ft]
Type of seal: Volclay pellets

Depth top of sand pack: [217-ft]
20→30-mesh silica sand

Depth top of screen: [224.0-ft]
4-in, #20-slot, continous wrap
304 stainless steel
Telescoping screen, 233→243-ft
8-in, #30-slot, continous wrap
304 stainless steel

Depth bottom of screen: [245.0-ft]
Depth bottom of borehole:

Drawing By: RKL/2W07-01.ASB   Date: 15Apr93

Reference: ______

SUMMARY OF CONSTRUCTION DATA AND FIELD OBSERVATIONS
RESOURCE PROTECTION WELL - 299-W7-1

WELL DESIGNATION	:	299-W7-1
CERCLA UNIT	:	200 Aggregate Area Management Study
RCRA FACILITY	:	LLWMA-3
HANFORD COORDINATES	:	N 46,551 W 78,601 [200W-10Dec87
LAMBERT COORDINATES	:	N 451,622 E 2,217,821 [10Dec87]
DATE DRILLED	:	Jul87
DEPTH DRILLED (GS)	:	244.8-ft
MEASURED DEPTH (GS)	:	Not documented
DEPTH TO WATER (GS)	:	226.0-ft, Jul87; 229.9-ft, 24Mar93
CASING DIAMETER	:	4-in stainless steel, +2.16↔224-ft
ELEV TOP CASING	:	690.71-ft, [200W-10Dec87]
ELEV GROUND SURFACE	:	688.55-ft, Brass cap [200W-10Dec87]
PERFORATED INTERVAL	:	Not applicable
SCREENED INTERVAL	:	224↔245-ft, 4-in #20-slot stainless steel; 233↔243-ft, 8-in telescoping, #30-slot, stainless steel
COMMENTS	:	FIELD INSPECTION, OTHER:
AVAILABLE LOGS	:	Geologist, driller
TV SCAN COMMENTS	:	Not applicable
DATE EVALUATED	:	Not applicable
EVAL RECOMMENDATION	:	Not applicable
LISTED USE	:	LLBG Monthly water level measurements, 01Dec87↔24Mar93; Not on water sample schedule
PUMP TYPE	:	Hydrostar
MAINTENANCE	:	

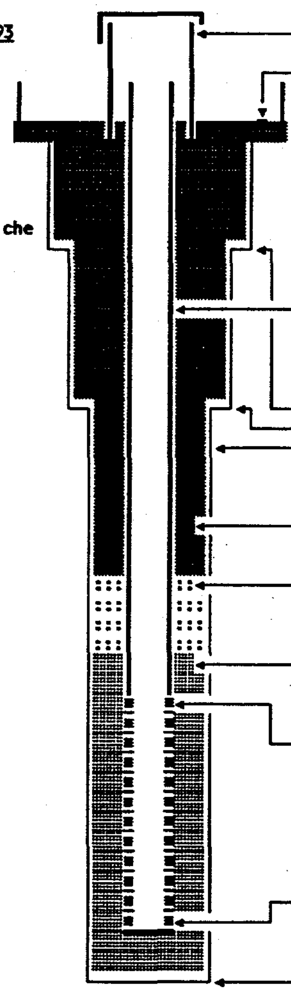
WELL CONSTRUCTION AND COMPLETION SUMMARY

Drilling Method: Cable tool	Sample Method: Drive barrel Hard tool	WELL NUMBER: 299-W7-11 TEMPORARY WELL NO: MW-1
Drilling Fluid Used: 200 W Water Supply	Additives Used: Not documented	Hanford Coordinates: N/S N 46,512 E/W W 77,769
Driller's Name: G. Thomas	WA State Lic Nr: 0867	State NAD83 Coordinates: N 137,636.0m 451,614 E 566,186.2m 2,217,437
Drilling Company: Kaiser Engineers	Company Location: Hanford	Start Card #: Not documented T___ R___ S___
Date Started: 10Apr91	Date Complete: 24May91	Elevation Ground surface (ft): 678.03 (Brass cap)

Depth to water: 215.1-ft May91
(Ground surface) 219.8-ft 24Mar93

GENERALIZED STRATIGRAPHY
Geologist's Log
Sl=slightly

0-25: Sandy GRAVEL
25-30: Sl silty sandy GRAVEL
25-42: Sandy GRAVEL
42-50: SILT
50-55: Silty sandy GRAVEL w/caliche
55-60: Gravelly SAND
60-65: SAND
65-70: Gravelly silty SAND
70-75: Sl gravelly silty SAND
75-80: Silty SAND
80-85: Sl silty SAND
85-120: SAND
120-140: Sandy GRAVEL
140-155: Silty sandy GRAVEL
155-160: Sandy GRAVEL
160-165: Silty gravelly SAND
165-170: Silty sandy GRAVEL
170-175: Silty GRAVEL
175-185: Silty sandy GRAVEL
185-195: Sandy GRAVEL
195-200: Silty sandy GRAVEL
200-230: Sandy GRAVEL
230-234.5: Silty sandy GRAVEL



Elevation of reference point: [681.45-ft]
(top of casing)
Height of reference point above ground surface [3.42-ft]
Depth of surface seal [1.9-20.0-ft]
Type of surface seal: Pre-mix concrete
4x4-ft x 6-in surface pad to 1.9-ft
4 equidistant protective posts
Cement grout, 1.9-20.0-ft

I.D. of riser pipe: [4-in]
Type of riser pipe:
Stainless steel

Diameter of borehole,
0-19.8-ft, 13-in nominal
19.8-165.2-ft, 11-in nominal
165.2-234.5-ft, 9-in nominal

Type of filler, 20.0-203.9-ft
8-20 mesh bentonite crumbles

Depth top of seal: [203.9-ft]
Type of seal:
1/4-3/8-in Volclay tablets

Depth top of sand pack: [207.9-ft]
20-40-mesh silica sand

Depth top of screen: [211.5-ft]
4-in, #10-slot, stainless steel with channel pack

Depth bottom of screen [232.0-ft]

Depth to bottom of borehole: [234.5-ft]

Drawing By: RKL/2W07-11.ASB Date: 16Apr93

Reference:__________

SUMMARY OF CONSTRUCTION DATA AND FIELD OBSERVATIONS
RESOURCE PROTECTION WELL - 299-W7-11

WELL DESIGNATION	:	299-W7-11
CERCLA UNIT	:	200 Aggregate Area Management Study
RCRA FACILITY	:	LLBG
HANFORD COORDINATES	:	N 46,512 W 77,769 [200W-28May92]
LAMBERT COORDINATES	:	N 451,614 E 2,217,437 [HANCONV] N 137,636.0m E 566,186.2m [NAD83-28May92]
DATE DRILLED	:	May91
DEPTH DRILLED (GS)	:	234.5-ft
MEASURED DEPTH (GS)	:	Not documented
DEPTH TO WATER (GS)	:	215.1-ft, May91; 219.8-ft 24Mar93
CASING DIAMETER	:	4-in stainless steel, +0.9↔211.5-ft; 6-in stainless steel, +3.42↔~0.5-ft
ELEV TOP CASING	:	681.45-ft [NGVD'29-28May92]
ELEV GROUND SURFACE	:	678.03-ft, Brass cap [NGVD'29-28May92]
PERFORATED INTERVAL	:	Not applicable
SCREENED INTERVAL	:	211.5↔232.0-ft, 4-in #10-slot stainless steel
COMMENTS	:	FIELD INSPECTION, OTHER:
AVAILABLE LOGS	:	Geologist, driller
TV SCAN COMMENTS	:	Not applicable
DATE EVALUATED	:	Not applicable
EVAL RECCMMENDATION	:	Not applicable
LISTED USE	:	LLBG Monthly water level measurement, 24Jan92↔24Mar93; Not on water sample schedule
PUMP TYPE	:	Hydrostar, intake @ 232.1-ft (TOC)
MAINTENANCE	:	

WELL CONSTRUCTION AND COMPLETION SUMMARY

Drilling Method: Cable tool
Drilling Fluid Used: 200 W Water Supply
Driller's Name: T. Gifford
Drilling Company: Kaiser Engineers
Date Started: 10Apr91

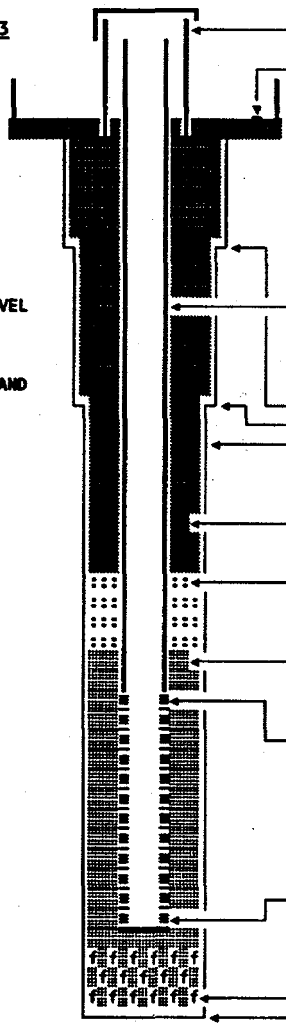
Sample Method: Drive barrel Hard tool
Additives Used: Not documented
WA State Lic Nr: 0867
Company Location: Hanford
Date Complete: 28May91

WELL NUMBER: 299-W7-12
TEMPORARY WELL NO: ______
Hanford Coordinates: N/S N 46,514 E/W W 78,246
State NAD83 N 137,636.3m E 566,040.8m
Coordinates: N 451,615 E 2,216,960
Start Card #: Not documented T___ R___ S______
Elevation Ground surface (ft): 684.64 (Brass cap)

Depth to water: 224.0-ft Jun91
(Ground surface) 226.0-ft 24Mar93

GENERALIZED STRATIGRAPHY Geologist's Log
Sl=slightly

0–5: Sandy GRAVEL
5–10: Gravelly SAND
10–30: Silty sandy GRAVEL
30–35: Sl silty sandy GRAVEL
35–50: Silty sandy GRAVEL
50–56: Sl silty sandy GRAVEL
56–60: Silty SAND
60–63: Sandy SILT
63–65: Cemented silty, sandy GRAVEL
65–75: Silty SAND
75–80: Sl silty sandy GRAVEL
80–110: Sl gravelly silty SAND
110–115: Sl silty, sl gravelly SAND
115–120: Sl gravelly SAND
120–125: Sl silty gravelly SAND
125–135: Silty gravelly SAND
135–140: Sl silty gravelly SAND
140–160: Sl sandy silty GRAVEL
160–190: Silty GRAVEL
190–225: Sandy GRAVEL
225–230: Gravelly SAND
230–245: Sandy GRAVEL



Elevation of reference point: [687.93-ft]
(top of casing)
Height of reference point above ground surface [3.29-ft]
Depth of surface seal [1.9–22.1-ft]

Type of surface seal: Pre-mix concrete
4x4-ft x 6-in surface pad to 1.9-ft
4 equidistant protective posts
Cement grout, 1.9–22.1-ft

I.D. of riser pipe: [4-in]
Type of riser pipe:
Stainless steel

Diameter of borehole,
0–21.4-ft, 13-in nominal
21.4–164.5-ft, 11-in nominal
164.5–245.0-ft, 9-in nominal

Type of filler, 22.1–207.8-ft
8–20 mesh bentonite crumbles

Depth top of seal: [207.8-ft]
Type of seal:
1/4–3/8-in Volclay pellets

Depth top of sand pack: [214.6-ft]
10–20-mesh silica sand

Depth top of screen: [219.3-ft]
4-in, #20-slot,
T304 stainless steel

Depth bottom of screen [240.0-ft]

Fill, 240.5–245.0-ft
Depth to bottom of borehole: [245.0-ft]

Drawing By: RKL/2W07-12.ASB Date: 16Apr93
Reference: ______

SUMMARY OF CONSTRUCTION DATA AND FIELD OBSERVATIONS
RESOURCE PROTECTION WELL - 299-W7-12

WELL DESIGNATION	:	299-W7-12
CERCLA UNIT	:	200 Aggregate Area Management Study
RCRA FACILITY	:	LLBG
HANFORD COORDINATES	:	N 46,514 W 78,246 [200W-07Sep91]
LAMBERT COORDINATES	:	N 451,615 E 2,216,960 [HANCONV] N 137,636.3m E 566,040.8m [NAD83-07Sep91]
DATE DRILLED	:	May91
DEPTH DRILLED (GS)	:	245.0-ft
MEASURED DEPTH (GS)	:	Not documented
DEPTH TO WATER (GS)	:	224.0-ft, Jun91; 226.0-ft, 24Mar93
CASING DIAMETER	:	4-in stainless steel, +1.0→219.3-ft; 6-in stainless steel, +3.29→~0.5-ft
ELEV TOP CASING	:	687.93-ft [NGVD'29-07Sep91]
ELEV GROUND SURFACE	:	684.64-ft, Brass cap [NGVD'29-07Sep91]
PERFORATED INTERVAL	:	Not applicable
SCREENED INTERVAL	:	219.3→240.0-ft, 4-in #20-slot stainless steel
COMMENTS	:	FIELD INSPECTION, OTHER:
AVAILABLE LOGS	:	Geologist, driller
TV SCAN COMMENTS	:	Not applicable
DATE EVALUATED	:	Not applicable
EVAL RECOMMENDATION	:	Not applicable
LISTED USE	:	LLBG Monthly water level measurement, 24Jan92→24Mar93; Not on water sample schedule
PUMP TYPE	:	Hydrostar, intake @ 236.7-ft (GS)
MAINTENANCE	:	

