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LOCKHEED MARTIN

EVALUATION OF CALENDAR YEAR 1997 GROUNDWATER AND SURFACE WATER QUALITY DATA FOR THE CHESTNUT RIDGE HYDROGEOLOGIC REGIME AT THE U.S. DEPARTMENT OF ENERGY Y-12 PLANT, OAK RIDGE, TENNESSEE

September 1998

Prepared by

AJA TECHNICAL SERVICES, INC.
Under Subcontract No. 70Y-MVM64

for the

Environmental Compliance Department
Environment, Safety, and Health Organization
Oak Ridge Y-12 Plant
Oak Ridge, Tennessee 37831

Managed by

LOCKHEED MARTIN ENERGY SYSTEMS, INC.
for the U.S. Department of Energy
Under Contract No. DE-AC05-84OR21400

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LOCKHEED MARTIN ENERGY SYSTEMS, INC.
FOR THE UNITED STATES
DEPARTMENT OF ENERGY

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List of Acronyms and Abbreviations

ASO	Analytical Services Organization
BCV	Bear Creek Valley
bgs	below ground surface
CERCLA	Comprehensive Environmental Response, Compensation, and Liability Act
Chestnut Ridge Regime	Chestnut Ridge Hydrogeologic Regime
CY	calendar year
DNAPLs	dense, nonaqueous phase liquids
DOE	U.S. Department of Energy
DQO	data quality objective
ETTP	East Tennessee Technology Park
ft	feet
ft/d	feet per day
GWPP	Groundwater Protection Program
GWQAP	groundwater quality assessment plan
MCL	Maximum Contaminant Level (for drinking water)
µg/L	micrograms per liter
mg/L	milligrams per liter
msl	mean sea level
ORR	Oak Ridge Reservation
PCE	tetrachloroethene
pCi/L	picoCuries per liter
PCP	post closure permit (RCRA)
ppm	parts per million
PVC	polyvinyl chloride
QA/QC	quality assurance/quality control
RCRA	Resource Conservation and Recovery Act
ROD	record of decision (CERCLA)
Security Pits	Chestnut Ridge Security Pits
Sediment Disposal Basin	Chestnut Ridge Sediment Disposal Basin
SWDF	solid waste disposal facility (non-RCRA)
TCE	trichloroethene
TCFM	trichlorofluoromethane
TDEC	Tennessee Department of Environment and Conservation
TDS	total dissolved solids
TSS	total suspended solids
UTL	upper tolerance limit
VOC	volatile organic compound
1,1-DCA	1,1-dichloroethane
1,2-DCE	1,2-dichloroethene
1,1,1-TCA	1,1,1-trichloroethane

1.0 INTRODUCTION

This report presents an evaluation of the groundwater monitoring data obtained in the Chestnut Ridge Hydrogeologic Regime (Chestnut Ridge Regime) during calendar year (CY) 1997. The Chestnut Ridge Regime encompasses a section of Chestnut Ridge bordered by the U.S. Department of Energy (DOE) Y-12 Plant in Bear Creek Valley (BCV) to the north, Scarboro Road to the east, Bethel Valley Road to the south, and an unnamed drainage basin southwest of the Y-12 Plant (Figure 1). Groundwater quality monitoring is performed at hazardous and nonhazardous waste management facilities in the regime under the auspices of the Y-12 Plant Groundwater Protection Program (GWPP). The CY 1997 monitoring data are presented in *Calendar Year 1997 Annual Groundwater Monitoring Report for the Chestnut Ridge Hydrogeologic Regime at the U.S. Department of Energy Y-12 Plant, Oak Ridge, Tennessee* (AJA Technical Services, Inc. 1998), which also presents results of site-specific monitoring data evaluations required under the Resource Conservation and Recovery Act (RCRA) post-closure permit (PCP) for the Chestnut Ridge Regime (permit no. TNHW-088). This report provides additional evaluation of the CY 1997 data with an emphasis on regime-wide groundwater geochemistry and long-term concentration trends of regulated and non-regulated monitoring parameters.

2.0 BACKGROUND INFORMATION

The following sections contain background information regarding the waste management sites in the Chestnut Ridge Regime and their associated groundwater monitoring programs, a general description of topography and bedrock geology in the regime, an overview of the hydrogeologic characteristics and groundwater flow patterns in the Knox Aquifer, and a discussion of surface water drainage features.

2.1 Waste Management Sites and Groundwater Monitoring Programs

Groundwater and surface water quality monitoring was performed during CY 1997 for the multiple programmatic purposes of: (1) RCRA post-closure corrective action monitoring at the Chestnut Ridge Security Pits (Security Pits) as specified in the PCP for the Chestnut Ridge Regime; (2) RCRA post-closure detection monitoring at the Chestnut Ridge Sediment Disposal Basin (Sediment Disposal Basin) and Kerr Hollow Quarry as required under the PCP; (3) detection monitoring at Industrial Landfills II, IV, and V, and Construction/Demolition Landfills VI and VII in accordance with the regulations governing nonhazardous solid waste disposal facilities (SWDFs) and applicable conditions of operating permits issued by the Tennessee Department of Environment and Conservation (TDEC); (4) monitoring specified in the respective Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA) record of decision (ROD) for the United Nuclear Corporation Site and Kerr Hollow Quarry; and (5) regime-wide DOE Order 5400.1 surveillance monitoring and exit pathway/perimeter monitoring (collectively referenced as DOE Order 5400.1 monitoring) performed under the auspices of the Y-12 Plant Groundwater Protection Program. These sites are located throughout the regime (Figure 2) and are being operated or have been closed in accordance with applicable regulations (Table 1).

2.2 Topography and Bedrock Geology

Chestnut Ridge is flanked to the north by BCV and to the south by Bethel Valley. Ground surface elevations along the ridge crest decrease from about 1,200 feet (ft) above mean sea level (msl) west of Industrial Landfill IV to about 1,060 ft msl east of the Sediment Disposal Basin (Figure 3). The northern flank of the ridge is a steep slope rising more than 200 ft above the floor of BCV, and the more gently sloped southern flank is dominated by a parallel series of east-west trending hills.

The geology in the vicinity of the DOE Oak Ridge Reservation (ORR) is characterized by thrust-faulted sequences of Lower Cambrian to Upper Ordovician clastic (primarily shale and siltstone) and carbonate (limestone and dolostone) bedrock. Interbedded limestone and shale formations of the Conasauga Group directly underlie the Y-12 Plant in BCV, primarily dolostone strata of the Knox Group form Chestnut Ridge, and the argillaceous limestones and interbedded shales of the Chickamauga Group underlie Bethel Valley (Figure 3). Strike and dip of bedding in the area is generally N 55°E and 45°SE, respectively (as referenced to true north).

Red-brown to yellow-orange residuum (primarily clays and iron sesquioxides) that develops on the Knox Group directly underlies all the waste management sites in the Chestnut Ridge Regime except Kerr Hollow Quarry and Rogers Quarry. The residuum, which is thickest (>100 ft) along the ridge crest and thin or nonexistent near karst features (Ketelle and Huff 1984), contains semi-continuous, relict beds of fractured chert and other lithologic inhomogeneities (such as silt bodies) that provide a weakly connected network through which saturated flow can occur (Solomon et al. 1992).

All but the southernmost portion of the Chestnut Ridge Regime is underlain by the Knox Group (Figure 3); the depth to bedrock varies, but is usually less than 100 ft below ground surface (bgs). The Knox Group consists of about 2,600 to 3,300 ft of gray to blue-gray, thin- to thick-bedded cherty dolostone with interbedded limestone, and is divided into five formations (listed from oldest to youngest): Copper Ridge Dolomite, Chepultepec Dolomite, Longview Dolomite, Kingsport Formation, and Mascot Dolomite. Topographic and stratigraphic relationships show that the Copper Ridge Dolomite underlies the ridge crest and steep northern ridge flank, the Longview Dolomite forms a series of steeply sloped hills across the middle of the southern ridge flank, and the Mascot Dolomite disconformably underlies the Chickamauga Group along the southern boundary of the regime (Hatcher et al. 1992).

The most pervasive structural features in the Chestnut Ridge Regime are extensional, hybrid, and shear fractures (Solomon et al. 1992). Three major fracture orientations are evident: one that roughly parallels bedding, one steeply dipping set that parallels geologic strike, and one steeply dipping set oriented perpendicular to strike (Dreier et al. 1987). Most fractures are short, ranging from tenths of inches to a few feet in length (Solomon et al. 1992). Dissolution of carbonates along fractures has produced many surface karst features on Chestnut Ridge, including a series of sinkholes along the crest of the ridge that show a prominent alignment parallel to strike. This linear trend may result from dissolution along a common bedding plane or fracture set (Ketelle and Huff 1984; Smith et al. 1983).

2.3 Groundwater System

The Knox Group and the underlying Maynardville Limestone formation (Conasauga Group) comprise the Knox Aquifer, which is the principal hydrogeologic unit in the Chestnut Ridge Regime. The Knox Aquifer generally consists of three vertically gradational subsystems: (1) the stormflow zone, (2) the vadose zone, and (3) the groundwater zone. The subsystems are distinguished by groundwater flux, which decreases with depth (Solomon et al. 1992).

Investigations near the Oak Ridge National Laboratory show that groundwater occurs intermittently above the water table in a shallow "stormflow zone" that extends to a depth of about 6 ft bgs (Moore 1989). Macropores and mesopores provide the primary channels for lateral flow in the stormflow zone, which lasts only a few days or weeks after rainfall. Groundwater in the stormflow zone is either lost to evapotranspiration, discharge at nearby seeps, springs, and streams, or recharge to the water table (Moore 1989).

The vadose zone occurs between the stormflow zone and the water table, which typically occurs near the bedrock/residuum interface, and is unsaturated except in the capillary fringe above the water table and within wetting fronts during periods of vertical percolation from the stormflow zone (Moore 1989). Most recharge through the vadose zone is episodic and occurs along discrete permeable flowpaths that become saturated, although surrounding micropores remain unsaturated (Solomon et al. 1992). Based on infiltrometer test data, Moore (1988) determined a geometric mean hydraulic conductivity of about 0.006 feet per day (ft/d) for residuum on Chestnut Ridge.

Groundwater below the vadose zone occurs within orthogonal sets of permeable, planar fractures that form water-producing zones within an essentially impermeable matrix, and dissolution of the carbonate bedrock has enlarged fractures and produced an interconnected conduit-flow system characteristic of karst aquifers. Because the occurrence of solution features and the frequency, aperture, and connectivity of permeable fractures decrease with depth, the bulk hydraulic conductivity of the groundwater zone is vertically gradational. Most groundwater flux occurs within the transitional horizon between residuum and unweathered bedrock (water table interval); lower flux (and longer solute residence times) occurs at successively greater depths in the bedrock (Solomon et al. 1992). Results of borehole packer tests in the Knox Group and dye-tracer studies on Chestnut Ridge suggest a wide range of hydraulic conductivity typical of karst aquifers: 0.0002 ft/d for matrix intervals, 3.1 ft/d for water-producing intervals, and at least 100 ft/d for permeable conduits (King and Haase 1988; Ketelle and Huff 1984; Geraghty & Miller, Inc. 1990).