WELL CONSTRUCTION AND COMPLETION SUMMARY

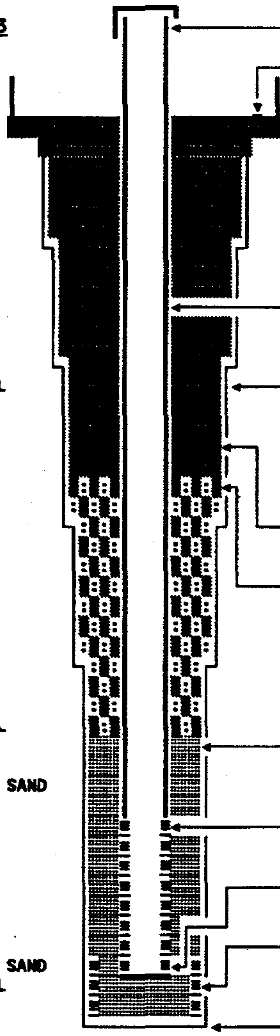
Drilling Method: Cable tool
Sample Method: Hard tool
Drilling Fluid Used: 200 W Water Supply
Additives Used: Not documented
Driller's Name: W. Moomaw
WA State Lic Nr: Not documented
Drilling Company: Onwego Drilling Co
Company Location: Kennewick, WA
Date Started: 27Jul87
Date Complete: 23Nov87

WELL NUMBER: 299-W7-3
TEMPORARY WELL NO: None
Hanford Coordinates: N/S N 46,520 E/W W 77,420
State Coordinates: N 451,623 E 2,217,786
Start Card #: Not documented T___ R___ S______
Elevation Ground surface (ft): 673.71 (Brass cap)

Depth to water: 211.7-ft Sep87
(Ground surface) 217.4-ft 24Mar93

GENERALIZED STRATIGRAPHY
Geologist's Log

0-5: GRAVEL (Backhoe to 8-ft)
10-35: Silty sandy GRAVEL
35-40: Gravelly silty CLAY
40-45: Silty sandy GRAVEL
45-50: Gravelly sandy SILT
50-65: Silty sandy GRAVEL
65-85: Gravelly silty SAND
85-95: Gravelly SAND
95-100: SAND
100-110: Gravelly SAND
110-120: Silty sandy GRAVEL
120-125: Silty gravelly SAND
125-145: Silty sandy-sandy GRAVEL
145-140: Silty gravelly SAND
140-175: Silty sandy GRAVEL
175-180: Silty gravelly SAND
180-185: Sandy GRAVEL
185-195: Gravelly SAND
195-205: Sandy GRAVEL
205-220: Silty gravelly SAND
220-235: Sandy GRAVEL
235-255: Slightly silty-slightly gravelly SAND
255-262: SAND w/CLAY 259-261-ft
262-280: Sandy GRAVEL
280-285: Gravelly SAND
285-310: Sandy GRAVEL-GRAVEL
315-320: Gravelly SAND
320-325: GRAVEL
325-345: Silty sandy-sandy GRAVEL
345-350: Gravelly SAND
350-355: Silty sandy GRAVEL
355-370: Gravelly silty-gravelly SAND
370-380: SAND
380-390: Silty sandy GRAVEL
390-400: Gravelly SAND
400-405: Sandy GRAVEL
405-410: Gravelly silty SAND
410-415: Silty sandy GRAVEL
415-420: Gravelly silty SAND
420-435: Sandy GRAVEL
435-445: Gravelly-gravelly silty SAND
445-465: Silty sandy-sandy GRAVEL
465-473: SAND-sandy GRAVEL
473-476.7: BASALT



Elevation of reference point: (top of casing) [676.14-ft]
Height of reference point above ground surface [2.43-ft]
Depth of surface seal [0-20-ft]
Type of surface seal: Pre-mix concrete
4x4-ft x 6-in surface pad to 5.0-ft
4 equidistant protective posts
Dry bentonite 5-20-ft
I.D. of riser pipe: [4-in]
Type of riser pipe: Stainless steel
Diameter of borehole,
0-48-ft, 21-in nominal
48-147-ft, 17-in nominal
147-230-ft, 13-in nominal
230-350-ft, 11-in nominal
350-476.7-ft, 9-in nominal
Type of filler, 20-196-ft
Bentonite slurry
Depth top of seal: [196.0-ft]
Type of seal: Volclay grout
Depth top of sand pack: [427.0-ft]
20-30-mesh silica sand
Depth top of screen: [449.0-ft]
4-in, #20-slot, continous wrap
304 stainless steel
Depth bottom of screen: [470.0-ft]
Telescoping screen, ~470-476.7-ft
8-in, #30-slot, continous wrap
304 stainless steel (damaged)
Depth to bottom of borehole: [476.7-ft]

Drawing By: RKL/2W07-03.ASB Date: 16Apr93
Reference: ____________

SUMMARY OF CONSTRUCTION DATA AND FIELD OBSERVATIONS
RESOURCE PROTECTION WELL - 299-W7-3

WELL DESIGNATION	:	299-W7-3
CERCLA UNIT	:	200 Aggregate Area Management Study
RCRA FACILITY	:	LLWMA-3
HANFORD COORDINATES	:	N 46,520 W 77,420 [200W-10Dec87]
LAMBERT COORDINATES	:	N 451,623 E 2,217,786 [HANCONV]
DATE DRILLED	:	Nov87
DEPTH DRILLED (GS)	:	476.7-ft
MEASURED DEPTH (GS)	:	Not documented
DEPTH TO WATER (GS)	:	211.7-ft, Sep87; 217.4-ft, 24Mar93
CASING DIAMETER	:	4-in stainless steel, +2.43~449-ft
ELEV TOP CASING	:	676.14-ft, [200W-10Dec87]
ELEV GROUND SURFACE	:	673.71-ft, Brass cap [200W-10Dec87]
PERFORATED INTERVAL	:	Not applicable
SCREENED INTERVAL	:	449~470-ft, 4-in #20-slot stainless steel; ~470~477-ft, 8-in telescoping, #30-slot, stainless steel
COMMENTS	:	FIELD INSPECTION, OTHER:
AVAILABLE LOGS	:	Geologist, driller
TV SCAN COMMENTS	:	Not applicable
DATE EVALUATED	:	Not applicable
EVAL RECOMMENDATION	:	Not applicable
LISTED USE	:	LLBG Monthly water level measurement, 01Dec87~24Mar93; Not on water sample schedule
PUMP TYPE	:	Hydrostar
MAINTENANCE	:	

WELL CONSTRUCTION AND COMPLETION SUMMARY

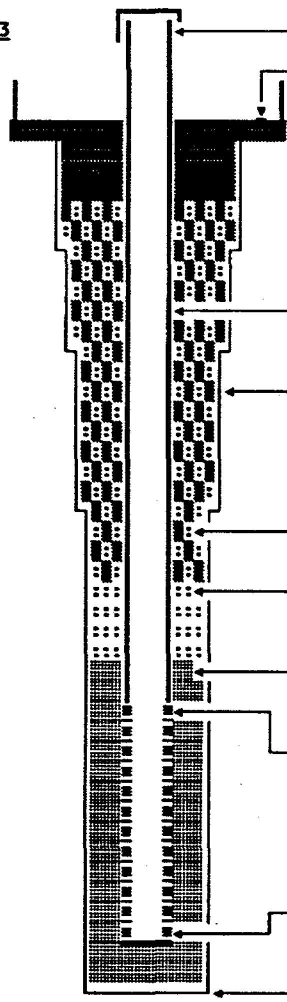
Drilling Method: Cable tool
Sample Method: Hard tool
Drilling Fluid Used: 200 W Water Supply
Additives Used: Not documented
Driller's Name: H. Joy/D. Garcia
WA State Lic Nr: Not documented
Drilling Company: Onwego Drilling Co
Company Location: Kennewick, WA
Date Started: 30Sep87
Date Complete: 19Nov87

WELL NUMBER: 299-W7-5
TEMPORARY WELL NO: None
Hanford Coordinates: N/S N 46,509 E/W W 76,816
State Coordinates: N 445,614 E 2,218,405
Start Card #: Not documented T___ R___ S___
Elevation Ground surface (ft): 670.41 (Brass cap)

Depth to water: 211-ft Nov87
(Ground surface) 213.5-ft 24Mar93

GENERALIZED STRATIGRAPHY Geologist's Log

5,10: GRAVEL
10: Sandy GRAVEL
15↔25: Sandy GRAVEL
30↔45: Silty sandy GRAVEL
50,55: Silty gravelly SAND
60: Gravelly silty SAND
65↔75: Silty gravelly SAND
80↔105: Sandy GRAVEL
110↔125: Silty sandy GRAVEL
130↔150: Sandy GRAVEL
155↔185: Silty sandy GRAVEL
190↔200: silty gravelly SAND
205: Silty sandy GRAVEL
210: Silty gravelly SAND
215: Gravelly SAND
220: Sandy GRAVEL
225: Silty/clayey SAND



Elevation of reference point: (top of casing) [673.05-ft]
Height of reference point above ground surface [2.64-ft]
Depth of surface seal [0↔5-ft]
Type of surface seal: Pre-mix concrete
4x4-ft x 6-in surface pad
4 equidistant protective posts
Dry bentonite 2↔5-ft
I.D. of riser pipe: [4-in]
Type of riser pipe: Stainless steel
Diameter of borehole,
0↔10.0-ft, 17-in nominal
10.0↔50.8-ft, 13-in nomnal
50.8↔154.6-ft, 11-in nominal
154.6↔229.0-ft, 9-in nominal
Type of filler, 5↔190-ft
Bentonite slurry
Depth top of seal: [190.0-ft]
Type of seal: Dry bentonite, 190↔197-ft
Volclay pellets, 197↔200-ft
Depth top of sand pack: [200-ft]
10↔20-mesh silica sand
Depth top of screen: [207.0-ft]
4-in, #20-slot stainless steel
Depth bottom of screen [227.7-ft]
Depth to bottom of borehole: [229.0-ft]

Drawing By: RKL/2W07-05.ASB Date: 16Apr93
Reference:

SUMMARY OF CONSTRUCTION DATA AND FIELD OBSERVATIONS
RESOURCE PROTECTION WELL - 299-W7-5

WELL DESIGNATION	:	299-W7-5
CERCLA UNIT	:	200 Aggregate Area Management Study
RCRA FACILITY	:	LLWMA-3
HANFORD COORDINATES	:	N 46,509 W 76,816 [200W-18Jul90]
LAMBERT COORDINATES	:	N 445,614 E 2,218,405 [HANCONV]
DATE DRILLED	:	Nov87
DEPTH DRILLED (GS)	:	229.0-ft
MEASURED DEPTH (GS)	:	Not documented
DEPTH TO WATER (GS)	:	211.0-ft, Nov87; 213.5-ft, 24Mar93
CASING DIAMETER	:	4-in stainless steel, +2.64→207-ft
ELEV TOP CASING	:	673.05-ft, [200W-18Jul90]
ELEV GROUND SURFACE	:	670.41-ft, Brass cap [200W-18Jul90]
PERFORATED INTERVAL	:	Not applicable
SCREENED INTERVAL	:	207→227.7-ft, 4-in #20-slot stainless steel;
COMMENTS	:	FIELD INSPECTION, 20Jan92; Stainless steel casing. 4-ft by 4-ft concrete pad, 4 posts, 1 removable capped and locked, brass cap in pad with well ID. Not in radiation zone. OTHER:
AVAILABLE LOGS	:	Geologist, driller
TV SCAN COMMENTS	:	Not applicable
DATE EVALUATED	:	Not applicable
EVAL RECOMMENDATION	:	Not applicable
LISTED USE	:	LLBG Monthly water level measurement, 10Dec87→24Mar93 Not on water sample schedule
PUMP TYPE	:	Hydrostar
MAINTENANCE	:	

WELL CONSTRUCTION AND COMPLETION SUMMARY

Drilling Method: Cable tool
Drilling Fluid Used: 200 W Water Supply
Driller's Name: B. Boley
Drilling Company: Onwego Drilling Co
Date Started: 02Sep87

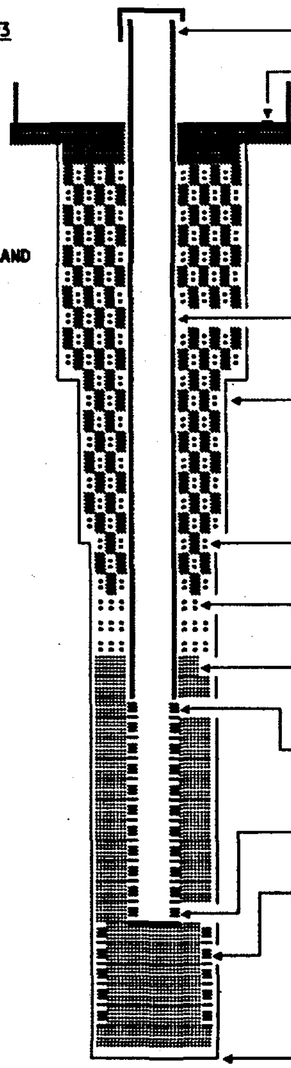
Sample Method: Hard tool
Additives Used: Not documented
WA State Lic Nr: Not documented
Company Location: Kennewick, WA
Date Complete: 02Nov87

WELL NUMBER: 299-W7-6
TEMPORARY WELL NO: None
Hanford Coordinates: N/S N 46.509 E/W W 76.219
State Coordinates: N 451,615 E 2,218,987
Start Card #: Not documented T____ R____ S______
Elevation Ground surface (ft): 676.25 (Brass cap)

Depth to water: 218.0-ft Sep87
(Ground surface) 219.4-ft 24Mar93

GENERALIZED STRATIGRAPHY Geologist's Log

0-5: Not documented
5-10: Sandy GRAVEL
10-15: Gravelly SAND
15-20: Sandy GRAVEL
20-35: Silty sandy GRAVEL
35-45: Slightly silty gravelly SAND
45-55: Gravelly SAND
55-75: Slightly gravelly SAND
75-80: Gravelly SAND
80-100: Gravelly silty SAND
100-105: Silty gravelly SAND
105-110: Gravelly silty SAND
110-175: Sandy GRAVEL
175-190: Silty sandy GRAVEL
190-195: Silty gravelly SAND
195-205: Silty sandy GRAVEL
205-210: Sandy GRAVEL
210-215: Silty sandy GRAVEL
215-230: Sandy GRAVEL
230-235: Silty gravelly SAND
235-242.8: Silty sandy GRAVEL



Elevation of reference point: (top of casing) [678.64-ft]
Height of reference point above ground surface [2.39-ft]
Depth of surface seal [0-200-ft]
Type of surface seal: Pre-mix concrete
4x4-ft x 6-in surface pad to 2.0-ft
4 equidistant protective posts
Dry bentonite 2-3-ft
Bentonite slurry 3-200.5-ft
I.D. of riser pipe: [4-in]
Type of riser pipe: Stainless steel
Diameter of borehole,
0-51.2-ft, 13-in nominal
51.2-152-ft, 11-in nominal
152-242.8-ft, 9-in nominal
Type of filler, 3-200.5-ft
Bentonite slurry
Depth top of seal: [200.5-ft]
Type of seal: Volclay pellets
Depth top of sand pack: [205.5-ft]
10-20-mesh silica sand
Depth top of screen: [209.0-ft]
4-in, #20-slot, continous wrap
304 stainless steel
Depth bottom of screen: [229.0-ft]
Telescoping screen, 231-241-ft
8-in, #30-slot, continous wrap
304 stainless steel
Depth to bottom of borehole: [242.8-ft]

Drawing By: RKL/2W07-06.ASB Date: 16Apr93

Reference:

SUMMARY OF CONSTRUCTION DATA AND FIELD OBSERVATIONS
RESOURCE PROTECTION WELL - 299-W7-6

WELL DESIGNATION	:	299-W7-6
CERCLA UNIT	:	200 Aggregate Area Management Study
RCRA FACILITY	:	LLWMA-3
HANFORD COORDINATES	:	N 46,509 W 76,219 [200W-10Dec87]
LAMBERT COORDINATES	:	N 451,615 E 2,218,987 [HANCONV]
DATE DRILLED	:	Nov87
DEPTH DRILLED (GS)	:	242.8-ft
MEASURED DEPTH (GS)	:	Not documented
DEPTH TO WATER (GS)	:	218.0-ft, Sep87; 219.4-ft, 24Mar93
CASING DIAMETER	:	4-in stainless steel, +2.39–209-ft
ELEV TOP CASING	:	678.64-ft [200W-10Dec87]
ELEV GROUND SURFACE	:	676.25-ft, Brass cap [200W-10Dec87]
PERFORATED INTERVAL	:	Not applicable
SCREENED INTERVAL	:	209–229-ft, 4-in #20-slot stainless steel; 231–241-ft, 8-in telescoping, #30-slot, stainless steel
COMMENTS	:	FIELD INSPECTION, OTHER:
AVAILABLE LOGS	:	Geologist, driller
TV SCAN COMMENTS	:	Not applicable
DATE EVALUATED	:	Not applicable
EVAL RECOMMENDATION	:	Not applicable
LISTED USE	:	LLBG Monthly water level measurement, 01Dec87–24Mar93; Not on water sample schedule
PUMP TYPE	:	Hydrostar
MAINTENANCE	:	

WELL CONSTRUCTION AND COMPLETION SUMMARY

Drilling Method: Cable tool
Drilling Fluid Used: 200 W Water Supply
Driller's Name: L. Cordon
Drilling Company: Basin & Range Drill
Date Started: 23Oct89

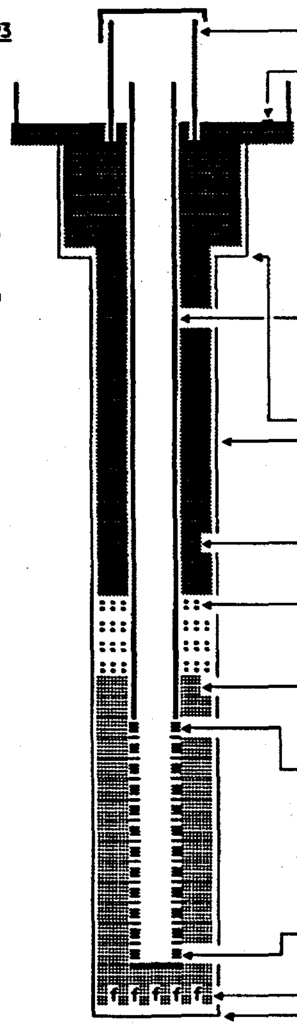
Sample Method: Drive barrel Hard tool
Additives Used: Not documented
WA State Lic Nr: Not documented
Company Location: Not documented
Date Complete: 27Nov89

WELL NUMBER: 299-W7-7
TEMPORARY WELL NO: None
Hanford Coordinates: N/S N 46,509.3 E/W W 76,518.7
State NAD83 Coordinates: N 137,636.3m 451,615 E 566,567.1m 2,218,687
Start Card #: Not documented T___ R___ S___
Elevation Ground surface (ft): 671.96 (Brass cap)

Depth to water: 211.8-ft Nov89
(Ground surface) 215.0-ft 24Mar93

GENERALIZED STRATIGRAPHY
Geologist's Log
Sl=slightly

0-30: Muddy sandy GRAVEL
30-35: Gravelly sandy MUD
35-45: Gravelly muddy SAND
45-50: Muddy sandy GRAVEL
50-55: Sl gravelly sl muddy SAND
55-60: SAND
60-65: Sl gravelly SAND
65-70: Sl gravelly sl muddy SAND
70-75: Gravelly SAND
75-90: Sandy GRAVEL
90-105: Muddy sandy GRAVEL
105-110: Sl muddy gravelly SAND
110-135: Sandy GRAVEL
135-145: Muddy sandy GRAVEL
145-155: Sandy GRAVEL
155-230: Muddy sandy GRAVEL



Elevation of reference point: (top of casing) [674.94-ft]
Height of reference point above ground surface [2.98-ft]
Depth of surface seal [2-17.4-ft]
Type of surface seal: Pre-mix concrete 4x4-ft x 6-in surface pad to 2-ft 4 equidistant protective posts Cement grout-Portland Cement with gypsum, 2.0-17.4-ft
I.D. of riser pipe: [4-in]
Type of riser pipe: Stainless steel
Diameter of borehole, 0-20.2-ft, 13-in nominal 20.2-227.8-ft, 9-in nominal
Type of filler, 17.4-198-ft Bentonite crumbles
Depth top of seal: [198.0-ft]
Type of seal: 3/8-in Volclay pellets
Depth top of sand pack: [202.7-ft]
20-40-mesh silica sand
Depth top of screen: [207.1-ft]
4-in, #10-slot, stainless steel with channel pack
Depth bottom of screen [227.8-ft]
Fill 229.6-230.8-ft
Depth to bottom of borehole: [230.8-ft]

Drawing By: RKL/2W07-07.ASB Date: 16Apr93
Reference: WHC-MR-0204

SUMMARY OF CONSTRUCTION DATA AND FIELD OBSERVATIONS
RESOURCE PROTECTION WELL - 299-W7-7

```
WELL DESIGNATION      :   299-W7-7
CERCLA UNIT           :   200 Aggregate Area Management Study
RCRA FACILITY         :   LLBG
HANFORD COORDINATES   :   N  46,509.3   W    76,518.7  [200W-29Jan90]
LAMBERT COORDINATES   :   N 451,615     E 2,218,687    [HANCONV]
                          N 137,636.3m  E   566,567.1m [NAD83-29Jan90]
DATE DRILLED          :   Nov89
DEPTH DRILLED  (GS)   :   230.8-ft
MEASURED DEPTH (GS)   :   Not documented
DEPTH TO WATER (GS)   :   211.8-ft, Nov89;
                          215.0-ft, 24Mar93
CASING DIAMETER       :   4-in stainless steel, +0.9-207-ft;
                          6-in stainless steel, +2.98-~0.5-ft
ELEV TOP CASING       :   674.94-ft              [200W-29Jan90]
ELEV GROUND SURFACE   :   671.96-ft, Brass cap [200W-29Jan90]
PERFORATED INTERVAL   :   Not applicable
SCREENED INTERVAL     :   207.1-227.8-ft, 4-in #10-slot stainless steel, with channel pack
COMMENTS              :   FIELD INSPECTION,
                          OTHER:
AVAILABLE LOGS        :   Geologist, driller
TV SCAN COMMENTS      :   Not applicable
DATE EVALUATED        :   Not applicable
EVAL RECOMMENDATION   :   Not applicable
LISTED USE            :   LLBG Quarterly water level measurement, 27Feb90-24Mar93;
                          Not on water sample schedule
PUMP TYPE             :   Hydrostar
MAINTENANCE           :
```

WELL CONSTRUCTION AND COMPLETION SUMMARY

Drilling Method: Cable tool
Drilling Fluid Used: 200 W Water Supply
Driller's Name: L. Cordon
Drilling Company: Basin & Range Drill
Date Started: 19Oct89

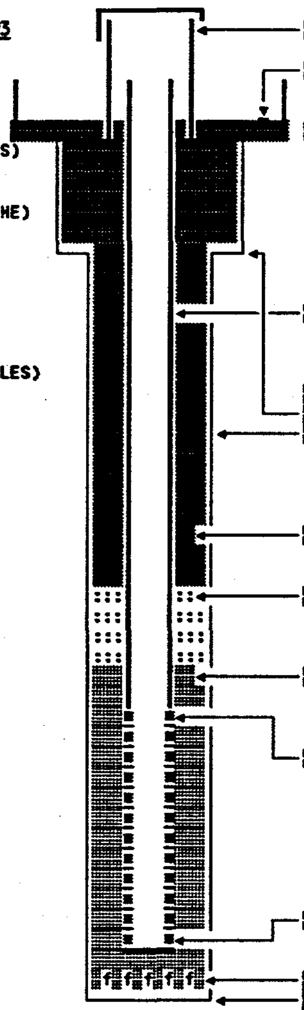
Sample Method: Drive barrel Hard tool
Additives Used: Not documented
WA State Lic Nr: Not documented
Company Location: Not documented
Date Complete: 13Dec89

WELL NUMBER: 299-W7-8
TEMPORARY WELL NO: None
Hanford Coordinates: N/S N 46,509.8 E/W W 76,880.1
State NAD83 Coordinates: N 137,637.0m 451,614 E 566,761.7m 2,218,326
Start Card #: Not documented T___ R___ S___
Elevation Ground surface (ft): 684.40 (Brass cap)

Depth to water: 229.2-ft Nov89
(Ground surface) 228.8-ft 24Mar93

GENERALIZED Geologist's
STRATIGRAPHY Log
Sl=slightly

0–20: Sandy GRAVEL (trace COBBLES)
20–28.5: Muddy sandy GRAVEL
28.5–35: Sandy MUD
35–39.5: Muddy SAND (trace CALICHE)
39.5–48: Sandy GRAVEL
(fines 47–48-ft)
48–51: Sl gravelly SAND
51–57: Muddy sandy GRAVEL
57–59: Gravelly SAND
59–78: SAND
78–85: Gravelly SAND
85–110: Sandy GRAVEL (trace COBBLES)
110–120: SAND
120–130: Sandy GRAVEL
130–235: Muddy sandy GRAVEL
235–240: Sl muddy gravelly SAND
240–244.5: Muddy sandy GRAVEL



Elevation of reference point: [687.35-ft]
(top of casing)
Height of reference point above ground surface [2.95-ft]
Depth of surface seal [2–18.7-ft]

Type of surface seal: Pre-mix concrete
4x4-ft x 6-in surface pad to 2-ft
4 equidistant protective posts
Cement grout-Portland Cement
with gypsum, 2.0–18.7-ft

I.D. of riser pipe: [4-in]
Type of riser pipe:
Stainless steel

Diameter of borehole,
0–18.7-ft, 13-in nominal
18.7–244.5-ft, 9-in nominal

Type of filler, 18.7–215-ft
8–20 mesh bentonite

Depth top of seal: [215.0-ft]
Type of seal:
1/4-in Volclay tablets

Depth top of sand pack: [217.3-ft]
20–40-mesh silica sand

Depth top of screen: [219.8-ft]
4-in, #10-slot, stainless steel
with channel pack

Depth bottom of screen [240.6-ft]

Fill 243.4–244.5-ft
Depth to bottom of borehole: [240.6-ft]

Drawing By: RKL/2W07-08.ASB Date: 16Apr93

Reference: WHC-MR-0204

SUMMARY OF CONSTRUCTION DATA AND FIELD OBSERVATIONS
RESOURCE PROTECTION WELL - 299-W7-8

WELL DESIGNATION	:	299-W7-8
CERCLA UNIT	:	200 Aggregate Area Management Study
RCRA FACILITY	:	LLBG
HANFORD COORDINATES	:	N 46,509.8 W 76,880.1 [200W-29Jan90]
LAMBERT COORDINATES	:	N 451,614 E 2,218,326 [HANCONV] N 137,637.0m E 566,761.7m [NAD83-29Jan90]
DATE DRILLED	:	Dec89
DEPTH DRILLED (GS)	:	240.6-ft
MEASURED DEPTH (GS)	:	Not documented
DEPTH TO WATER (GS)	:	229.2-ft, Nov89; 228.8-ft, 24Mar93
CASING DIAMETER	:	4-in stainless steel, +ND↔207-ft; 6-in stainless steel, +2.95↔~0.5-ft
ELEV TOP CASING	:	687.35-ft, [200W-29Jan90]
ELEV GROUND SURFACE	:	684.40-ft, Brass cap [200W-29Jan90]
PERFORATED INTERVAL	:	Not applicable
SCREENED INTERVAL	:	219.8↔240.6-ft, 4-in #10-slot stainless steel, with channel pack
COMMENTS	:	FIELD INSPECTION, OTHER:
AVAILABLE LOGS	:	Geologist, driller
TV SCAN COMMENTS	:	Not applicable
DATE EVALUATED	:	Not applicable
EVAL RECOMMENDATION	:	Not applicable
LISTED USE	:	LLBG Monthly water level measurement, 27Feb90↔24Mar93 Not on water sample schedule
PUMP TYPE	:	Hydrostar
MAINTENANCE	:	