The water table in the Chestnut Ridge Regime generally mirrors surface topography (Figure 4). Groundwater elevation isopleths indicate eastward (strike parallel) flow along the ridge crest in the northern part of the regime, which is a recharge area and a flow divide, with flow components to the north (across strike) toward the Maynardville Limestone at the base of the ridge, and south (parallel to dip) toward the tributaries on the southern flank of the ridge. Radial groundwater flow directions from hilltops toward crosscutting tributaries dominate the central part of the regime, and flow in the southernmost part of the regime is south toward Melton Hill Reservoir (Clinch River). Seasonal water table fluctuations, which are greatest (>15 ft) in wells located along the crest of Chestnut Ridge (Table 2), do not significantly alter the overall directions of groundwater flow. Horizontal hydraulic gradients are highest (0.04 - 0.07) along the steep northern flank of Chestnut Ridge and in the upper reaches of tributaries on the southern ridge flank. Gradients are less steep (0.004 - 0.02) along the crest of the ridge and in drainage basins between hills in the central part of the regime, and are nearly flat (0.001 - 0.003) in Bethel Valley along the southern boundary of the regime.

Groundwater elevations in several wells located on the ridge crest, notably well GW-293 at the East Chestnut Ridge Waste Pile and well GW-322 at the Security Pits (Table 2), are more than 10 ft lower than in nearby wells less than 100 ft away. Substantial differences between water table elevations over such short distances potentially reflect localized depressions in the water table associated with highly permeable conduits that function as local drains for the shallow karst network. The location of such conduits may correspond with the bedding plane or fracture set associated with the strike-parallel series of sinkholes along the crest of the ridge.

2.4 Surface Water System

Surface streams in the Chestnut Ridge Regime comprise five primary drainage basins on the southern flank of Chestnut Ridge (Figure 3): (1) an unnamed tributary located west of Industrial Landfill II in the western part of the regime; (2) an unnamed tributary located east of Industrial Landfill II; (3) the McCoy Branch drainage basin in the central part of the regime; (4) an unnamed drainage basin in the central part of the regime near Construction/Demolition Landfill VII; and (5) an unnamed drainage basin the eastern part of the regime near Kerr Hollow Quarry. The surface streams are mainly intermittent above an elevation of 900 ft msl and receive flow via surface runoff, stormflow discharge, and groundwater baseflow. Baseflow contributions increase downstream and spring discharge represents substantial contributions to the total flow in most of the tributaries during summer months (Lockheed Martin Energy Systems, Inc. 1996). All of the tributaries discharge into Melton Hill Reservoir (Clinch River) south of the Chestnut Ridge Regime.

3.0 SAMPLING AND ANALYSIS SUMMARY

Groundwater and surface water sampling in the Chestnut Ridge Regime was performed in accordance with the *Sampling and Analysis Plan for Groundwater and Surface Water Monitoring at the Y-12 Plant during Calendar Year 1997* (AJA Technical Services, Inc. 1996). The following sections provide an overview of the sampling and analysis activities that were performed during CY 1997, including the sampling locations and frequency; sample collection, transportation, and chain-of-custody control; field measurements and laboratory analytical parameters; and results of quality assurance/quality control (QA/QC) sampling.

3.1 Sampling Locations and Frequency

Groundwater and surface water samples were collected from 39 of the monitoring wells located at the waste management sites in the Chestnut Ridge Regime, two springs located on the southern flank of Chestnut Ridge, and Outfall 301 located on the southwest side of Kerr Hollow Quarry (Figure 5). As noted in Section 2.1, sampling was performed for the purposes of RCRA post-closure detection/corrective action monitoring, SWDF detection monitoring, CERCLA ROD monitoring, and DOE Order 5400.1 monitoring.

The network of monitoring wells used for semiannual RCRA post-closure corrective action monitoring at the Security Pits included one upgradient/background well (GW-521), two point-of-compliance wells (GW-609 and GW-796), and six plume delineation wells (GW-301, GW-557, GW-798, GW-799, GW-801, and GW-831) (Figure 5). Samples were collected from each well during the first quarter (January 7 - 16, 1997) and third quarter (July 9 - 24, 1997) of the year (Table 3).

The RCRA post-closure detection monitoring well network at the Sediment Disposal Basin includes one upgradient well (GW-159) and three point-of-compliance wells (GW-156, GW-731, and GW-732). Two upgradient/background wells (GW-142 and GW-231) and three point-of-compliance wells (GW-143, GW-144, and GW-145) comprise the detection monitoring network at Kerr Hollow Quarry (Figure 5). Sampling was performed semiannually at each site during the second quarter (April 21 - May 1, 1997) and fourth quarter (October 20 - November 14, 1997) of the year. To provide the data needed for the statistical evaluations specified in the PCP, four replicate groundwater samples were collected from each well over as many as nine consecutive days during each sampling event (Table 3). Additionally, each of the RCRA post-closure detection monitoring wells at Kerr Hollow Quarry were resampled in August 1997. Resampling was required to verify the statistically significant increasing boron (GW-145) trend that was indicated by statistical analysis of the replicate results from the first semiannual sampling event.

Groundwater samples were collected from 21 monitoring wells and spring SCR4.3SP for the purposes of SWDF detection monitoring (Table 3). The wells are located around Industrial Landfills II, IV, and V, and Construction/Demolition Landfills VI and VII; spring SCR4.3SP is located next to an unnamed tributary approximately 1,200 ft directly south of Construction/Demolition Landfill VII (Figure 5). Semiannual sampling for SWDF detection monitoring purposes was performed during the first and third, or second and fourth quarters of the year (Table 3). Additionally, well GW-141 at Industrial Landfill IV was resampled in February 1997 to confirm the elevated lead, beryllium, and gross alpha concentrations reported for the sample collected in January 1997, and well GW-539 was resampled in December 1997 to confirm the elevated nickel concentrations reported for the sample collected in October 1997. Groundwater samples were not collected from Construction/Demolition Landfill VI well GW-542 during the second semiannual sampling event (October 1997) because it was dry.

Groundwater samples were collected from wells 1090, GW-203, GW-205, GW-221, GW-302, and GW-339 in April 1997 (Table 3) as part of the post-closure surveillance and maintenance activities specified in the CERCLA ROD for the United Nuclear Corporation Site (Figure 5). The ROD for Kerr Hollow Quarry requires sampling of surface water discharging from Outfall 301, which is located on the southwest side of the quarry (Figure 5). Sampling was performed April 30, 1997 in coordination with RCRA post-closure detection monitoring at the site. Responsibility for all of the post-ROD monitoring was transferred to the Environmental Restoration Integrated Water Quality Program on October 1, 1997; this organization collected semiannual samples required during the fourth calendar quarter.

Groundwater samples were collected semiannually from spring SCR2.2SP for the purposes of DOE Order 5400.1 monitoring in the Chestnut Ridge Regime. Spring SCR2.2SP is located in Bethel Valley about 2,500 ft south of Industrial Landfill II (Figure 5), and samples of the groundwater discharging from the spring were collected in January and July 1997 (Table 3).

3.2 Sample Collection, Transportation, and Chain-of-Custody Control

Personnel from the Sampling and Environmental Support Department of the Analytical Service Organization (ASO) at the East Tennessee Technology Park (ETTP), formerly the Oak Ridge K-25 Site, were responsible for collection, transportation, and chain-of-custody control of the groundwater and surface water samples. Sampling was performed in accordance with the *Technical Procedure for Groundwater Sampling* (Lockheed Martin Energy Systems, Inc. 1995), which was updated and revised to describe the method for low-flow minimal drawdown groundwater sampling. Approved by the TDEC in June 1997 for SWDF detection monitoring and in July 1997 for RCRA post-closure monitoring (detection and corrective action), this method was used to collect all of the groundwater samples during the fourth quarter of CY 1997 (Table 3).

Dedicated bladder pumps (Well Wizards™), portable gas-piston pumps (Bennet Pumps™), and disposable bailers were used to collect groundwater samples from the monitoring wells; grab sample bottles were used to collect samples from springs SCR2.2SP and SCR4.3SP and Outfall 301. Each type of monitoring well sampling equipment was used for conventional purging and sampling, whereby at least three well-volumes of groundwater were purged from the well (if the well did not go dry) before samples were collected. The Well Wizards™ also enable low-flow minimal drawdown sampling, whereby samples were collected immediately after field measurements (see Section 3.3) had stabilized (minimal variation over four consecutive readings) in groundwater purged at a very low flow rate (<300 milliliters per minute) with minimal water-level drawdown in the well (less than 0.1 ft per quarter-hour).

Filtered and unfiltered samples were collected from each monitoring well and spring; only unfiltered samples were collected from Outfall 301. Samples collected with a Well Wizard™ or Bennet Pump™ were filtered in the field using in-line 0.45 micron filters, and samples collected with a bailer were filtered in the laboratory, as were samples collected with grab sample bottles. All the groundwater and surface water samples were collected in appropriate containers, labeled, logged, placed in ice-filled coolers, and transported to the appropriate ASO laboratory in accordance with established chain-of-custody control requirements.

3.3 Field Measurements and Laboratory Analytes

Field personnel measured the depth to water before purging and sampling the groundwater in each monitoring well, and recorded field measurements of pH, temperature, conductivity, dissolved oxygen, and the oxidation/reduction potential for each groundwater and surface water sample (Table 4). Laboratory analyses of most groundwater samples included the following standard suite of analytes: (1) pH, conductivity, turbidity, total suspended solids (TSS), and total dissolved solids (TDS); (2) major ions and trace metals, which is the term used hereafter to differentiate metals that are typically minor constituents in groundwater (e.g., cobalt) from metals that are usually major ionic species (e.g., magnesium); (3) an extensive suite of volatile organic compounds (VOCs) and (4) gross alpha and gross beta activity (Table 4). Unfiltered samples were analyzed for all of the standard laboratory analytes; filtered samples were analyzed only for principal cations and trace metals. Surface water samples from Outfall 301 were analyzed only for the principal cations, trace metals, radioanalytes, and TSS to support the five-year evaluation specified by the CERCLA ROD for Kerr Hollow Quarry (Table 4).

In addition to the standard suite of analytes, groundwater samples collected at a few locations were analyzed for other parameters, depending on the requirements of the governing monitoring program. For example, groundwater samples from wells at the United Nuclear Corporation Site also were analyzed for strontium-89/90.

3.4 Quality Assurance/Quality Control Sampling

Quality assurance/quality control samples included 54 trip blanks, 31 laboratory blanks, 14 equipment rinsate samples, and two field blanks. Each QA/QC sample was analyzed for VOCs; selected equipment rinsates were also analyzed for inorganics (major ions and trace metals), radionuclides, and several miscellaneous analytes (e.g., TDS). One or more of 28 VOCs were detected in 43 (80%) of the trip blanks, 19 (61%) of the laboratory blanks, all but one of the equipment rinsate samples, and both field blanks (Table 5). Results for the VOCs indicate contamination of the QA/QC samples during laboratory analysis, transportation/storage, or a combination of both, as well as contamination of deionized water used to prepare the blank samples and to decontaminate sampling equipment. Results for inorganics, radionuclides, and miscellaneous analytes are characteristic of deionized water and indicate adequate decontamination of the portable sampling pumps.

Common laboratory reagents (acetone, 2-butanone, 2-hexanone, and methylene chloride) account for about 65% of the VOCs detected in the QA/QC samples (Table 5). The frequent detection of these compounds indicates contamination in the laboratory environment, which likewise accounts for the bulk of the acetone, 2-butanone, 2-hexanone, and methylene chloride results for the associated groundwater and surface water samples. Also, results for the laboratory blanks reflect the change in the ASO laboratory that performed the VOC analyses. For example, acetone was detected in only five of the 46 laboratory blanks analyzed by the ETTP ASO laboratory during CY 1996 compared to 17 of the 31 laboratory blanks analyzed by the Y-12 Plant ASO laboratory during CY 1997.

Chloroform was detected in two of the four field blanks, 11 (78%) of the equipment rinsate samples, and 18 (33%) of the trip blanks, but was not detected in any of the laboratory blanks (Table 5). The lack of chloroform in the laboratory blanks discounts contamination during analysis of the samples. Contamination during transportation and storage seems unlikely because chloroform was detected in only 13 of the groundwater samples analyzed during CY 1997. Also, improper equipment decontamination is not indicated because chloroform was detected in rinsate samples associated with wells that monitor uncontaminated groundwater. Chloroform was most likely present in the deionized water that was used to prepare trip blanks and field blanks and to decontaminate sampling equipment. Results for a laboratory blank sample analyzed during the fourth quarter (sample no. Q973380059, AJA Technical Services, Inc. 1998) likewise suggest contamination of the deionized water used to prepare the blank; 18 VOCs were detected in this sample, including several compounds (e.g., 1,4-dichloro-2-butene) that were not detected in any other type of QA/QC sample (Table 5).

4.0 DATA EVALUATION

An evaluation of the groundwater quality data reported for the network of monitoring wells in the Chestnut Ridge Regime that were sampled during CY 1997 is presented in the following sections. The evaluation is organized by major groups of related analytes (major ions, trace metals, VOCs, and radiological parameters), and is focused on the CY 1997 analytical results that meet the applicable data quality objectives (DQOs) defined in: *Y-12 Plant Groundwater Protection Program - Groundwater Monitoring Program Data Management Plan* (Martin Marietta Energy Systems, Inc. 1993). Analytical results that do not meet applicable DQOs were either replaced with a surrogate value, such as the analytical detection limit, or were considered qualitative for evaluation purposes. A summary of the CY 1997 groundwater monitoring data qualified by the applicable DQO criteria is provided in Appendix C.

4.1 Major Ions

Principal ion data for groundwater samples from the majority of CY 1997 sampling locations are characteristic of uncontaminated, calcium-magnesium-bicarbonate groundwater in the Knox Aquifer (Figure 6). Results for most of the wells are generally characterized by equal or nearly equal molar concentrations of calcium and magnesium, which is typical of water in contact with dolomite; low molar proportions (<5%) of chloride, potassium, sodium, and sulfate; carbonate alkalinity, fluoride, and nitrate as N (hereafter synonymous with "nitrate") concentrations below respective analytical reporting limits or less than 1 milligram per liter (mg/L) (see Appendix C). Aside from the distinctive geochemistry of the groundwater at wells GW-143 and GW-145, the principal ion data for several wells located elsewhere in the Chestnut Ridge Regime are conspicuous with respect to results for chloride, nitrate, potassium, and sodium.

Wells GW-143 and GW-145 at Kerr Hollow Quarry yield moderately-mineralized, sulfate-enriched, calcium-magnesium-bicarbonate groundwater (Figure 6). Groundwater samples from these wells are characterized by unequal molar proportions of calcium and magnesium; sulfate levels of 10 to 30 mg/L; and much higher sodium (>20 mg/L), chloride (>10 mg/L), and fluoride (>2 mg/L) concentrations than typical of most Knox Group wells. Dissolution of locally disseminated gypsum

($CaSO_4 \cdot 2H_2O$) probably accounts for the sulfate-enriched geochemistry of the groundwater in wells GW-143 and GW-145, both of which monitor low-yield intervals in the Mascot Dolomite at depths of 253 ft bgs and 110 ft bgs, respectively. Enriched levels of other solutes (e.g., sodium) in the groundwater at these wells may be a legacy of the sedimentary basin brines that are encountered at depth elsewhere on the ORR. In the past when these brines occupied a structurally higher position in the Knox Group, solutes from the brines diffused into the bedrock between intervening permeable fractures. Groundwater circulation through the permeable fractures "flushed" the brines from the active (shallow) flow system, which reversed the concentration gradient such that the solutes in the low-permeability matrix now slowly diffuse back into the permeable fractures (Saunders and Toran 1992).

Chloride concentrations in the groundwater at well GW-539, located about 500 ft east (downgradient) of Construction/Demolition Landfill VI and upgradient of Industrial Landfill II (Figure 5), typically exceed 10 mg/L and are about five times higher than the chloride levels in the groundwater at upgradient wells GW-542, GW-543, and GW-827. Well GW-539 produces groundwater from a depth of 156 ft bgs in the middle part of the Knox Group (Chepultepec Dolomite). However, the landfill is an unlikely source of the chloride because the elevated concentrations predate its construction. A truck wash-down area located about 50 ft southwest of the well may be a source of the chloride, although this seems unlikely considering the very low hydraulic conductivity of the groundwater flowpaths intercepted by the well (about 1 ft per year as indicated by results of falling head permeability tests) (Jones 1998). Thus, elevated chloride levels in the groundwater produced from well GW-539 probably reflect concentrations in the low-yield intervals within the Knox Group.

Chloride concentrations above 20 mg/L and sodium levels above 10 mg/L are characteristic of the groundwater samples from wells 1090, GW-302, and GW-339 at the United Nuclear Corporation Site (see Appendix C). Elevated levels of these ions may reflect recharge of surface water containing dissolved salt used to de-ice the South Patrol Road and Mt. Vernon Road; well 1090 is located at the intersection of these roads, and wells GW-302 and GW-339 are immediately south of the South Patrol Road (Figure 5). In contrast, a gravel road provides all-weather access to wells GW-203, GW-205, and GW-221 immediately south of the United Nuclear Corporation Site, and the chloride and sodium levels reported for these wells rarely exceed 3 mg/L.

Nitrate concentrations rarely exceed 1 mg/L in the groundwater from most of the Knox Group wells in the Chestnut Ridge Regime. Some wells in the regime, however, consistently yield groundwater samples with nitrate concentrations above 1 mg/L. In CY 1997, the highest nitrate concentrations were reported for the replicate groundwater samples collected from Kerr Hollow Quarry well GW-144 in April (2.93 - 3.03 mg/L) and October 1997 (1.83 - 2.01 mg/L). Historical data for this well, which is completed at a depth of 195 ft bgs in the Upper Knox Group (Mascot Dolomite), show that nitrate concentrations fluctuate seasonally but have increased since the early 1990s (Figure 7). Kerr Hollow Quarry may not be the source of the elevated nitrate observed at well GW-144 because, based on waste characterization, nitrate is not a target compound required for RCRA post-closure detection monitoring at the site. The increasing nitrate concentrations in the groundwater at this well may be related to the surface application of municipal sewage sludge at a 20-acre hayfield about 800 ft west-northwest of the well (Upper Hayfield 2 Site) and a 45-acre hayfield about 1,200 ft east-northeast (Scarboro Site) of the well (Figure 5). Under an agreement with the DOE and TDEC, the City of Oak Ridge began landfarming sludge at the Upper Hayfield 2 Site in November/December 1989 and at the Scarboro Site in August 1990 (U.S. Department of Energy 1998). Assuming primarily strike-parallel groundwater flow, well GW-144 is hydraulically downgradient of both sites (Figure 4). Downgradient groundwater transport of nitrate leached from the sludge seems possible considering the mobility of nitrate, particularly in light of the low (<200 mg/L) TDS of groundwater samples from well GW-144. Low TDS implies short groundwater residence time and suggests that the well intercepts hydraulically active recharge and discharge flowpaths; the monitored interval for well GW-144 intercepts a water-producing fracture at 170 ft bgs that yields over 20 gallons per minute (Jones et al. 1995).

Potassium concentrations reported for the replicate groundwater samples collected from well GW-731 at the Sediment Disposal Basin increased from about 3 mg/L in March 1997 to more than 30 mg/L in October 1997 and the pH (field measurement) increased from 8.4 in March to 10 in October (see Appendix C). These unusual potassium and pH results strongly indicate contamination from cement grout that was circulated into fractures and solution features in the surrounding bedrock during the installation of the well and/or the plugging and abandonment of nearby well GW-157. The order-of-magnitude increases in the levels of potassium and pH correspond with the change from the conventional sampling method (used in March 1997) to the low-flow minimal drawdown purging and sampling method (used in October 1997). Apparently, the conventional sampling method induced flow of clean groundwater into the well which diluted the grout-contaminated groundwater near the well screen. Well GW-731 should be redeveloped to collect representative samples using the low-flow minimal drawdown method.

Elevated levels of potassium (6.4 - 19 mg/L), pH (8.4 - 10.7), and TSS (47 - 391 mg/L) also were reported for the four replicate samples collected from well GW-732 at the Sediment Disposal Basin during October 1997. These samples also had elevated trace metal concentrations (e.g.,uranium) that were suspected artifacts associated with preservation of turbid samples (see Section 4.2). Well GW-732 was redeveloped in March 1998 and the potassium (0.95 - 1.9 mg/L), TSS (<1 - 5 mg/L), and pH (7.63 - 8.31) levels, as well as the trace metal concentrations, in the subsequent samples were consistent with previous post-closure monitoring results (Bechtel Jacobs Company LLC 1998).