WELL CONSTRUCTION AND COMPLETION SUMMARY

Drilling Method: Cable tool
Drilling Fluid Used: 200 W Water Supply
Driller's Name: R. Thorsen
Drilling Company: Kaiser Engineers
Date Started: 03Oct89

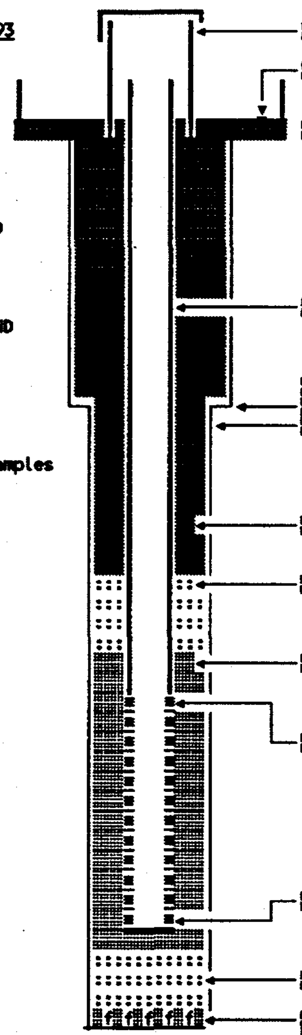
Sample Method: Drive barrel Hard tool
Additives Used: Not documented
WA State Lic Nr: Not documented
Company Location: Hanford
Date Complete: 11Apr90

WELL NUMBER: 299-W7-9
TEMPORARY WELL NO: W5-MW1
Hanford Coordinates: N/S N 46,549.3 E/W W 78,888.9
State NAD83 137,646.59m E 565,844.83m
Coordinates: N 451,649 E 2,216,317
Start Card #: Not documented T____ R____ S______
Elevation Ground surface (ft): 689.11 (Brass cap)

Depth to water: 227.0-ft Nov89
(Ground surface) 230.0-ft 24Mar93

GENERALIZED STRATIGRAPHY
Geologist's Log
Sl=slightly

0-10: Gravelly muddy SAND
10-20: Muddy sandy GRAVEL
20-25: Sandy GRAVEL
25-65: Muddy sandy GRAVEL
65-70: Sl gravelly sl muddy SAND
70-75: Muddy SAND
75-82: Muddy sandy GRAVEL
82-86: SAND
86-90: Gravelly SAND
95-104: Sl gravelly sl muddy SAND
104-138: SAND
138-144: Sl muddy SAND
144-155: Sandy GRAVEL
155-160: Gravelly SAND
160-205: Sandy GRAVEL
205-245: Muddy sandy GRAVEL
245-252.2: Not documented, no samples



Elevation of reference point: (top of casing) [692.09-ft]
Height of reference point above ground surface [2.98-ft]
Depth of surface seal [2-19.0-ft]
Type of surface seal: Pre-mix concrete 4x4-ft x 6-in surface pad to 2-ft
4 equidistant protective posts
Cement grout-Portland Cement Type I & II, 2.5-20.2-ft
I.D. of riser pipe: [4-in]
Type of riser pipe: Stainless steel
Diameter of borehole,
0-143.5-ft, 11-in nominal
143.5-252.2-ft, 9-in nominal
Type of filler, 20.2-209.8-ft
8-20 mesh bentonite crumbles
Depth top of seal: [209.8-ft]
Type of seal: 1/4-in Volclay tablets
Depth top of sand pack: [214.3-ft]
20-40-mesh silica sand
Depth top of screen: [220.3-ft]
4-in, #10-slot, stainless steel with channel pack
Depth bottom of screen [241.1-ft]
Volclay tablets, 242.8-248.4-ft
Fill 248.4-252.2-ft
Depth to bottom of borehole: [252.2-ft]

Drawing By: RKL/2W07-09.ASB Date: 16Apr93
Reference: WHC-MR-0205

SUMMARY OF CONSTRUCTION DATA AND FIELD OBSERVATIONS
RESOURCE PROTECTION WELL - 299-W7-9

```
WELL DESIGNATION     :  299-W7-9
CERCLA UNIT          :  200 Aggregate Area Management Study
RCRA FACILITY        :  LLBG
HANFORD COORDINATES :  N  46,549.3    W    78,888.9    [200W-30Aug90]
LAMBERT COORDINATES :  N 451,649      E 2,216,317      [HANFORD CONV]
             (NAD 83)   N 137,646.59m  E   565,844.83m [NAD83-30Aug90]
DATE DRILLED         :  Apr90
DEPTH DRILLED  (GS) :  252.2-ft
MEASURED DEPTH (GS) :  Not documented
DEPTH TO WATER (GS) :  227.0-ft, Nov89;
                        230.0-ft, 24Mar93
CASING DIAMETER      :  4-in stainless steel, +1.0-220.3-ft;
                        6-in stainless steel, +2.98-~0.5-ft
ELEV TOP CASING      :  692.09-ft,          [200W-30Aug90]
ELEV GROUND SURFACE :  689.11-ft, Brass cap [200W-30Aug90]
PERFORATED INTERVAL :  Not applicable
SCREENED INTERVAL    :  220.3-241.1-ft, 4-in #10-slot stainless steel, with channel pack
COMMENTS             :  FIELD INSPECTION,
                        OTHER:
AVAILABLE LOGS       :  Geologist, driller
TV SCAN COMMENTS     :  Not applicable
DATE EVALUATED       :  Not applicable
EVAL RECOMMENDATION :  Not applicable
LISTED USE           :  LLBG Monthly water level measurement, 19Apr90-24Mar93;
                        Not on water sample schedule
PUMP TYPE            :  Hydrostar
MAINTENANCE          :
```

WELL CONSTRUCTION AND COMPLETION SUMMARY

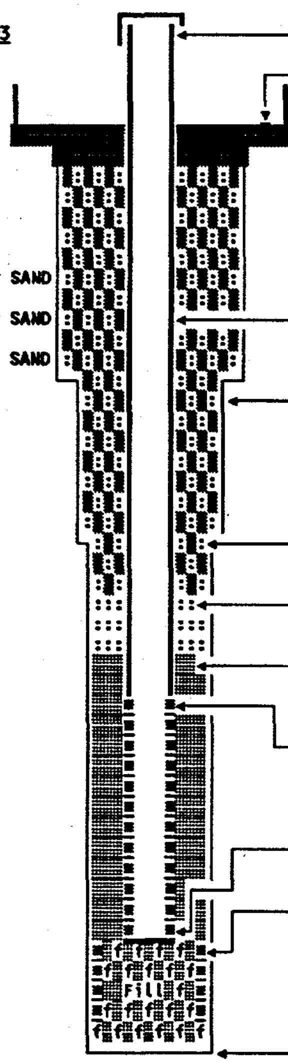
Drilling Method: Cable tool	Sample Method: Hard tool	WELL NUMBER: 299-W8-1 / TEMPORARY WELL NO: None
Drilling Fluid Used: 200 W Water Supply	Additives Used: Not documented	Hanford Coordinates: N/S N 46,551 E/W W 79,200
Driller's Name: L. Bultena	WA State Lic Nr: Not documented	State Coordinates: N 451,650 E 2,248,987
Drilling Company: Onwego Drilling Co	Company Location: Kennewick, WA	Start Card #: Not documented T___ R___ S___
Date Started: 09Jun87	Date Complete: 23Jul87	Elevation Ground surface (ft): 699.45 (Brass cap)

Depth to water: 239.6-ft Sep88
(Ground surface) 240.4-ft 24Mar93

GENERALIZED STRATIGRAPHY

Geologist's Log

0-5: Backfill
5-65: Sandy GRAVEL
65-80: Gravelly SAND
80-90: Gravelly sandy SILT
90-95: Silty sandy GRAVEL
95-105: Sandy GRAVEL
105-110: Slightly silty gravelly SAND
110-115: Slightly gravelly SAND
115-135: Slightly gravelly silty SAND
135-145: Silty SAND
145-155: Slightly gravelly silty SAND
155-165: Silty gravelly SAND
165-180: Sandy sandy GRAVEL
180-195: Sandy GRAVEL
195-200: Silty sandy GRAVEL
200-205: Silty/clayey GRAVEL
205-210: Gravelly silty SAND
210-270.5: Silty sandy GRAVEL



Elevation of reference point: (top of casing) [701.33-ft]

Height of reference point above ground surface [1.88-ft]

Depth of surface seal [0-206-ft]

Type of surface seal: Pre-mix concrete
4x4-ft x 6-in surface pad to 3.0-ft
4 equidistant protective posts
Volclay bentonite grout 3-206-ft

I.D. of riser pipe: [4-in]
Type of riser pipe: Stainless steel

Diameter of borehole,
0-62.7-ft, 13-in nominal
62.7-156.8-ft, 11-in nominal
156.8-270.5-ft, 9-in nominal

Type of filler, 3-206-ft
Volclay bentontite grout

Depth top of seal: [206.0-ft]
Type of seal: Volclay pellets

Depth top of sand pack: [210.5-ft]
20-30-mesh silica sand

Depth top of screen: [236.2-ft]
4-in, #20-slot, continous wrap
304 stainless steel

Depth bottom of screen: [256.5-ft]

Telescoping screen, 257-267.7-ft
8-in, #30-slot, continous wrap
304 stainless steel

Depth to bottom of borehole: [270.5-ft]

Drawing By: RKL/2W08-01.ASB Date: 16Apr93

Reference: ____________

SUMMARY OF CONSTRUCTION DATA AND FIELD OBSERVATIONS
RESOURCE PROTECTION WELL - 299-W8-1

WELL DESIGNATION	:	299-W8-1
CERCLA UNIT	:	200 Aggregate Area Management Study
RCRA FACILITY	:	LLWMA-3
HANFORD COORDINATES	:	N 46,551 W 79,200 [200W-10Dec87]
LAMBERT COORDINATES	:	N 451,650 E 2,216,006 [HANCONV]
DATE DRILLED	:	Jul87
DEPTH DRILLED (GS)	:	270.5-ft
MEASURED DEPTH (GS)	:	Not documented
DEPTH TO WATER (GS)	:	239.6-ft, Sep88; 240.4-ft, 24Mar93
CASING DIAMETER	:	4-in stainless steel, +1.88→202-ft
ELEV TOP CASING	:	701.33-ft, [200W-10Dec87]
ELEV GROUND SURFACE	:	699.45-ft, Brass cap [200W-10Dec87]
PERFORATED INTERVAL	:	Not applicable
SCREENED INTERVAL	:	236→256-ft, 4-in #20-slot stainless steel; 257→267-ft, 8-in telescoping, #30-slot, stainless steel
COMMENTS	:	FIELD INSPECTION, OTHER:
AVAILABLE LOGS	:	Geologist, driller
TV SCAN COMMENTS	:	Not applicable
DATE EVALUATED	:	Not applicable
EVAL RECOMMENDATION	:	Not applicable
LISTED USE	:	LLBG Monthly water level measurement, 01Dec87→24Mar93; Not on water sample schedule
PUMP TYPE	:	Hydrostar
MAINTENANCE	:	

WELL CONSTRUCTION AND COMPLETION SUMMARY

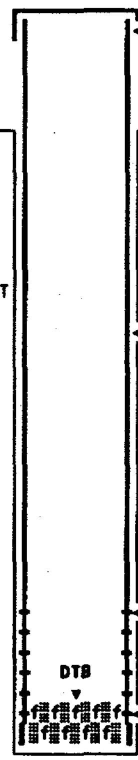
Drilling Method: Cable tool	Sample Method: Hard tool (nom)	WELL NUMBER: 699-48-71 A5214 TEMPORARY WELL NO:
Drilling Fluid Used: Water	Additives Used: Not documented	Hanford Coordinates: N/S N 47,838 E/W W 70,660
Driller's Name: Chausse- Roberts	WA State Lic Nr: Not documented	State Coordinates: N 452,958 E 2,224,542
Drilling Company: Not documented	Company Location: Not documented	Start Card #: Not documented T 13N R 25E S 31G1
Date Started: 24Aug56	Date Complete: 26Sep56	Elevation Ground surface: 686.5-ft Estimated

Depth to water: 264-ft 26Sep56
(Ground surface) 242.8-ft 02Jun94

GENERALIZED STRATIGRAPHY Driller's Log

0→7: TOP SOIL-GRAVEL
7→27: BOULDERS-GRAVEL
27→42: SAND-SILT-some GRAVEL
42→67: SAND
67→72: SAND-GRAVEL-COBBLES
72→81: COBBLES-SAND-GRAVEL
81→90: SAND-GRAVEL-COBBLES
90→95: Cemented SAND-GRAVEL-COBBLES-SILT
95→116: SAND-SILT-GRAVEL
116→152: SAND-SILT-GRAVEL (Boulders)
152→170: SAND-GRAVEL-BOULDERS, no SILT
170→284: SAND-SILT-GRAVEL
284→295: SAND-GRAVEL
295→303: SAND-GRAVEL-SILT
303→305: SAND and SILT