4.2 Trace Metals

The following evaluation of the CY 1997 trace metal data is focused on total concentrations that meet applicable DQO criteria and exceed the applicable upper tolerance limit (UTL) reported in *Determination of Reference Concentrations for Inorganic Analytes in Groundwater at the Department of Energy Y-12 Plant, Oak Ridge, Tennessee* (HSW Environmental Consultants, Inc. et al. 1995). The UTLs for each metal were determined from statistical analysis of historical (1986 - 1993) data for specific groups of wells (i.e., clusters) differentiated by similar geochemical characteristics and they represent the maximum concentrations expected in the groundwater monitored by the wells comprising each cluster. The total concentrations of 15 trace metals reported for 72 unfiltered groundwater samples from 17 monitoring wells and spring SCR4.3SP collected in CY 1997 exceeded applicable UTLs. The bulk (60%) of these results, as shown in the following summary, are for boron, elemental strontium, and total uranium, and more than 80% of the elevated concentrations of these metals were reported for the replicate groundwater samples collected from Kerr Hollow Quarry wells GW-142, GW-143, GW-144, and GW-145.

Trace Metal	Number of Results > UTL	Number of Sampling Locations	Maximum Concentration (mg/L)	Sampling Location	Sampling Date
Aluminum	7	5	26	GW-141	01/07/97
Barium	13	1	0.52	GW-142	11/12/97
Beryllium	7	4	0.014	GW-141	01/07/97
Boron	49	10	0.95	GW-143	08/04/97
Chromium	2	2	0.42	GW-302	04/15/97
Copper	6	4	0.077	GW-142	08/04/97
Iron	8	4	32	GW-142	08/05/97
Lead	4	2	0.075	GW-141	01/07/97
Manganese	4	3	0.69	GW-141	01/07/97
Mercury	2	1	0.00034	GW-141	01/07/97
Nickel	8	6	0.19	GW-302	04/15/97
Strontium	36	4	8.5	GW-145	08/04/97
Uranium	20	3	0.024	GW-142	08/05/97
Vanadium	4	3	0.064	GW-141	01/07/97
Zinc	4	4	0.59	GW-141	01/07/97

Few of these results indicate groundwater contamination from waste disposal activities in the regime. In some wells, the elevated trace metal concentrations probably reflect ambient levels in the groundwater. For instance, the unusually high strontium concentrations that are characteristic of the unfiltered groundwater from several of the wells at Kerr Hollow Quarry (particularly GW-145) may be caused by advective mixing of sulfate-enriched groundwater with deeper bedrock brines, upward diffusion of solutes from the deeper brine, diffusion of residual brine solutes from the bedrock matrix, or a combination of these natural processes (Saunders and Toran 1992).

Many of the elevated trace metal concentrations are sampling and/or analytical artifacts resulting from preservation (acidification) of turbid samples. As shown in the preceding data summary, for example, the highest concentrations of aluminum, beryllium, lead, manganese, mercury, vanadium, and zinc were reported for the highly turbid groundwater sample collected from well GW-141 in January 1997 (TSS = 590 mg/L). Furthermore, uranium concentrations slightly above the 0.005 mg/L UTL were reported for two turbid samples (TSS = 47 and 391 mg/L) collected from well GW-732 during October 1997 (Appendix C).

Corrosion of stainless steel well casing and screen, rather than groundwater contamination, is the probable source of the elevated total chromium concentrations reported for wells GW-302 (0.42 mg/L) and GW-339 (0.033 mg/L) and the elevated nickel concentrations reported for wells GW-302 (0.19 mg/L), GW-339 (0.055 mg/L), and GW-539 (0.1 - 0.17 mg/L). Chloride can enhance corrosion of stainless steel, and each of these wells monitor groundwater with chloride concentrations above 10 mg/L (see Section 4.1). Although the chloride levels seem too low to be corrosive, the oxidizing effect may be enhanced on well screens in groundwater with a high dissolved oxygen content (> 4 parts per million [ppm]) or if the well screen was exposed to air during purging under the conventional sampling method. Wells GW-339 and GW-539 typically were purged to dryness and well GW-302 yielded three well volumes without going dry during each sampling event before implementing the low-flow minimal drawdown method. As shown in the following summary of CY 1997 groundwater samples with the highest chloride concentrations in the Chestnut Ridge Regime, elevated chromium and nickel in samples from these wells seem conspicuously coincidental in light of the overall lack of both metals in groundwater samples with equal or greater chloride concentrations from wells constructed with polyvinyl chloride (PVC) well screens.

Well	Construction Material	Dissolved Oxygen (ppm)	Maximum CY 1997 Concentration (mg/L)		
			Chloride	Nickel	Chromium
1090	PVC	1.4	28.1	<0.01	<0.01
GW-339	Stainless Steel	4.1	27.5	0.055	0.033
GW-302	Stainless Steel	4.7	25.5	0.19	0.042
GW-539	Stainless Steel	11.0	14.6	0.17	<0.01
GW-145	PVC	7.5	13.7	<0.01	<0.01

Nickel and chromium concentrations generally fluctuate concurrently and show increasing trends in samples from wells GW-302, GW-339, and GW-539 (Figure 8). In April 1998, the TDEC approved replacing well GW-539 with well GW-540 for future monitoring at Construction/Demolition Landfill VI and Industrial Landfill II after reviewing a demonstration that Construction/Demolition Landfill VI was not the source of elevated nickel concentrations in groundwater at well GW-539 (Tennessee Department of Environment and Conservation, 1998).

Total (and dissolved) boron concentrations reported for the groundwater samples collected from well GW-217 in January (0.13 mg/L) and July 1997 (0.15 mg/L) are an order of magnitude higher than typical of all other Knox Group wells except those at Kerr Hollow Quarry. This well is located downgradient from the eastern end of Industrial Landfill IV (Figure 5), near the unlined portion (about 150 ft X 150 ft) of the landfill that received waste beginning in October 1989. Results of falling head permeability tests indicate that the monitored interval of well GW-217 (165 - 180 ft bgs) intercepts relatively low permeability flowpaths (0.01 - 0.2 ft/d) in the lower Knox Group (Copper Ridge Dolomite) (Jones 1998). Historical boron data for the well show a conspicuous concentration "spike" (0.69 mg/L) in January 1992 followed by a steadily increasing trend through October 1994 and a stable if not slightly decreasing trend through July 1997 (Figure 9). Because the more important boron solute species are anionic (uncharged), they are probably not extensively absorbed onto mineral surfaces and are therefore highly mobile in groundwater (Hem 1985). Thus, the elevated boron concentrations in the groundwater at well GW-217 potentially reflect migration of contaminants originating from inorganic wastes disposed in the landfill, possibly borax (hydrated sodium borate) cleaning fluids.

Uranium results for each of the replicate samples collected from well GW-142, which is completed at a depth of 295 ft bgs about 300 ft east of Kerr Hollow Quarry (Figure 5), exceed the 0.005 mg/L UTL (see Appendix C); total concentrations range from 0.0055 mg/L (November 11, 1997) to 0.024 mg/L (August 5, 1997). These results are consistent with historical uranium data for the well, which show similarly wide seasonal fluctuations (Figure 10). Additionally, total uranium concentrations reported for unfiltered replicate samples collected using the conventional purging/sampling method are almost an order of magnitude higher and show considerably more variability than uranium concentrations reported for replicate samples collected using the low-flow minimal drawdown sampling method (Figure 10). The difference between uranium results obtained using each sampling method suggests that the uranium concentrations reported for samples collected using the conventional method may not be representative of actual concentrations in the groundwater near the well. Furthermore, the monitored interval of well GW-142 intercepts a fairly inactive groundwater flow path as shown by the very large water-level drawdown (about 60 ft) observed during post-closure sampling events using the conventional sampling method. Considering the very low hydraulic gradient in the area — seasonal water levels in the seven wells near Kerr Hollow Quarry vary by less than one ft (Figure 4)— long-term sampling of well GW-142 using the conventional sampling method may have induced groundwater flow (and migration of uranium) toward the well.

In contrast to well GW-142, however, the data for well GW-144 do not indicate any significant difference between uranium results for samples collected using the conventional purging/sampling method compared to results for samples obtained using the low-flow minimal drawdown sampling method (Figure 11). This is probably because the monitored interval for well GW-144 intercepts a much more active groundwater flow path than the monitored interval for well GW-142, as shown by the small drawdown (< 1 ft) observed during post-closure sampling events using the conventional sampling method. Notably, uranium was first detected in June 1990 and concentrations showed a sharp increase to above the UTL in August 1991, then decreased to nearly stable levels after 1993 (Figure 11). These data strongly suggest a causal relationship of total uranium concentrations above 0.003 mg/L with the closure activities performed at the site during 1990 through 1993 (HSW Environmental Consultants, Inc. 1995).

4.3 Volatile Organic Compounds

Excluding false-positive VOC results and a few spurious results for several common laboratory reagents such as acetone and 2-butanone, groundwater contamination is clearly indicated by the CY 1997 VOC data reported for wells GW-144, GW-305, GW-609, and GW-796 and potentially indicated by results for wells GW-142, GW-143, and GW-145 (Figure 12). The Security Pits are the confirmed source of the chloroethenes and chloroethanes in the groundwater at wells GW-609 and GW-796. Migration from Kerr Hollow Quarry is indicated by trace levels of chloromethanes and chloroethenes in groundwater at wells GW-142, GW-143, GW-144, and GW-145. Industrial Landfill IV is the most likely source of the chloroethanes and chloroethenes in the groundwater at well GW-305.

Historical data for the network of monitoring wells at the Security Pits generally define a narrow, elongated plume of dissolved VOCs extending parallel with geologic strike for at least 2,600 ft downgradient to the east, and perpendicular to strike for at least 500 ft downgradient to the north and south (Figure 12). The primary components of the plume include 1,1-dichloroethene, 1,1-dichloroethane (1,1-DCA), and 1,1,1-trichloroethane (1,1,1-TCA) in the western trench area; and tetrachloroethene (PCE), trichloroethene (TCE), and 1,2-dichloroethene (1,2-DCE) in the eastern trench area. The distribution of the plume constituents relative to the respective source areas and elongation of the plume along the axis of Chestnut Ridge despite steeper hydraulic gradients toward the ridge flanks suggest primarily eastward strike-parallel horizontal transport in the groundwater. The maximum depth of vertical transport has not been conclusively determined; however, available monitoring data show that VOCs occur at least 150 ft bgs in the western trench area, 250 ft bgs near the middle of the site, and 270 ft bgs downgradient of the eastern trench area (AJA Technical Services, Inc. 1997).

As shown in the following summary, similar concentrations of PCE, TCE, 1,2-DCE, and trichlorofluoromethane (TCFM) were detected in both groundwater samples collected from well GW-609 during CY 1997, and the PCE concentrations exceed the 5 microgram per liter (µg/L) Maximum Contaminant Level (MCL) for drinking water.