REMEDIATION:
Jun73 by Page
Slotted casing,
assumed 239→251-ft [HANFORD WELLS]



Elevation of reference point: [688.15-ft]
(top of casing)
Height of reference point above ground surface [1.65-ft]
Depth of surface seal [ND]
No surface seal documented:
8-in ID carbon steel casing, +1.6→303-ft
9-in nominal hole, 0→303-ft
8-in casing perforations,: 239→251-ft, Not documented 251→302-ft, 5 holes/ft
Borehole drilled depth: [305-ft]
DTB=Depth to bottom, 283.6-ft, 12Jul93

Drawing By: RKL/6N48W72.ASB
Date : 23Sep94
Reference : HANFORD WELLS

SUMMARY OF CONSTRUCTION DATA AND FIELD OBSERVATIONS
RESOURCE PROTECTION WELL - 699-48-71

WELL DESIGNATION	:	699-48-71
CERCLA UNIT	:	Not applicable
RCRA FACILITY	:	Not applicable
HANFORD COORDINATES	:	N 47,838 W 70,660 [HANFORD WELLS]
LAMBERT COORDINATES	:	N 452,958 E 2,224,542 [HANCONV]
DATE DRILLED	:	Sep56
DEPTH DRILLED (GS)	:	305-ft
MEASURED DEPTH (GS)	:	283.6-ft, 12Jul93
DEPTH TO WATER (GS)	:	264.0-ft, 26Sep56, 242.8-ft, 02Jun94
CASING DIAMETER	:	8-in, from +1.6-303-ft
ELEV TOP CASING	:	688.15-ft [HANFORD WELLS]
ELEV GROUND SURFACE	:	686.5-ft Estimated
PERFORATED INTERVAL	:	239-302-ft
SCREENED INTERVAL	:	Not applicable
COMMENTS	:	FIELD INSPECTION, 12Jul93, 8-in carbon steel casing. No pad, no posts. Capped and locked. No permanent identification. Not in a radiation zone. OTHER:
AVAILABLE LOGS	:	Driller
TV SCAN COMMENTS	:	Not applicable
DATE EVALUATED	:	Not applicable
EVAL RECOMMENDATION	:	Not applicable
LISTED USE	:	Sitewide semiannual w/l measurement, 01Jun84-02Jun94,
CURRENT USER	:	WHC ES&M w/l monitoring, PNL sitewide sampling and w/l monitoring
PUMP TYPE	:	Electric submersible
MAINTENANCE	:	Maintenance activities documented in the Hanford Wells Database System

WELL CONSTRUCTION AND COMPLETION SUMMARY

Drilling Method: Cable tool
Drilling Fluid Used: Water
Driller's Name: Greenfield
Drilling Company: Not documented
Date Started: 24May48

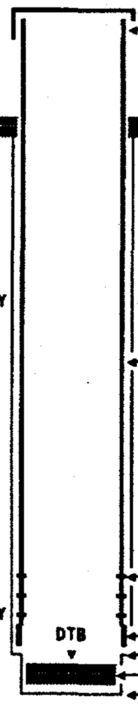
Sample Method: Hard tool (nom)
Additives Used: Topsoil, clay
WA State Lic Nr: Not documented
Company Location: ND
Date Complete: 06Jul48

WELL NUMBER: 699-49-79 A5221
TEMPORARY WELL NO: ____
Hanford Coordinates: N/S N 48,600 E/W W 79,122
State Coordinates: N 453,699 E 2,216,078
Start Card #: Not documented T 13N R 25N S 36D1
Elevation Ground surface: 688.1-ft Estimated

Depth to water: ~270-ft Jul48
(Ground surface) 233.8-ft 01Jun94

GENERALIZED STRATIGRAPHY | Driller's Log

0-20: ROCKS
20-22: Grey SAND
22-25: Black SAND
25-30: GRAVEL
30-35: Black SAND
35-40: Black and white SAND
40-45: CLAY, SAND and GRAVEL
45-47: Coarse B&W SAND & little GRAVEL
47-50: Fine B&W SAND, little GRAVEL/CLAY
50-85: SAND, CLAY & little GRAVEL
85-95: SAND & CLAY w/very little GRAVEL
95-117: SAND & CLAY
117-120: SAND, CLAY & ROCKS
120-123: SAND & GRAVEL w/little CLAY
123-130: SAND & GRAVEL
130-135: Grey SAND
135-140: SAND & GRAVEL
140-150: GRAVEL & little SAND
150-154: SAND & GRAVEL
154-159: SAND
159-160: SAND, GRAVEL & ROCKS
160-163: Fine grey SAND
163-180: SAND & GRAVEL some ROCKS
180-200: SAND & little GRAVEL & ROCKS
200-210: SAND, GRAVEL, ROCKS w/some CLAY
210-225: SAND, ROCKS & some CLAY
225-265: SAND, CLAY & ROCKS
265-270: SAND & silty GRAVEL
270-277: SAND, GRAVEL & little CLAY
277-280: SAND & GRAVEL, some ROCKS
280-285: Silty sandy GRAVEL
285-290: Silty SAND & GRAVEL
290 : SAND & GRAVEL



Elevation of reference point: (top of casing) [689.20-ft]
Height of reference point above ground surface [1.1-ft]
Depth of surface seal [ND]
No surface seal documented:
Has 4x4-ft concrete pad

9-in nominal hole, 0-~265-ft
8-in ID carbon steel casing, +1.1-~265-ft

8-in casing perforations,
225-235-ft, 4 cuts/ft
235-245-ft, 4 cuts/ft
245-260-ft, 1 cut/ft
260-265-ft, 2 cuts/ft
8-in nominal hole, ~265-290-ft
Cement plug, ~279-280-ft
Borehole drilled depth: [290.0-ft]

DTB=Depth to bottom,
279.4-ft, 21Feb91

REMEDIATIONS:
Aug56, Gentz,
Perforated 235-265-ft
Aug74, M. Bultena
Perforated 225-235-ft
Fill to 280-ft
Mar80, M. Bultena
Set cement plug @ 279-ft

Drawing By: RKL/6N49W79.ASB
Date : 23Sep94
Reference : HANFORD WELLS

SUMMARY OF CONSTRUCTION DATA AND FIELD OBSERVATIONS
RESOURCE PROTECTION WELL - 699-49-79

WELL DESIGNATION	:	699-49-79
RCRA FACILITY	:	Not applicable
CERCLA UNIT	:	Not applicable
HANFORD COORDINATES	:	N 48,600 W 79,122 [HANFORD WELLS]
LAMBERT COORDINATES	:	N 453,699 E 2,216,078 [HANCONV]
DATE DRILLED	:	Jul48
DEPTH DRILLED (GS)	:	290.0-ft
MEASURED DEPTH (GS)	:	279.4-ft, 21Feb91
DEPTH TO WATER (GS)	:	~270-ft Jul48 233.8-ft, 01Jun94
CASING DIAMETER	:	8-in, carbon steel, +1.1↔~265-ft
ELEV TOP CASING	:	689.20-ft [HANFORD WELLS]
ELEV GROUND SURFACE	:	688.1-ft, Estimated
PERFORATED INTERVAL	:	225↔265-ft
SCREENED INTERVAL	:	Not applicable
COMMENTS	:	FIELD INSPECTION, 21Feb91, 8-in carbon steel casing. Capped and locked Has 4x4-ft pad, no posts, identification stamped on BM in pad. Not in radiation zone. OTHER;
AVAILABLE LOGS	:	Driller
TV SCAN COMMENTS	:	Not applicable
DATE EVALUATED	:	Not applicable
EVAL RECOMMENDATION	:	Not applicable
LISTED USE	:	Sitewide semiannual w/l measurement, 26Nov48↔01Jun94;
CURRENT USER	:	ER characterization and WHC ES&M w/l monitoring, PNL sitewide sampling and w/l monitoring
PUMP TYPE	:	Electric submersible
MAINTENANCE	:	Maintenance activities documented in the Hanford Wells Database System

WELL CONSTRUCTION AND COMPLETION SUMMARY

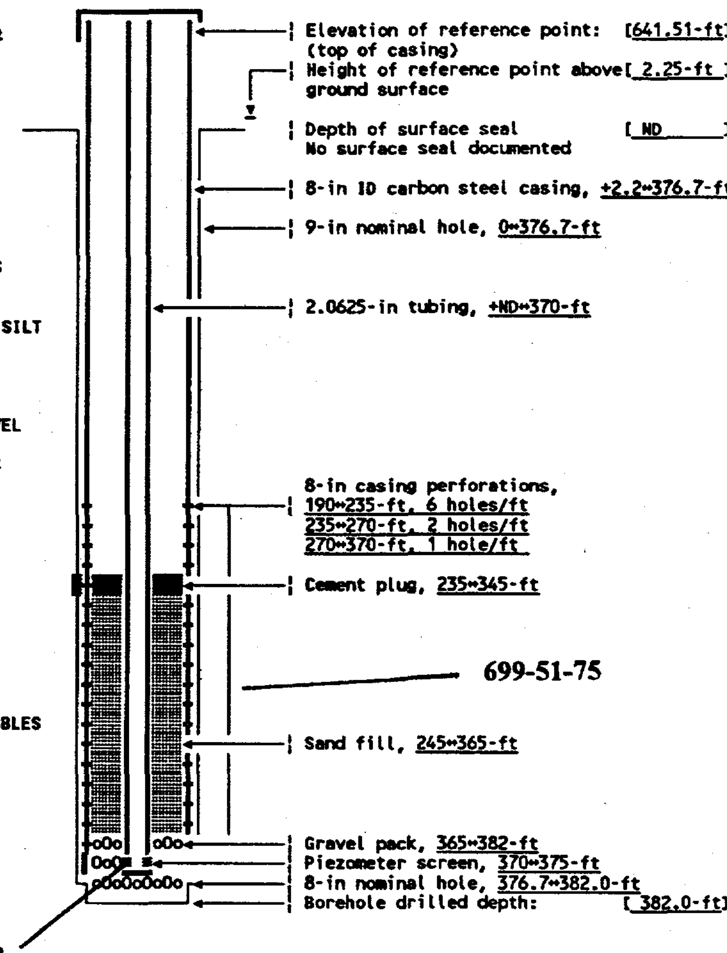
Drilling Method: Cable tool
Sample Method: Hard tool (nom)
WELL NUMBER: 699-51-75 A5232
TEMPORARY WELL NO: ________
Drilling Fluid Used: Water
Additives Used: Not documented
Hanford Coordinates: N/S N 50,667 E/W W 75,151
Driller's Name: Gentz
WA State Lic Nr: Not documented
State Coordinates: N 455,776 E 2,220,044
Drilling Company: Not documented
Company Location: Not documented
Start Card #: Not documented T 13N R 25E S 25Q1
Date Started: 21Aug57
Date Complete: 04Oct57
Elevation Ground surface: 639.3-ft Estimated

Depth to water: 193-ft Oct57
(Ground surface) 191.6-ft 01Jun94

GENERALIZED STRATIGRAPHY

Driller's Log

0–15: BOULDERS, GRAVEL and SAND
15–45: BOULDERS, GRAVEL
45–55: COBBLES-BOULDERS
55–65: BOULDERS-GRAVEL
65–75: COBBLES-GRAVEL-BOULDERS
75–100: COBBLES-GRAVEL
100–120: SAND, GRAVEL and COBBLES
120–130: COBBLES and GRAVEL
130–160: GRAVEL, SAND and SILT
160–170: COBBLES, GRAVEL, SAND & SILT
170–215: GRAVEL, SAND and SILT
215–225: SAND-STONE
225–230: COBBLES-GRAVEL-SAND
230–235: GRAVEL and SAND
235–240: Coarse SAND, little GRAVEL
240–255: SAND-GRAVEL
255–260: SAND, GRAVEL and COBBLES
260–270: GRAVEL and SAND
270–275: SAND little SILT
275–280: SAND-GRAVEL-SILT
280–285: SAND-GRAVEL
285–295: SAND, COBBLES, GRAVEL
295–305: Coarse GRAVEL-fine SAND
305–320: Small and coarse GRAVEL, fine SAND
320–335: Coarse GRAVEL and SAND
335–340: SAND-SILT-GRAVEL
340–345: SAND-GRAVEL
345–350: SAND-GRAVEL-COBBLES
350–360: SAND, GRAVEL, BASALT COBBLES
360–365: SAND and GRAVEL
365–370: SAND-SILT-GRAVEL
370–375: SAND, GRAVEL, BASALT
375–380: SAND, GRAVEL, BASALT and COBBLES
380–382: BASALT



Drawing By: RKL/6N51W75A.ASB
Date: 26Sep94
Reference: HANFORD WELLS

SUMMARY OF CONSTRUCTION DATA AND FIELD OBSERVATIONS
RESOURCE PROTECTION WELL - 699-51-75

WELL DESIGNATION	:	699-51-75
RCRA FACILITY	:	Not applicable
CERCLA UNIT	:	Not applicable
HANFORD COORDINATES	:	N 50,667 W 75,151 [Hanford Wells]
LAMBERT COORDINATES	:	N 455,776 E 2,220,044 [HANCONV]
DATE DRILLED	:	Oct57
DEPTH DRILLED (GS)	:	382.0-ft
MEASURED DEPTH (GS)	:	Not documented
DEPTH TO WATER (GS)	:	193.0-ft, Oct57 191.6-ft, 01Jun94
CASING DIAMETER	:	8-in, carbon steel, +2.25-376.7-ft, 2.0625-in, +ND-370-ft
ELEV TOP CASING	:	641.51-ft [HANFORD WELLS]
ELEV GROUND SURFACE	:	639.3-ft, Estimated
PERFORATED INTERVAL	:	190-370-ft
SCREENED INTERVAL	:	370-375, piezometer
COMMENTS	:	FIELD INSPECTION, 31Jan90, 8-in carbon steel casing. Capped and locked No pad, posts or permanent identification. Not in radiation zone. OTHER;
AVAILABLE LOGS	:	Driller
TV SCAN COMMENTS	:	Not applicable
DATE EVALUATED	:	Not applicable
EVAL RECOMMENDATION	:	Not applicable
LISTED USE	:	Sitewide semiannual w/l measurement, 15Oct57-01Jun94;
CURRENT USER	:	WHC ES&M w/l monitoring, PNL sitewide sampling, w/l monitoring and characterization
PUMP TYPE	:	Electric submersible
MAINTENANCE	:	Maintenance activities documented in the Hanford Wells Database System

Appendix C

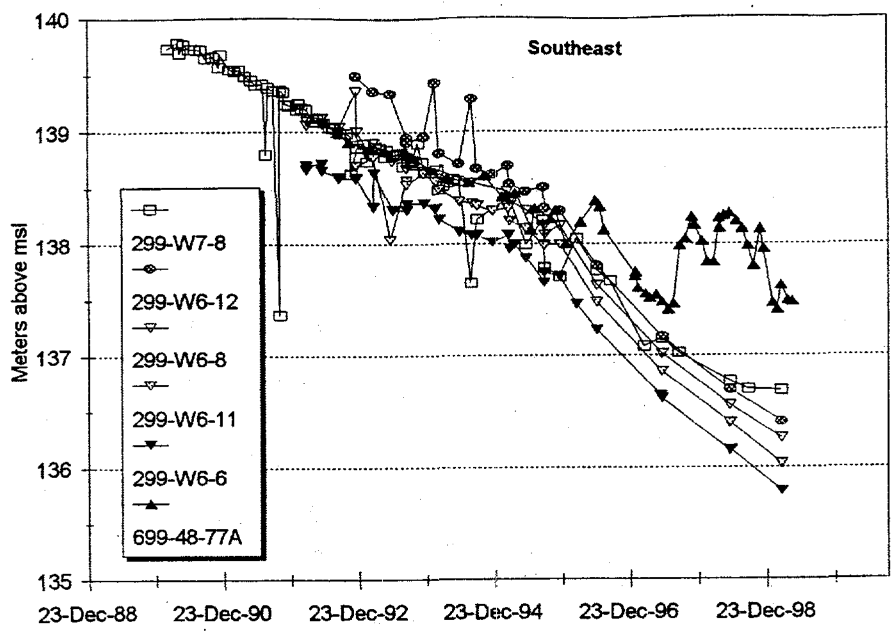
Hydrographs and Serviceability Information for SALDS Tritium-Tracking Wells

Appendix C

Hydrographs and Serviceability Information for SALDS Tritium-Tracking Wells

Figures C.1 and C.2 are composite hydrographs of SALDS tritium-tracking wells grouped by general locations relative to the SALDS. Each group is compared with the hydrograph of the SALDS proximal well 699-48-77A Separate hydrographs of the SALDS proximal wells are presented in Figure 2.4.

Table C.1 contains well construction and serviceability information for 21 wells in the SALDS tritium-tracking network. Records for well 699-51-75P are limited and were excluded from these plots.



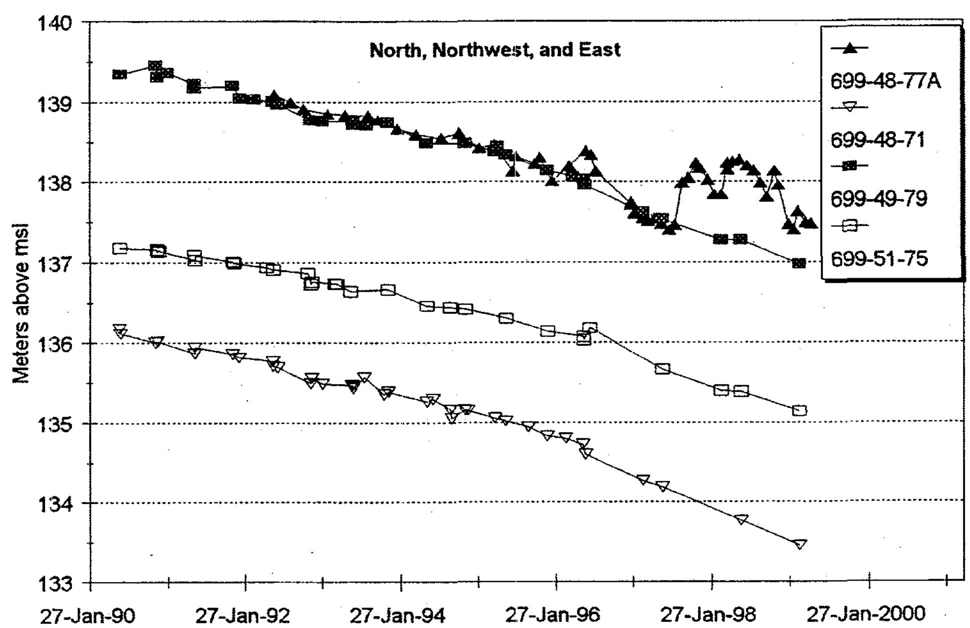
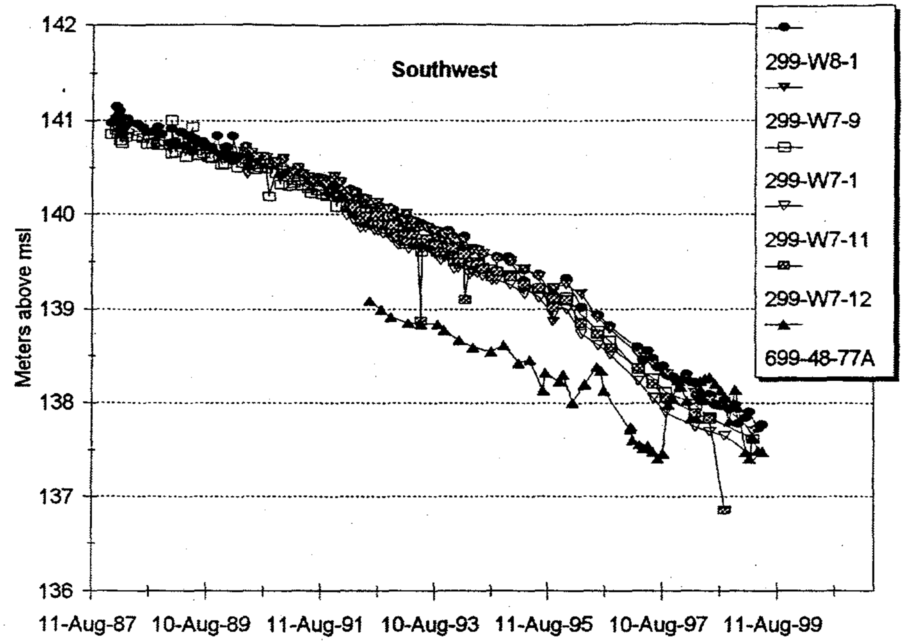


Figure C.1. Hydrographs for Wells in the SALDS Tritium-Tracking Network Southeast (top) and North, Northwest, and East (bottom) of the SALDS Drainfield (see Figure 1.3 for locations)



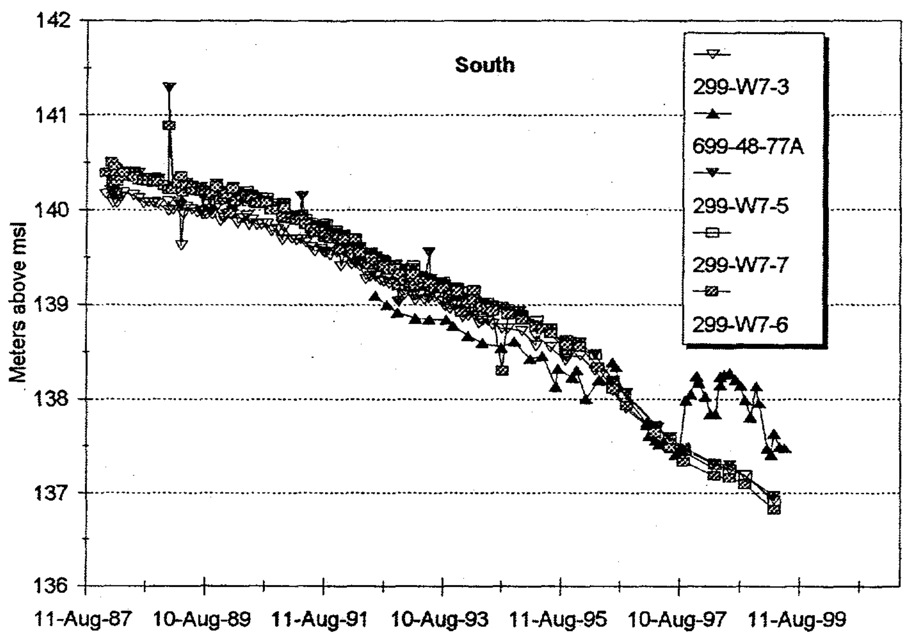


Figure C.2. Hydrographs for Wells in the SALDS Tritium-Tracking Network Southeast (top) and South (bottom) of the SALDS Drainfield (see Figure 1.3 for locations)

Table C.1. Well Serviceability Information for SALDS Tritium-Tracking Network

Well	98 Date	99 Date	98 DTW ft	99 DTW	WT Elev ft	Ref Elev ft	Depth of well screen bottom	Depth of pump intake	Water left above intake (ft)	Amount pump can be lowered (ft)	Water left in well	Annual Rate of decline (ft)	Years of Service Left
299-W6-6	10-Jun-98	11-Mar-99	263.31	264.49	445.50	709.99	432.47	422.2	158.89	10.27	169.16	1.57	107.0
299-W6-7	11-Jun-98	11-Mar-99	263.5	264.7	445.58	710.28	270.63	267	3.50	3.63	7.13	1.60	3.8
299-W6-8	10-Jun-98	11-Mar-99	246.73	247.69	447.04	694.73	253.99	na	---	---	7.26	1.28	4.9
299-W6-11	10-Jun-98	11-Mar-99	255.36	256.56	446.30	702.86	274.02	272.00	16.64	2.02	18.66	1.60	11.0
299-W6-12	11-Jun-98	11-Mar-99	244.07	244.99	447.52	692.51	260.17	257.00	12.93	3.17	16.10	1.23	12.3
299-W7-1	10-Jun-98	11-Mar-99	238.44	239.21	451.50	690.71	247.16	244.65	6.21	2.51	8.72	1.03	7.5
299-W7-11	10-Jun-98	11-Mar-99	229.67	230.57	450.88	681.45	235.42	232	2.33	3.42	5.75	1.20	4.0
299-W7-12	10-Jun-98	10-Mar-99	235.73	236.81	451.12	687.93	243.29	na	---	---	7.56	1.44	4.5
299-W7-3	10-Jun-98	11-Mar-99	225.81	226.88	449.26	676.14	472.43	461.79	235.98	10.64	246.62	1.43	172.3
299-W7-5	10-Jun-98	11-Mar-99	222.58	223.65	449.40	673.05	230.34	227.25	4.67	3.09	7.76	1.43	4.7
299-W7-6	10-Jun-98	11-Mar-99	228.63	229.74	448.90	678.64	236.69	234.2	5.57	2.49	8.06	1.48	4.8
299-W7-7	10-Jun-98	11-Mar-99	224.62	225.72	449.22	674.94	230.78	227.8	3.18	2.98	6.16	1.47	3.5
299-W7-8	10-Jun-98	11-Mar-99	238.64	238.92	448.43	687.35	243.55	240.03	0.95	3.52	4.91	0.37	10.5
299-W7-9	10-Jun-98	11-Mar-99	239.24	240.3	451.79	692.09	244.08	na	---	---	4.84	1.41	2.7
299-W8-1	10-Jun-98	11-May-99	248.28	249.31	452.02	701.33	258.38	na	---	---	10.10	1.12	8.1
699-48-71	18-Jun-98	16-Mar-99	249.28	250.3	437.85	688.15	285.25	na	---	---	35.97	1.37	25.5
699-48-77A	10-Jun-98	11-May-99	221.06	223.65	451.07	674.72	235.17	233.52	12.46	1.65	14.11	2.82	4.6
699-48-77C	10-Jun-98	11-May-99	224.15	225.52	448.76	674.28	312.37	303.9	79.75	8.47	88.22	1.49	58.4
699-48-77D	10-Jun-98	11-May-99	222.97	224.53	449.34	673.87	237.20	233.35	10.38	3.85	14.23	1.70	7.8
699-49-79	17-Jun-98	16-Mar-99	238.82	239.78	449.42	689.2	280.50	na	---	---	41.68	1.29	31.6
699-51-75	17-Jun-98	16-Mar-99	197.32	198.12	443.39	641.51	235.00	204.1	6.78	30.90	37.68	1.07	34.2

*All measurements are in feet, as they appear in the database.
DTW and well screen bottom is measured from top of casing.
"na" = information not available

Appendix D

Tritium Results from SALDS Tritium-Tracking Wells

Appendix D

Tritium Results from SALDS Tritium-Tracking Wells

The following table lists analytical results for tritium for groundwater samples from all 21 SALDS tritium-tracking wells through July 1999. The records begin with January 1995, approximately one year prior to the beginning of SALDS operation. Older wells, constructed during the 1960s, also have tritium records dating from that period, but are excluded for brevity as are records for two wells dropped in 1997, 299-W6-5 and 299-W7-2. The entire record for all wells may be viewed in the HEIS database.