Compound	MCL (µg/L)	Concentration (µg/L)	
		January 14, 1997	July 24, 1997
PCE	5	13	12
TCE	5	1	1
1,2-DCE	.	9	10
TCFM	.	5	5

Results for each of these compounds except TCFM, which has not been previously reported for the groundwater samples from well GW-609, are consistent with historical data showing decreasing VOC concentration trends that began after the disposal trenches at the Security Pits were closed and capped in the mid- to late-1980s. As illustrated by results for PCE (Figure 13), the long-term decreasing trend is accompanied by short-term temporal fluctuations that generally correspond with pre-sampling water level elevations (i.e., concentrations are often highest when water levels are highest), which may indicate greater flux of VOCs during seasonally and episodically high groundwater flow conditions. Conversely, VOC results for other wells at the site (e.g., GW-177) show a similar long-term decreasing trend but an inverse correlation with pre-sampling water level elevations (i.e., concentrations are highest when water levels are lowest) that suggests dilution from seasonal recharge of uncontaminated groundwater (AJA Technical Services, Inc. 1997). In either case, decreasing concentrations following closure of the disposal trenches coupled with seasonal concentration fluctuations suggest that the source of the VOCs is within the residuum and shallow bedrock underlying the disposal trenches, possibly in the form of dense nonaqueous phase liquids (DNAPLs). Steady dissolution of the DNAPL (as well as associated matrix diffusion processes) may explain the dilution-related concentration fluctuations, and flushing by seasonal recharge and discharge may explain the flow-related concentration fluctuations.

A very low (estimated) concentration of 1,1,1-TCA (1 µg/L) was detected in the groundwater sample collected in July 1997 from well GW-796, which is completed at a depth of 136.5 ft bgs in the Copper Ridge Dolomite about 500 ft south (across geologic strike) of the Security Pits (Figure 12). Similar concentrations of 1,1,1-TCA (2 µg/L or less) have been detected in all but one of the samples collected from the well since May 1993, including three results that are false positives because of 1,1,1-TCA contamination in the associated trip blank samples. Repeated detection of 1,1,1-TCA in the groundwater at this well reflects downgradient transport from the Security Pits, possibly along "quickflow" conduits oriented perpendicular to strike (Shevenell 1994). This interpretation is supported by the relatively low TDS (<150 mg/L) of the groundwater samples from the well, which suggests short groundwater residence time, and the hydraulic conductivity of the groundwater flowpaths intercepted by the monitored interval (1.2 - 4.2 ft/d), as indicated by falling-head permeability tests in the well (Jones 1998).

Although 1,1,1-TCA may have been present in the groundwater at an earlier date and was volatilized during sampling, the trace level (0.6 µg/L) initially detected in the groundwater sample collected from well GW-305 in January 1992 has steadily increased to 15 µg/L in July 1997 (Figure 14). Additionally, the first-time detection of 1,1-DCA in July 1996 (1 µg/L) was followed by higher levels in January (2 µg/L) and July 1997 (3 µg/L), and the first-time detection of 1,2-DCE in January 1997 (1 µg/L) was likewise followed by a higher concentration in July 1997 (2 µg/L). These VOC results strongly indicate groundwater transport along permeable flowpaths intercepted by the well, but the source of the VOCs has not been formally confirmed. Industrial Landfill IV is the only waste management site that is hydraulically upgradient of the well (Figure 4), and the screened interval for the well (165.3 - 179.6 ft bgs) potentially intercepts (assuming a dip of 45°) dip-parallel flowpaths that subcrop beneath the residuum directly under the unlined eastern portion of the site (Figure 5). This unlined portion began operation in October 1989 and had a 12-inch compacted clay layer installed over the cell in March 1998. Migration of VOCs from a nearby source area also seems likely considering the range of hydraulic conductivity values

(0.025 - 0.028 ft/d) indicated by falling head permeability tests in the well (Jones 1998). Moreover, the only confirmed source of chloroethenes and chloroethanes in the Chestnut Ridge Regime, the Security Pits, is more than 4,000 ft east of Industrial Landfill IV and seasonal groundwater elevations at the Security Pits are more than 20 ft lower than corresponding elevations in well GW-305 (Figure 4). Also, the elongated geometry of the dissolved VOC plume originating from the Security Pits (Figure 12) suggests primarily eastward rather than westward strike-parallel migration in the groundwater. Considering the lack of compelling evidence to the contrary, Industrial Landfill IV is the most likely source of the VOCs in the groundwater at well GW-305.

Excluding false-positive results, carbon tetrachloride, chloroform, PCE, TCE, or a combination of these VOCs was detected in at least one of the replicate groundwater samples collected from Kerr Hollow Quarry wells GW-142, GW-143, GW-144, and GW-145 (Appendix C). The results for these wells, summarized below, generally share several characteristics: (1) concentrations of each compound are very low (less than respective analytical reporting limits); (2) carbon tetrachloride and chloroform are detected more often (although many of the chloroform results are false positives because of contamination in the associated trip blanks) than PCE and TCE; and (3) these compounds are rarely detected (excluding false-positive results) in each of the replicate samples collected during each sampling event.

Well/Compound	Concentration (µg/L)							
	April 28 - May 1, 1997 (Conventional Purging/Sampling)				November 11-14, 1997 (Low-Flow Minimal Drawdown Sampling)			
	Rep. 1	Rep. 2	Rep. 3	Rep. 4	Rep. 1	Rep. 2	Rep. 3	Rep. 4
GW-142								
Carbon Tetrachloride	.	.	.	.	.	.	.	.
Chloroform	1	1	(1)	.	.	.	.	.
PCE	1	1	.	.	.	.	.	.
TCE	.	.	.	.	.	.	.	(1)
GW-143								
Carbon Tetrachloride	.	.	2	2	.	.	.	.
Chloroform	1	2	(2)	(2)	.	.	.	.
PCE	.	.	.	.	1	.	.	.
TCE	.	.	.	.	.	.	.	.

Well/Compound	Concentration (µg/L)							
	April 28 - May 1, 1997 (Conventional Purging/Sampling)				November 11-14, 1997 (Low-Flow Minimal Drawdown Sampling)			
	Rep. 1	Rep. 2	Rep. 3	Rep. 4	Rep. 1	Rep. 2	Rep. 3	Rep. 4
GW-144								
Carbon Tetrachloride	.	2	1	.	.	.	.	.
Chloroform	1	(1)	(1)	(1)	.	.	.	.
PCE	.	.	2	1	.	.	.	.
TCE	.	.	.	.	.	.	.	.
GW-145								
Carbon Tetrachloride	.	.	.	.	.	.	.	.
Chloroform	3	.	.	.	.	.	.	.
PCE	1	.	.	.	.	.	.	.
TCE	2	.	.	.	.	.	.	.
Note: "." = not detected; ( ) = false positive result.								

Because the concentrations are so low, the sporadic detection of these VOCs, particularly in samples collected using the conventional purging/sampling method, potentially reflects volatilization during sample collection and handling rather than the absence of the compounds in the groundwater at the site. Considering the general lack of these VOCs in the replicate samples collected using the low-flow minimal drawdown sampling method, however, the conventional purging/sampling method appears to induce migration of VOCs into the wells, which suggests that the samples obtained using this method are not representative. Additionally, no spatial or temporal patterns have been observed, although quarterly RCRA interim status detection monitoring results show that these compounds (particularly carbon tetrachloride) were detected the most frequently in the groundwater samples collected between the first quarter of 1990 and the fourth quarter of 1993, which suggests a causal relationship with the closure activities performed at the site during that time (HSW Environmental Consultants, Inc. 1995).

4.4 Radioactivity

Evaluation of groundwater quality with respect to radiological contamination focused on CY 1997 results for gross alpha and gross beta that exceed the associated minimum detectable activity and counting error (the value which expresses the degree of analytical uncertainty) reported for each sample. Gross alpha and gross beta results that meet these DQO criteria were reported for a total of 26 groundwater samples from eight monitoring wells (see Appendix C), but none of these results indicate groundwater contamination.

All the individual gross alpha results are less than the 15 picoCuries per liter (pCi/L) MCL for drinking water except those reported for samples collected from Industrial Landfill IV well GW-141 (17 ± 8.1 pCi/L) in January 1997 and two of the replicate samples collected from Kerr Hollow Quarry well GW-145 (both 16 ± 5 pCi/L) in April 1997 (see Appendix C). All the individual gross beta results are less than the Safe Drinking Water Act screening value of 50 pCi/L, with the highest beta activity reported for one of the replicate samples collected from well GW-143 in November 1997 (44 ± 7 pCi/L) and the sample collected from well GW-141 in January 1997 (35 ± 11 pCi/L). The elevated gross alpha and gross beta results for well GW-141 are probably analytical artifacts related to the high TSS (590 mg/L) of the sample collected in January 1997 (see Appendix C).

5.0 CONCLUSIONS AND RECOMMENDATIONS

The bulk of the CY 1997 groundwater quality data are consistent with historical results regarding the known sources of groundwater contamination in the Chestnut Ridge Regime, the primary types of groundwater contaminants from each confirmed source area, and the extent of contaminant transport in the Knox Aquifer. The following sections provide a summary of the groundwater quality data evaluation and recommendations based on these findings.

5.1 Evaluation Summary

Based on evaluation of results that meet the DQOs of the Y-12 Plant GWPP, groundwater contamination is indicated by results for seven of the monitoring wells that were sampled during CY 1997. Results for these wells are summarized below.

Well No.	Known (●) and Suspected (▲) Groundwater Contaminants					Known/*Suspected* Source of Contamination
	Boron	Chloride	Nitrate	Sodium	VOCs	
1090	.	▲	.	▲	.	*Surface water recharge*
GW-144	.	.	▲	.	●	Kerr Hollow Quarry/*Sludge Landfarming*
GW-217	▲	.	.	.	.	*Industrial Landfill IV*
GW-302	.	▲	.	▲	.	*Surface water recharge*
GW-305	.	.	.	.	●	*Industrial Landfill IV*
GW-339	.	▲	.	▲	.	*Surface water recharge*
GW-609	.	.	.	.	●	Security Pits
GW-796	.	.	.	.	●	Security Pits

The following observations are based on evaluation and interpretation of the CY 1997 data with respect to historical results for each of these wells.

- Atypically high chloride and sodium concentrations reported for wells 1090, GW-302, and GW-339 at the United Nuclear Corporation Site potentially reflect infiltration of surface water containing salt used to de-ice paved roads on Chestnut Ridge.

- Total boron concentrations reported for well GW-217 (0.17 - 0.18 mg/L) at Industrial Landfill IV are an order of magnitude or more higher than boron levels reported for all other Knox Aquifer wells in the regime except those at Kerr Hollow Quarry. Wastes disposed at

Industrial Landfill IV, possibly borax cleaning fluids, may be the source of the elevated boron concentrations in the groundwater at this well.

- The horizontal extent of the dissolved VOC plume in the groundwater at the Security Pits remains essentially unchanged from that defined by historic data. Decreasing VOC concentrations in the groundwater at the site indicate that the eastern and western disposal trenches at the site are no longer active sources of VOCs. A continued source may now be DNAPL in the residuum and bedrock underlying the disposal trenches.