Table D.1. Tritium Results for SALDS Network

Well	Result	Total Error	Units	Qualifier	Collect Date
299-W6-11	9450	860.6	pCi/L		08-Mar-95
299-W6-11	8390	794	pCi/L		15-Sep-95
299-W6-11	8200		pCi/L		18-Dec-96
299-W6-11	6200		pCi/L		13-Nov-97
299-W6-11	920		pCi/L		11-Sep-98
299-W6-12	563	221.7	pCi/L		09-Mar-95
299-W6-12	394	228	pCi/L		15-Sep-95
299-W6-12	360		pCi/L		18-Dec-96
299-W6-12	410		pCi/L		18-Dec-96
299-W6-12	480		pCi/L		13-Nov-97
299-W6-12	540		pCi/L		11-Sep-98
299-W6-6	19	184.7	pCi/L	U	09-Mar-95
299-W6-6	17.9	203	pCi/L	U	18-Sep-95
299-W6-6	63		pCi/L	U	19-Dec-96
299-W6-6	160		pCi/L	U	12-Nov-97
299-W6-6	257		pCi/L	U	11-Sep-98
299-W6-7	42900	3295	pCi/L		08-Mar-95
299-W6-7	45000	3460	pCi/L		18-Sep-95
299-W6-7	41000		pCi/L		19-Dec-96
299-W6-7	36000		pCi/L		12-Nov-97
299-W6-7	41000		pCi/L		11-Sep-98
299-W6-8	886	244.7	pCi/L		08-Mar-95
299-W6-8	723	241	pCi/L		21-Sep-95
299-W6-8	810		pCi/L		18-Dec-96
299-W6-8	700		pCi/L		13-Nov-97
299-W6-8	920		pCi/L		05-Mar-98
299-W6-8	860		pCi/L		05-Mar-98
299-W6-8	1000		pCi/L		11-Sep-98
299-W6-8	770		pCi/L		25-Mar-99
299-W7-1	176	205.7	pCi/L	U	13-Mar-95
299-W7-1	-160	223	pCi/L	U	11-Sep-95
299-W7-1	66.04	187.2	pCi/L	U	07-Mar-96
299-W7-1	-51.2	202	pCi/L	UJ	10-Sep-96
299-W7-1	73.2	196	pCi/L	U	12-Mar-97
299-W7-1	162		pCi/L	U	17-Nov-97
299-W7-1	180		pCi/L	U	05-Mar-98
299-W7-1	10.8	191	pCi/L	U	12-Mar-98
299-W7-1	-76.4	195	pCi/L	U	10-Sep-98
299-W7-1	-6.65	185	pCi/L	U	10-Mar-99
299-W7-11	90.2	200	pCi/L	U	13-Mar-95
299-W7-11	-144	224	pCi/L	U	11-Sep-95
299-W7-11	-41.442	179.8	pCi/L	U	11-Mar-96
299-W7-11	79.3	210	pCi/L	UJ	10-Sep-96
299-W7-11	102	211	pCi/L	U	11-Mar-97
299-W7-11	162		pCi/L	U	17-Nov-97
299-W7-11	180		pCi/L	U	05-Mar-98
299-W7-11	111	200	pCi/L	U	10-Mar-98
299-W7-11	52.2	197	pCi/L	U	10-Mar-98
299-W7-11	-20.5	199	pCi/L	U	14-Sep-98
299-W7-11	-57	181	pCi/L	U	11-Mar-99
299-W7-12	183	206	pCi/L	U	13-Mar-95
299-W7-12	120	201.8	pCi/L	U	13-Mar-95
299-W7-12	-21	198	pCi/L	U	12-Sep-95
299-W7-12	-104.37	175.5	pCi/L	U	11-Mar-96
299-W7-12	69.1	211	pCi/L	U	18-Sep-96

Table D.1. (contd)

Well	Result	Total Error	Units	Qualifier	Collect Date
299-W7-12	72.1	209	pCi/L	U	10-Mar-97
299-W7-12	-42.5	230	pCi/L	U	04-Sep-97
299-W7-12	43	196	pCi/L	U	10-Mar-98
299-W7-12	-29.7	199	pCi/L	U	14-Sep-98
299-W7-12	-14.3	184	pCi/L	U	10-Mar-99
299-W7-3	226	208.7	pCi/L		13-Mar-95
299-W7-3	-35.8	197	pCi/L	U	12-Sep-95
299-W7-3	103.92	188.9	pCi/L	U	07-Mar-96
299-W7-3	-182	233	pCi/L	U	17-Sep-96
299-W7-3	-31.7	189	pCi/L	U	12-Mar-97
299-W7-3	90.7	194	pCi/L	U	10-Sep-97
299-W7-3	35.8	197	pCi/L	U	10-Mar-98
299-W7-3	-49.8	214	pCi/L	U	16-Sep-98
299-W7-3	-26.1	183	pCi/L	U	10-Mar-99
299-W7-5	260	203.6	pCi/L		14-Mar-95
299-W7-5	331	221	pCi/L		12-Sep-95
299-W7-5	99.315	196.3	pCi/L	U	08-Mar-96
299-W7-5	174	255	pCi/L	U	17-Sep-96
299-W7-5	56.9	209	pCi/L	U	31-Mar-97
299-W7-5	330	209	pCi/L	J	08-Sep-97
299-W7-5	27.1	198	pCi/L	U	11-Mar-98
299-W7-5	115	213	pCi/L	U	15-Sep-98
299-W7-5	40.8	188	pCi/L	U	11-Mar-99
299-W7-6	487	230.6	pCi/L		20-Apr-95
299-W7-6	376	223	pCi/L		13-Sep-95
299-W7-6	271.12	204.7	pCi/L		29-Mar-96
299-W7-6	319	227	pCi/L	J	16-Sep-96
299-W7-6	199	210	pCi/L	U	12-Mar-97
299-W7-6	84.1	238	pCi/L	U	04-Sep-97
299-W7-6	418	259	pCi/L		04-Sep-97
299-W7-6	270		pCi/L		17-Nov-97
299-W7-6	150000		pCi/L		17-Nov-97
299-W7-6	240		pCi/L		05-Mar-98
299-W7-6	361	220	pCi/L	J	11-Mar-98
299-W7-6	222	236	pCi/L	U	15-Sep-98
299-W7-6	345	208	pCi/L	J	10-Mar-99
299-W7-7	350	210.1	pCi/L		14-Mar-95
299-W7-7	216	213	pCi/L		12-Sep-95
299-W7-7	384.46	215.5	pCi/L		08-Mar-96
299-W7-7	435	234	pCi/L		10-Sep-96
299-W7-7	293	225	pCi/L	J	10-Sep-96
299-W7-7	301	211	pCi/L	J	12-Mar-97
299-W7-7	233	203	pCi/L	U	10-Sep-97
299-W7-7	18.9	198	pCi/L	U	11-Mar-98
299-W7-7	18	219	pCi/L	U	15-Sep-98
299-W7-7	186	207	pCi/L	U	09-Mar-99
299-W7-8	451	217.2	pCi/L		14-Mar-95
299-W7-8	354	222	pCi/L		14-Sep-95
299-W7-8	409.29	209.7	pCi/L		11-Mar-96
299-W7-8	331	228	pCi/L	J	10-Sep-96
299-W7-8	231	219	pCi/L	U	11-Mar-97
299-W7-8	491	264	pCi/L		11-Sep-97
299-W7-8	422	225	pCi/L		11-Mar-98
299-W7-8	268	222	pCi/L	U	15-Sep-98
299-W7-8	314	207	pCi/L	J	11-Mar-99
299-W7-9	69.2	191	pCi/L	U	14-Mar-95

Table D.1. (contd)

Well	Result	Total Error	Units	Qualifier	Collect Date
299-W7-9	90	205	pCi/L	U	13-Sep-95
299-W7-9	115.63	190.6	pCi/L	U	11-Mar-96
299-W7-9	-51.7	202	pCi/L	UJ	10-Sep-96
299-W7-9	195	205	pCi/L	U	12-Mar-97
299-W7-9	25.1	189	pCi/L	U	10-Sep-97
299-W7-9	81.9	200	pCi/L	U	10-Mar-98
299-W7-9	-86.3	199	pCi/L	U	15-Sep-98
299-W7-9	223	200	pCi/L	U	11-Mar-99
299-W7-9	172	196	pCi/L	U	11-Mar-99
299-W8-1	45.1	189.4	pCi/L	U	14-Mar-95
299-W8-1	3.07	200	pCi/L	U	13-Sep-95
299-W8-1	176	193.5	pCi/L	U	11-Mar-96
299-W8-1	156	216	pCi/L	UJ	10-Sep-96
299-W8-1	215		pCi/L	U	23-Jan-97
299-W8-1	42.5	194	pCi/L	U	12-Mar-97
299-W8-1	212		pCi/L	U	02-Apr-97
299-W8-1	182		pCi/L	U	04-Sep-97
299-W8-1	173		pCi/L	U	17-Dec-97
299-W8-1	200		pCi/L	U	06-Feb-98
299-W8-1	95	196	pCi/L	U	12-Mar-98
299-W8-1	227		pCi/L	U	15-Apr-98
299-W8-1	263		pCi/L	U	09-Jul-98
299-W8-1	221	220	pCi/L	U	15-Sep-98
299-W8-1	274		pCi/L	U	20-Oct-98
299-W8-1	141		pCi/L	U	13-Jan-99
299-W8-1	193	198	pCi/L	U	11-Mar-99
299-W8-1	193		pCi/L	U	20-Apr-99
299-W8-1	220		pCi/L		13-Jul-99
699-48-71	128	203	pCi/L	U	18-Apr-95
699-48-71	27.8	197	pCi/L	U	18-Apr-95
699-48-71	45.6	215	pCi/L		23-Sep-95
699-48-71	2.559	200.1	pCi/L	U	18-Mar-96
699-48-71	-123.83	192.5	pCi/L		18-Mar-96
699-48-71	-118	182	pCi/L	U	17-Mar-97
699-48-71	147	219	pCi/L	U	18-Mar-98
699-48-77A	343		pCi/L	U	04-Feb-95
699-48-77A	300		pCi/L	U	17-Apr-95
699-48-77A	86.9	232	pCi/L	U	12-Jul-95
699-48-77A	142	224	pCi/L		27-Jul-95
699-48-77A	149	200	pCi/L	U	24-Oct-95
699-48-77A	64.5	194	pCi/L	U	24-Oct-95
699-48-77A	260		pCi/L	U	15-Jan-96
699-48-77A	300		pCi/L	U	03-Apr-96
699-48-77A	300		pCi/L	U	03-Apr-96
699-48-77A	135.05	207.7	pCi/L		03-Apr-96
699-48-77A	74000		pCi/L		15-Jul-96
699-48-77A	210000		pCi/L		06-Aug-96
699-48-77A	210000		pCi/L		06-Aug-96
699-48-77A	270000		pCi/L		23-Aug-96
699-48-77A	450000		pCi/L		23-Oct-96
699-48-77A	450000		pCi/L		23-Oct-96
699-48-77A	500000		pCi/L		23-Jan-97
699-48-77A	490000		pCi/L		23-Jan-97
699-48-77A	530000		pCi/L		02-Apr-97
699-48-77A	2000000		pCi/L		04-Sep-97
699-48-77A	1700000		pCi/L		17-Dec-97

Table D.1. (contd)

Well	Result	Total Error	Units	Qualifier	Collect Date
699-48-77A	1600000		pCi/L		17-Dec-97
699-48-77A	920000		pCi/L		06-Feb-98
699-48-77A	270000		pCi/L		15-Apr-98
699-48-77A	260000		pCi/L		15-Apr-98
699-48-77A	970000		pCi/L		09-Jul-98
699-48-77A	140000		pCi/L		20-Oct-98
699-48-77A	140000		pCi/L		20-Oct-98
699-48-77A	30000		pCi/L		13-Jan-99
699-48-77A	15000		pCi/L		20-Apr-99
699-48-77A	15000		pCi/L		20-Apr-99
699-48-77A	18000		pCi/L		14-Jul-99
699-48-77C	609		pCi/L		04-Feb-95
699-48-77C	594		pCi/L		04-Feb-95
699-48-77C	543		pCi/L		17-Apr-95
699-48-77C	465		pCi/L		17-Apr-95
699-48-77C	231	240	pCi/L	U	12-Jul-95
699-48-77C	336	212	pCi/L	J	24-Oct-95
699-48-77C	390		pCi/L		15-Jan-96
699-48-77C	350		pCi/L		15-Jan-96
699-48-77C	300		pCi/L	U	03-Apr-96
699-48-77C	410		pCi/L		15-Jul-96
699-48-77C	390		pCi/L		06-Aug-96
699-48-77C	3000		pCi/L		23-Aug-96
699-48-77C	180		pCi/L	U	23-Aug-96
699-48-77C	580		pCi/L		23-Oct-96
699-48-77C	2100		pCi/L		23-Jan-97
699-48-77C	420		pCi/L		02-Apr-97
699-48-77C	580		pCi/L		02-Apr-97
699-48-77C	270		pCi/L		04-Sep-97
699-48-77C	4100		pCi/L		17-Dec-97
699-48-77C	1300		pCi/L		06-Feb-98
699-48-77C	630		pCi/L		06-Feb-98
699-48-77C	310		pCi/L		15-Apr-98
699-48-77C	261		pCi/L	U	09-Jul-98
699-48-77C	2100		pCi/L		20-Oct-98
699-48-77C	8100		pCi/L		13-Jan-99
699-48-77C	35000		pCi/L		20-Apr-99
699-48-77C	77000		pCi/L		13-Jul-99
699-48-77C	77000		pCi/L		13-Jul-99
699-48-77D	343		pCi/L	U	04-Feb-95
699-48-77D	305		pCi/L		17-Apr-95
699-48-77D	39.1	229	pCi/L	U	12-Jul-95
699-48-77D	102	233	pCi/L	U	12-Jul-95
699-48-77D	57.9	194	pCi/L	U	24-Oct-95
699-48-77D	240		pCi/L	U	15-Jan-96
699-48-77D	300		pCi/L	U	03-Apr-96
699-48-77D	400		pCi/L	U	15-Jul-96
699-48-77D	400		pCi/L	U	15-Jul-96
699-48-77D	380		pCi/L	U	06-Aug-96
699-48-77D	410		pCi/L		23-Aug-96
699-48-77D	180		pCi/L	U	23-Oct-96
699-48-77D	410		pCi/L		23-Jan-97
699-48-77D	390		pCi/L		02-Apr-97
699-48-77D	69000		pCi/L		04-Sep-97
699-48-77D	80000		pCi/L		04-Sep-97
699-48-77D	970000		pCi/L		17-Dec-97