- The western disposal trenches at the Security Pits are the most likely source of 1,1,1-TCA in the groundwater at monitoring well GW-796, which is about 400 ft south (downgradient) of the Security Pits. The presence of 1,1,1-TCA in the groundwater at this well potentially indicates cross-strike groundwater transport via "quickflow" conduits described by Shevenell (1994).

- The concentration of 1,1,1-TCA in the groundwater at well GW-305 at Industrial Landfill IV has increased by an order of magnitude between January 1992 (0.6 μg/L) and July 1997 (15 μg/L). Additionally, traces levels of 1,1-DCA and 1,2-DCE are also present in the groundwater at the well. The only confirmed source of these compounds, the Security Pits, lies more than 4,000 ft east and 20 ft hydraulically downgradient of well GW-305. Industrial Landfill IV is the only waste management site that is hydraulically upgradient of the well, which suggests that this site is the potential source of the VOCs in the groundwater at well GW-305.

- Low concentrations (<5 μg/L) of carbon tetrachloride, chloroform, PCE, and TCE were detected in at least one of the replicate groundwater samples collected from Kerr Hollow Quarry wells GW-142, GW-143, GW-144, and GW-145. The results are generally consistent with historical data showing low levels of chloromethanes and chloroethenes in the groundwater downgradient of Kerr Hollow Quarry.

- Sewage sludge landfarming may represent a source of nitrate in shallow and intermediate groundwater at Kerr Hollow Quarry, which is downgradient of the application areas.

5.2 Recommendations

Indicator parameters for sewer sludge in groundwater (e.g., ammonia, fecal coliform, and total phosphate) should be added for one sampling event at Kerr Hollow Quarry. These additional parameters could support or negate the upgradient sludge landfarming areas as a source of nitrate in samples from well GW-144 at the site.

Other recommendations for future monitoring involve actions to reduce analytical and sampling artifacts that were observed in the CY 1997 data. Corrective actions should be taken to improve air quality in the organic analytical laboratory and sample storage areas so that the percentage of contaminated groundwater samples (and blank samples) and the number of VOCs detected are reduced to the levels achieved in 1996. Well GW-731 should be redeveloped to reduce the pH and potassium levels that probably reflect cement grout dissolved in groundwater near the well. The levels of these constituents increased significantly when samples were collected in CY 1997 using the low-flow minimal drawdown purging/sampling method. If redevelopment fails to achieve sample quality improvement, reverting to the conventional purging/sampling method should be considered for collecting representative groundwater samples.

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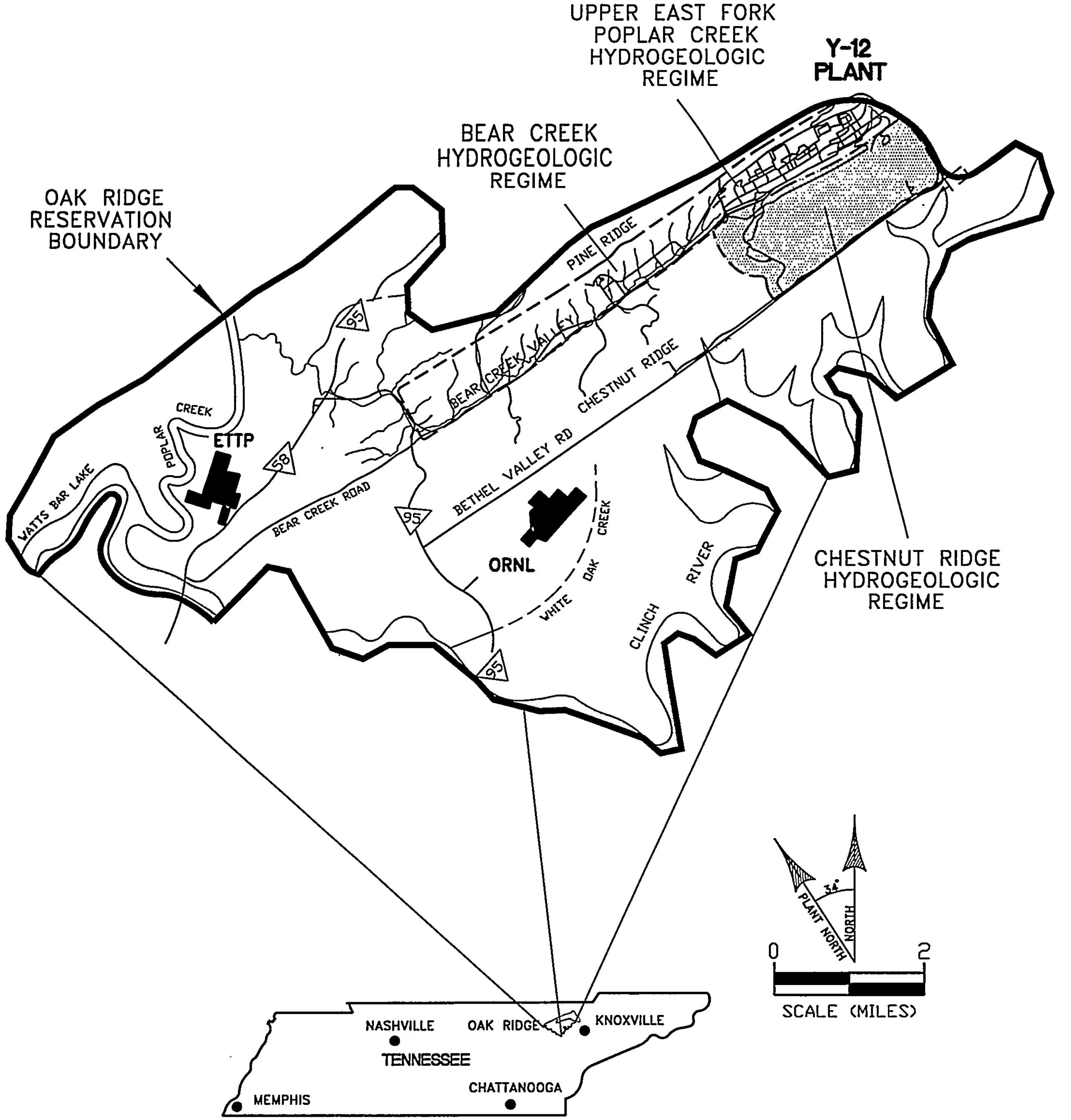
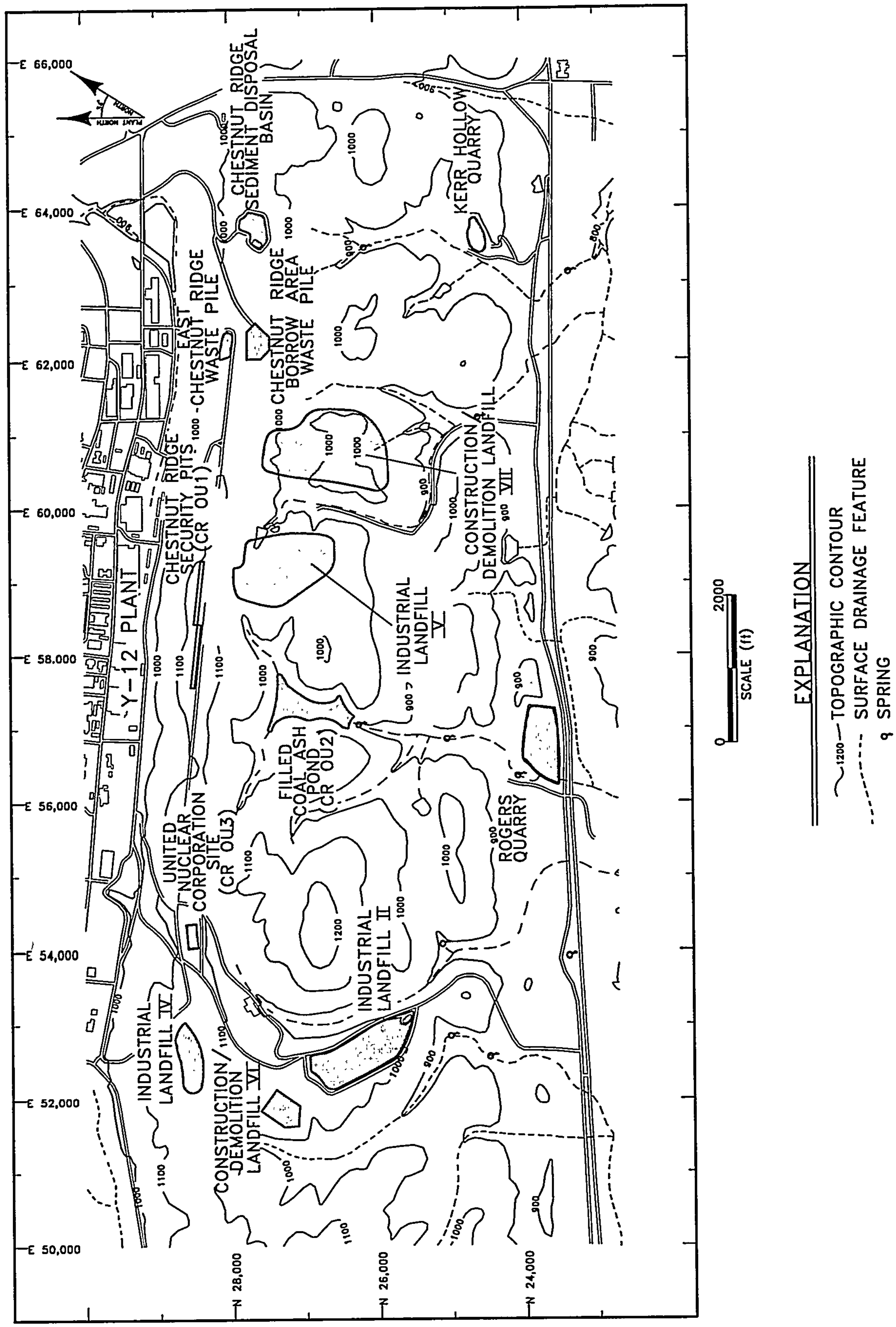
APPENDIX A

FIGURES



PREPARED FOR: *LOCKHEED MARTIN ENERGY SYSTEMS, INC.*	LOCATION:	Y-12 PLANT OAK RIDGE, TN.	FIGURE 1
PREPARED BY: *AJA TECHNICAL SERVICES, INC.*	DOC NUMBER:	MVM64V/2	HYDROGEOLOGIC REGIMES AT THE Y-12 PLANT
	DWG ID.:	HJC97-007	
	DATE:	8-15-98	



PREPARED FOR: *LOCKHEED MARTIN ENERGY SYSTEMS, INC.*	LOCATION:	Y-12 PLANT OAK RIDGE, TN.	FIGURE 2
PREPARED BY:	DOC NUMBER:	MVM64V/2	WASTE MANAGEMENT SITES IN THE CHESTNUT RIDGE HYDROGEOLOGIC REGIME
AJA TECHNICAL SERVICES, INC.	DWG ID.:	HJC97-006	
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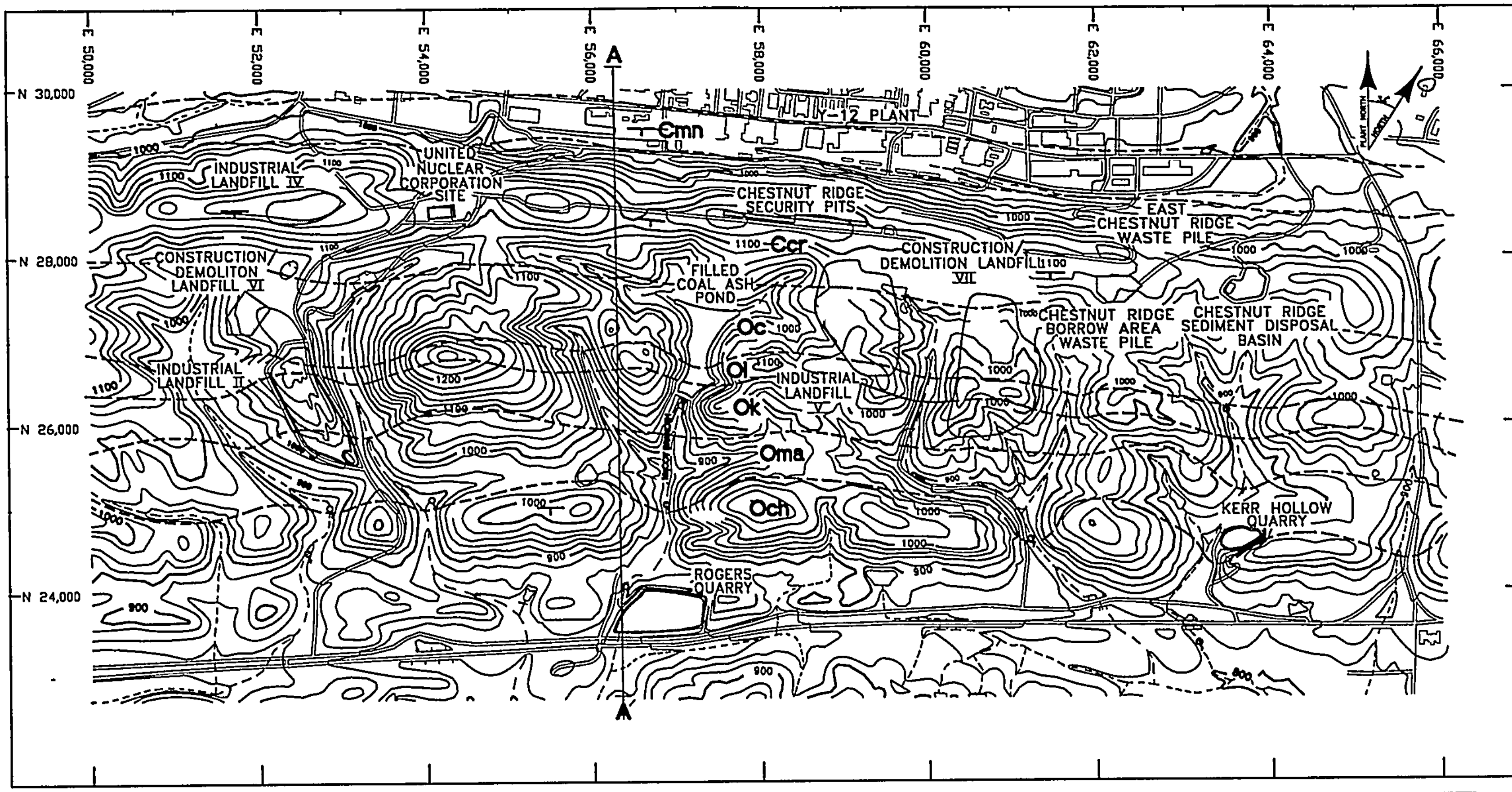
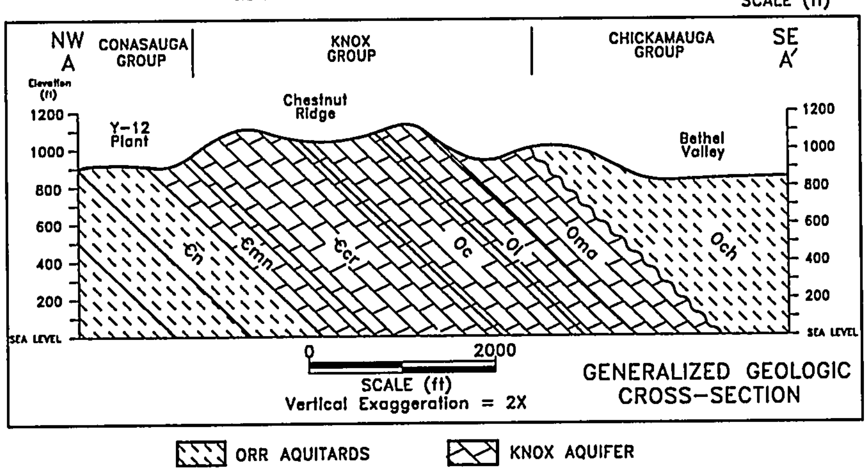
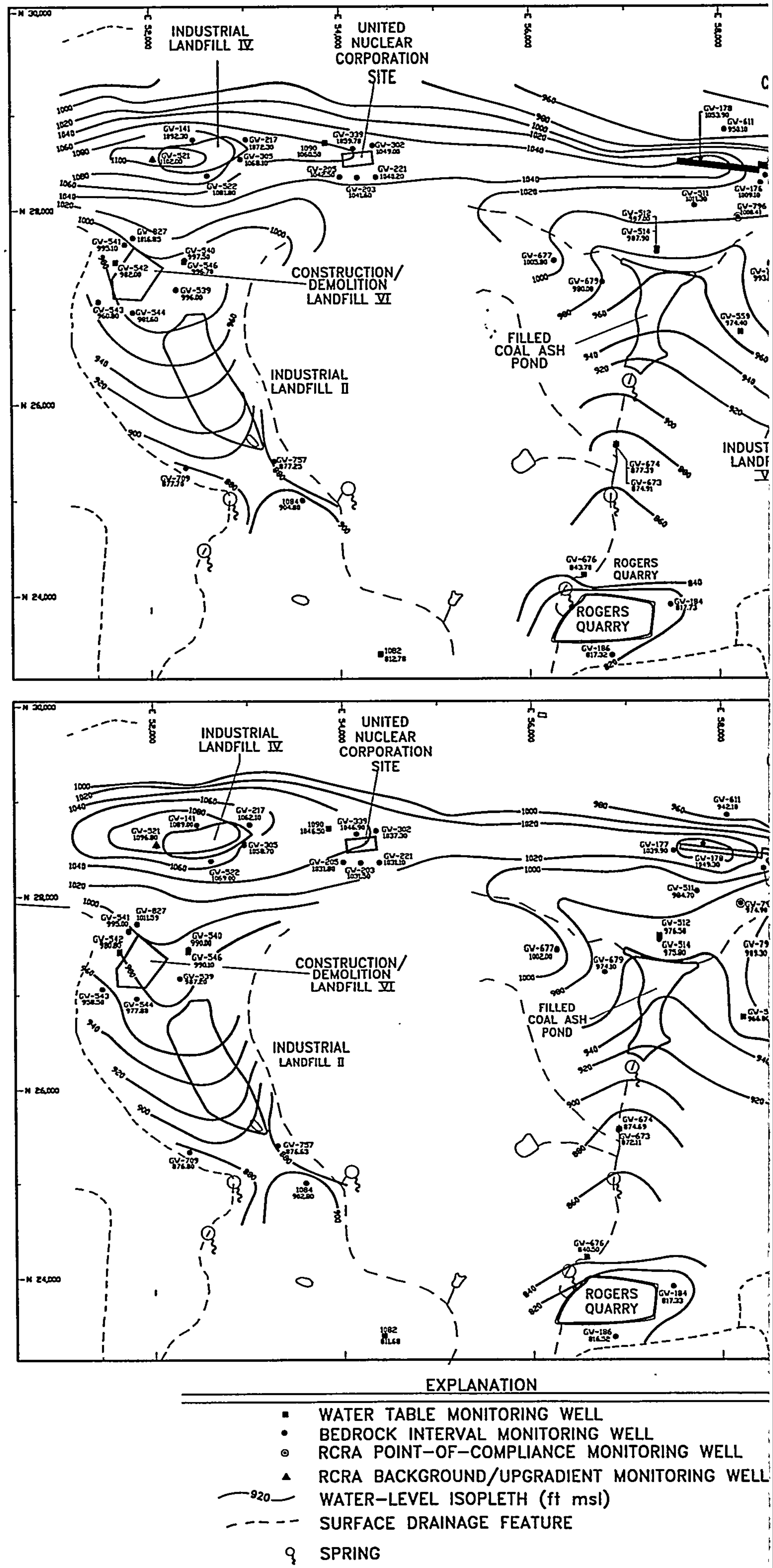


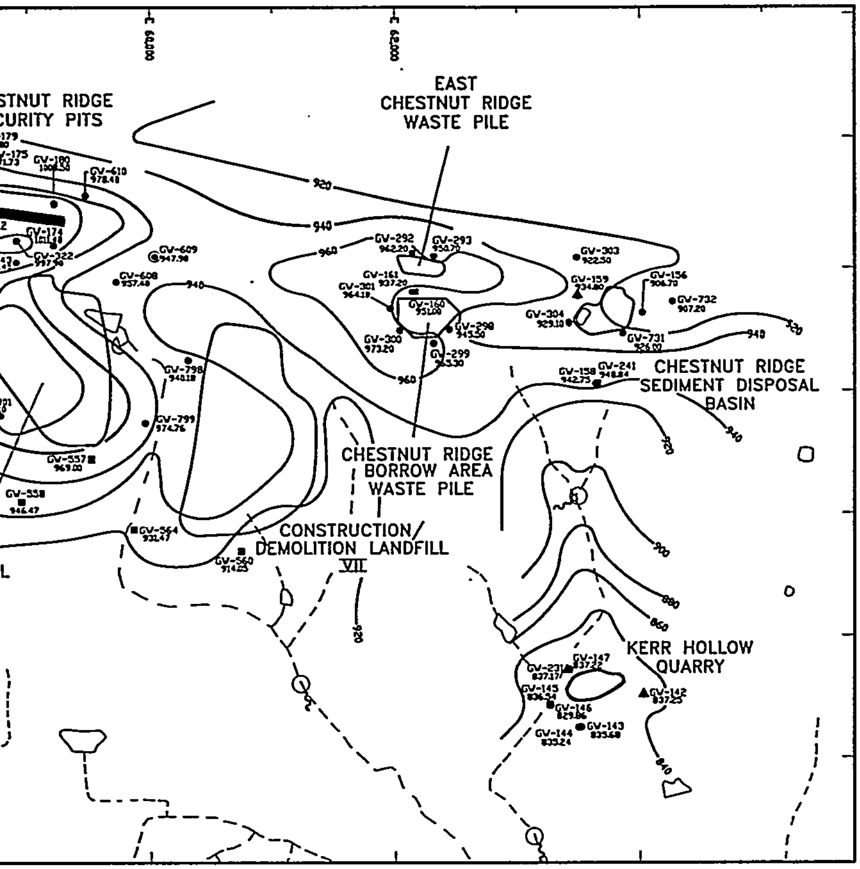
SOURCES: King and Haase, 1987
Hatcher et al, 1992