Table D.1. (contd)

Well	Result	Total Error	Units	Qualifier	Collect Date
699-48-77D	2100000		pCi/L		06-Feb-98
699-48-77D	1800000		pCi/L		15-Apr-98
699-48-77D	1100000		pCi/L		09-Jul-98
699-48-77D	1100000		pCi/L		09-Jul-98
699-48-77D	730000		pCi/L		20-Oct-98
699-48-77D	540000		pCi/L		13-Jan-99
699-48-77D	540000		pCi/L		13-Jan-99
699-48-77D	600000		pCi/L		20-Apr-99
699-48-77D	610000		pCi/L		14-Jul-99
699-49-79	154	205	pCi/L	U	18-Apr-95
699-49-79	127	207.8	pCi/L		01-May-95
699-49-79	24.6	201.1	pCi/L		01-May-95
699-49-79	17.912	200.7	pCi/L	U	22-Apr-96
699-49-79	162		pCi/L	U	17-Nov-97
699-49-79	238	226	pCi/L	U	18-Mar-98
699-49-79	140		pCi/L	U	25-Mar-99
699-51-75	3.58	212	pCi/L		17-Aug-95
699-51-75	-27.115	187.3	pCi/L		08-Jul-96
699-51-75	-9.24	196	pCi/L	U	24-Mar-97
699-51-75	-34.9	222	pCi/L	U	18-Mar-98
699-51-75	257		pCi/L	U	11-Sep-98
699-51-75	225		pCi/L	U	11-Sep-98
699-51-75	140		pCi/L	U	25-Mar-99
699-51-75	140		pCi/L	U	25-Mar-99

Appendix E

Analytical Results for Constituents with Enforcement Limits in Groundwater at the SALDS

Appendix E

Analytical Results for Constituents with Enforcement Limits in Groundwater at the SALDS

Tables E.1 through E.4 list all results above method detection limits for constituents with enforcement limits specified in Special Condition S1. of the SWDP for the SALDS. These tables include all results through July 1999 for the proximal wells 699-48-77A, 699-48-77C, and 699-48-77D, and background well 299-W8-1. Only results from proximal wells were compared with enforcement limits, thus the reason for footnote (b) throughout the "Enforcement Limits" column in Table E.1. Comments noting "see text" are issues concerning the constituent that are discussed in the main body of the document. Constituents with few results ("n" column) indicate that most results are below detection. Mean ($\overline{x}$) and standard deviation (s) are calculated for each constituent with more than one detection. Hanford Site background values are determined by Johnson (1993) ("B1" column) and DOE-RL (1997) ("B.2" column).

Table E.1. Analytical Results for Constituents with Enforcement Limits in Groundwater at the SALDS Through July 1999—Well 299-W8-1

Constituent	n	$\bar{x}^{(a)}$	$s^{(a)}$	Maximum Result(a)/Date	Enforcement Limit	B1	B2	Comments
Acetone	5	27.6	35.5	74/1-97	(b)	NA	NA	All results associated with blank contamination
Ammonia	4	105	73.7	200/8-92	(b)	<120	170	
Benzene	2	0.58	0.6	1.0/4-97	(b)	NA	NA	Estimated value and blank contamination (one each)
Cadmium, total	2	0.39	0.15	4.0/1-90	(b)	<10	1.29	
Chloroform	15	0.53	0.32	1.5/2-92	(b)	NA	NA	
Copper, total	10	4.12	7.89	26.0/11-91	(b)	<30	1.37	
Lead, total	12	1.84	2.56	8.9/2-92	(b)	<5	3.35	
Mercury, total	5	0.26	0.15	0.5/12-92	(b)	<0.1	0.004	
pH	151	8.04	0.27	6.92/10-88 9.08/10-98	(b)	6.90 8.24	8.07	Includes field and laboratory measurements (see text)
Sulfate	40	45,575	1,828	50,600/3-99	(b)	90,500	54,950	
Tetrahydrofuran	--	--	--	--	(b)	NA	NA	No detections; 28 analyses
Total dissolved solids	11	253,000	25,472	291,000/10-98	(b)	NA	277,190	
Gross alpha	14	1.76	0.82	3.28/3-95	(b)	5.79	3.48	pCi/L
Gross beta	43	4.95	1.84	8.41/12-93	(b)	12.62	9.73	pCi/L
Strontium-90	2	2.5	1.27	3.4/7-99	(b)	NA	1.14 (filtered)	pCi/L (see text)
Tritium	1	--	--	220/7-99	(b)	NA	182	Result is near MDA

(a) Results in μg/L unless otherwise noted.
(b) Constituent not assigned enforcement limit, but is subject to routine monitoring and reporting.
B1 = Hanford Site groundwater background concentrations by Johnson (1993), 95th percentile, μg/L.
B2 = Hanford Site groundwater background concentrations by DOE/RL (1997), 95th percentile, μg/L, based on unfiltered samples unless noted.
MDA = Minimum detectable activity.
NA = Background values not available for this constituent.

Table E.2. Analytical Results for Constituents with Enforcement Limits in Groundwater at the SALDS Through July 1999—Well 699-48-77A

Constituent	n	$\overline{x}$(a)	s(a)	Maximum Result(a)/Date	Enforcement Limit(a)	B1	B2	Comments
Acetone	1	--	--	19/11-92	160.0	NA	NA	Result associated with blank contamination.
Ammonia	2	55.0	21.2	70/10-93	1,100.0	<120	170	Both results associated with suspect QC data
Benzene	1	--	--	1.0/7-95	5.0	NA	NA	
Cadmium, total	5	1.04	1.71	3.6/10-95	10.0	<10	1.29	
Chloroform	3	0.43	0.27	4.2/4-96	6.2	NA	NA	
Copper, total	23	3.45	4.40	15/5-93	70.0	<30	1.37	
Lead, total	6	0.51	0.55	1.4/9-93	50.0	<5	3.35	Includes estimated values near MDL
Mercury, total	3	0.21	0.01	0.22/1-96	2.0	<0.1	0.004	
pH	115	7.85	0.24	6.93/6-92 8.58/10-94	6.5-8.5	6.90 8.24	8.07	Maximum result is suspect. Includes field and laboratory measurements (see text)
Sulfate	41	57,701	69,014	194,000/8-96	250,000.0	90,500	54,950	See text
Tetrahydrofuran	--	--	--	--	100.0	NA	NA	No detections; 28 analyses
Total dissolved solids	35	272,114	165,262	654,000/8-96	500,000.0	NA	277,190	See text
Gross Alpha	29	2.09	0.88	5.4/7-96	(b)	5.79	3.48	pCi/L
Gross Beta	36	4.28	2.46	7.7/10-93	(b)	12.62	9.73	pCi/L
Strontium-90	1	--	--	2.4/7-99	(b)	NA	1.14 (filtered)	pCi/L (see text)
Tritium	24	469,278	570,123	2,000,000/9-97	(b)	NA	182	pCi/L (see text)

(a) Results in μg/L unless otherwise noted.
(b) Constituent not assigned enforcement limit, but is subject to routine monitoring and reporting.
B1 = Hanford Site groundwater background concentrations by Johnson (1993), 95th percentile, μg/L.
B2 = Hanford Site groundwater background concentrations by DOE/RL (1997), 95th percentile, μg/L, based on unfiltered samples unless noted.
MDL = Minimum detection limit.
NA = Background values not available for this constituent.
QC = Quality control.

Table E.3. Analytical Results for Constituents with Enforcement Limits in Groundwater at the SALDS Through July 1999—Well 699-48-77C

Constituent	n	$\overline{X}^{(a)}$	$s^{(a)}$	Maximum Result[(a)]/Date	Enforcement Limit[(a)]	B1	B2	Comments
Acetone	4	8.8	5.3	15/4-97	160.0	NA	NA	3 results associated with blank contamination
Ammonia	--	--	--	--	1,100.0	<120	170	No detections; 23 analyses
Benzene	--	--	--	--	5.0	NA	NA	No detections; 25 analyses
Cadmium, total	4	0.51	0.64	1.45/1-99	10.0	<10	1.29	
Chloroform	11	0.76	0.09	0.9/7-98, 10-96	6.2	NA	NA	
Copper, total	11	2.25	3.61	11.8/10-94	70.0	<30	1.37	
Lead, total	5	0.41	0.50	1.3/10-95	50.0	<5	3.35	
Mercury, total	4	0.2	0	0.2/4-97	2.0	<0.1	0.004	
pH	81	7.92	0.15	7.56/4-95 8.32/10-98	6.5-8.5	6.90 8.24	8.07	Includes field and laboratory measurements (see text)
Sulfate	27	22,854	8,307	49,460/4-99	250,000.0	90,500	54,950	See text
Tetrahydrofuran	--	--	--	--	100.0	NA	NA	No detections; 24 analyses
Total dissolved solids	28	202,138	29,948	260,000/4-99	500,000.0	NA	277,190	See text
Gross alpha	14	1.73	0.51	2.5/4-97	[(b)]	5.79	3.48	pCi/L
Gross beta	30	5.62	6.23	28/4-97	[(b)]	12.62	9.73	pCi/L
Strontium-90	4	3.23	2.66	7.1/12-97	[(b)]	NA	1.14 (filtered)	pCi/L
Tritium	27	8,081	20,963	77,000/7-99	[(b)]	NA	182	pCi/L (see text)

(a) Results in µg/L unless otherwise noted.
(b) Constituent not assigned enforcement limit, but is subject to routine monitoring and reporting.
B1 = Hanford Site groundwater background concentrations by Johnson (1993), 95th percentile, µg/L.
B2 = Hanford Site groundwater background concentrations by DOE/RL (1997), 95th percentile, µg/L, based on unfiltered samples unless noted.
NA = Background values not available for this constituent.

Table E.4. Analytical Results for Constituents with Enforcement Limits in Groundwater at the SALDS Through July 1999—Well 699-48-77D

Constituent	n	$\overline{x}^{(a)}$	$s^{(a)}$	Maximum Result[(a)]/Date	Enforcement Limit[(a)]	B1	B2	Comments
Acetone	--	--	--	--	160.0	NA	NA	No detections; 25 analyses
Ammonia	--	--	--	--	1,100.0	<120	170	No detections; 23 analyses
Benzene	--	--	--	--	5.0	NA	NA	No detections; 25 analyses
Cadmium, total	3	1.15	0.94	1.87/1-99	10.0	<10	1.29	All estimated quantities
Chloroform	4	0.78	0.17	1.0/10-95	6.2	NA	NA	Maximum is estimated value
Copper, total	18	5.23	3.4	10.9/10-94	70.0	<30	1.37	
Lead, total	2	0.22	0.11	0.3/1-97	50.0	<5	3.35	3 filtered results are slightly higher (max = 2.4)
Mercury, total	3	0.32	0.07	0.4/4-97	2.0	<0.1	0.004	
pH	80	8.15	0.22	7.32/8-96 8.6/10-95	6.5-8.5	6.90 8.24	8.07	Includes field and laboratory measurements (see text)
Sulfate	28	31,843	21,874	105,000/8-96	250,000.0	90,500	54,950	See text
Tetrahydrofuran	--	--	--	--	100.0	NA	NA	No detections; 25 analyses
Total dissolved solids	28	211,000	43,220	309,000/7-96	500,000.0	NA	277,190	
Gross alpha	16	1.57	0.5	2.4/7-96, 10-96	(b)	5.79	3.48	pCi/L
Gross beta	23	3.60	2.05	6.95/10-95	(b)	12.62	9.73	pCi/L
Strontium-90	6	2.85	1.99	5.5/10-98	(b)	NA	1.14 (filtered)	pCi/L
Tritium	18	568,956	643,679	2,100,000/2-98	(b)	NA	182	pCi/L

(a) Results in μg/L unless otherwise noted.
(b) Constituent not assigned enforcement limit, but is subject to routine monitoring and reporting.
B1 = Hanford Site groundwater background concentrations by Johnson (1993), 95th percentile, μg/L.
B2 = Hanford Site groundwater background concentrations by DOE/RL (1997), 95th percentile, μg/L, based on unfiltered samples unless noted.
NA = Background values not available for this constituent.

Distribution

No. of Copies		
ONSITE		
4	**DOE Richland Operations Office**	
	M. J. Furman	A5-13
	R. D. Hildebrand	A5-13
	G. Richardson	H0-12
	G. L. Sinton	H0-12
10	**Fluor Hanford, Inc.**	
	M. J. Brown	S6-72
	K. J. Lueck	S6-72
	P. M. Olson (5)	S6-72
	D. K. Smith	S6-71
	R. W. Szelmeczka	S6-72
	LWPF Reg. File	S6-72

No. of Copies		
20	**Pacific Northwest National Laboratory**	
	D. B. Barnett (10)	K6-81
	S. P. Luttrell	K6-96
	W. J. Martin	K6-81
	R. M. Smith	K6-96
	Information Release Office (7)	