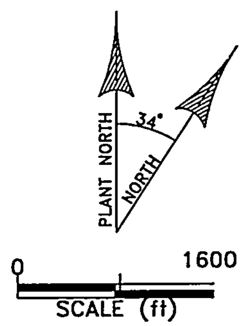
SYSTEM		HYDRO UNIT	GROUP	FORMATION	MAP SYMBOL	THICKNESS (FT)
ORDOVICIAN	UPPER	ORR AQUITARDS	CHICKA-MAUGA	UNDIFFERENTIATED	Och	1500 TO 2000
	MIDDLE	KNOX AQUIFER	KNOX	MISSING SECTION (Subaerial Erosion)		
	LOWER			MASCOT DOLOMITE	Oma	250–400
				KINGSPORT FORMATION	Ok	300–500
				LONGVIEW DOLOMITE	Ol	130–200
				CHEPULTEPEC DOLOMITE	Oc	500–700
CAMBRIAN	UPPER			COPPER RIDGE DOLOMITE	Ɛcr	800–1,100
			CONASAUGA	MAYNARDVILLE LIMESTONE	Ɛmn	418–450
	MIDDLE	ORR AQUITARDS		NOLICHUCKY SHALE	Ɛn	490–590

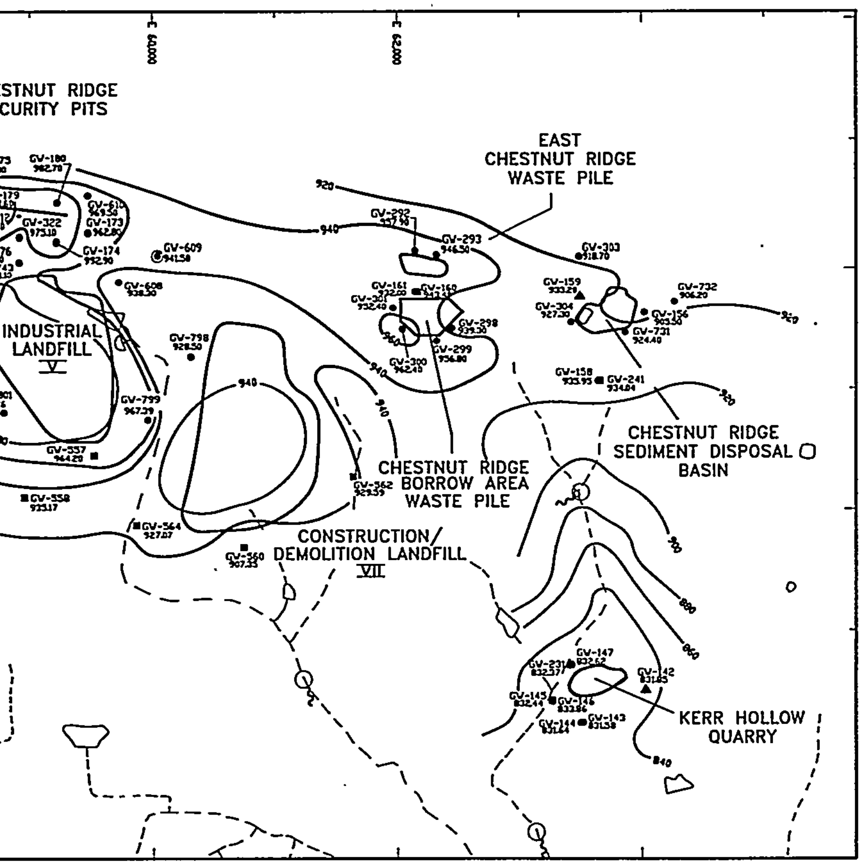
PREPARED FOR: *LOCKHEED MARTIN ENERGY SYSTEMS, INC.*	LOCATION:	Y-12 PLANT OAK RIDGE, TN.	FIGURE 3
PREPARED BY: *AJA TECHNICAL SERVICES, INC.*	DOC NUMBER:	MVM64V/2	TOPOGRAPHY AND BEDROCK GEOLOGY IN THE CHESTNUT RIDGE HYDROGEOLOGIC REGIME
	DWG ID.:	HJC96-023	
	DATE:	8-15-98	


INDUSTRIAL LANDFILL IV
UNITED NUCLEAR CORPORATION SITE
CONSTRUCTION/ DEMOLITION LANDFILL VI
INDUSTRIAL LANDFILL II
FILLED COAL ASH POND
ROGERS QUARRY
N 30,000
N 28,000
N 26,000
N 24,000
E 52,000
E 54,000
E 56,000
E 58,000
INDUSTRIAL LANDFILL IV
UNITED NUCLEAR CORPORATION SITE
CONSTRUCTION/ DEMOLITION LANDFILL VI
INDUSTRIAL LANDFILL II
FILLED COAL ASH POND
ROGERS QUARRY
EXPLANATION
WATER TABLE MONITORING WELL
BEDROCK INTERVAL MONITORING WELL
RCRA POINT-OF-COMPLIANCE MONITORING WELL
RCRA BACKGROUND/UPGRADIENT MONITORING WELL
920 WATER-LEVEL ISOPLETH (ft msl)
SURFACE DRAINAGE FEATURE
SPRING



GROUNDWATER ELEVATIONS
MARCH 31 - APRIL 4, 1997





GROUNDWATER ELEVATIONS
OCTOBER 6 - 9, 1997

PREPARED FOR: *LOCKHEED MARTIN ENERGY SYSTEMS, INC.*	LOCATION:	Y-12 PLANT OAK RIDGE, TN.	FIGURE 4
PREPARED BY: *AJA TECHNICAL SERVICES, INC.*	DOC NUMBER:	98-D002	SEASONAL GROUNDWATER ELEVATIONS IN THE CHESTNUT RIDGE HYDROGEOLOGIC REGIME, CY 1997
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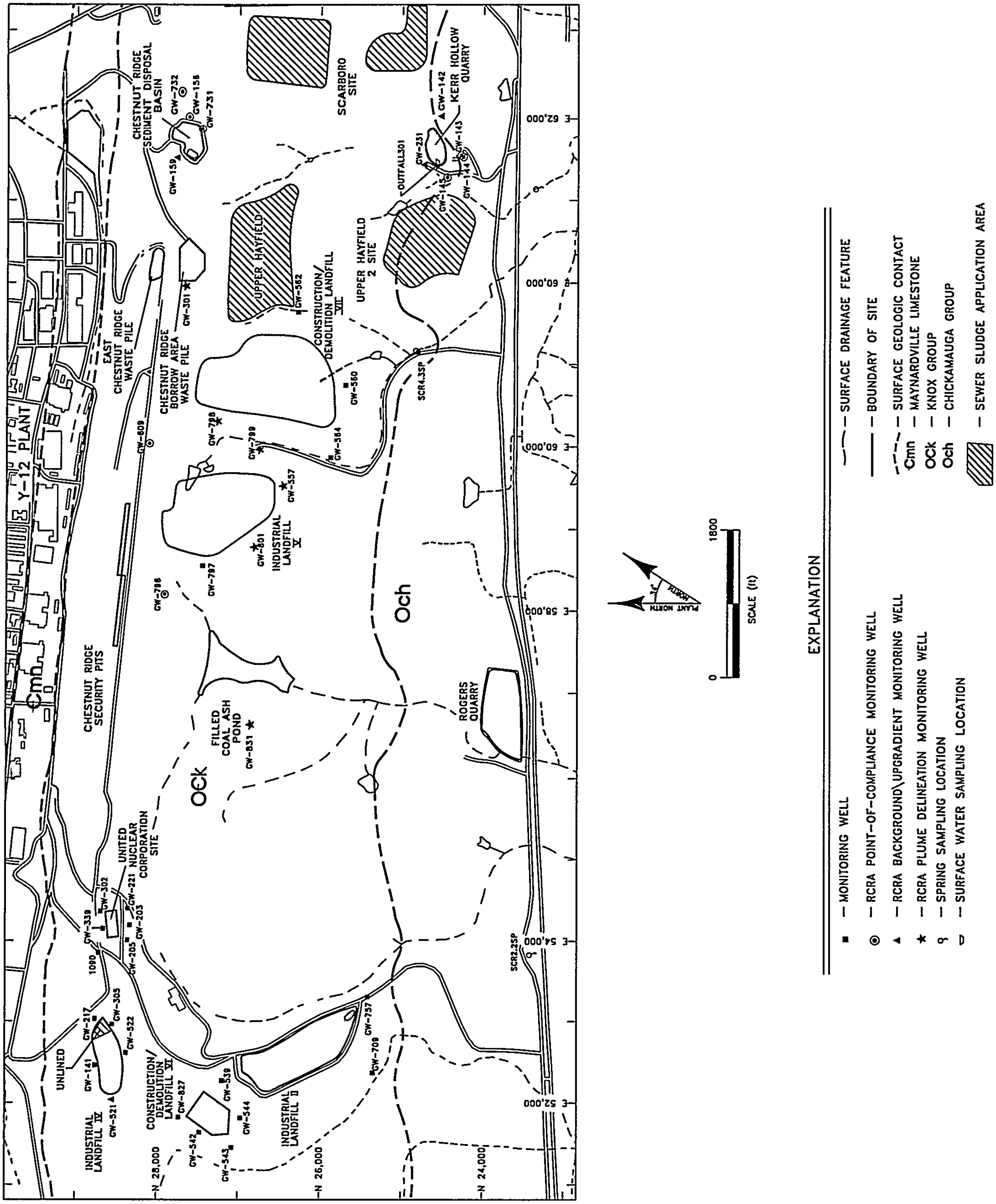

PREPARED FOR: *LOCKHEED MARTIN ENERGY SYSTEMS, INC.*	LOCATION:	Y-12 PLANT OAK RIDGE, TN.	FIGURE 5
PREPARED BY: *AJA TECHNICAL SERVICES, INC.*	DOC NUMBER:	MVM64V/2	CY 1997 GROUNDWATER AND SURFACE WATER SAMPLING LOCATIONS IN THE CHESTNUT RIDGE REGIME
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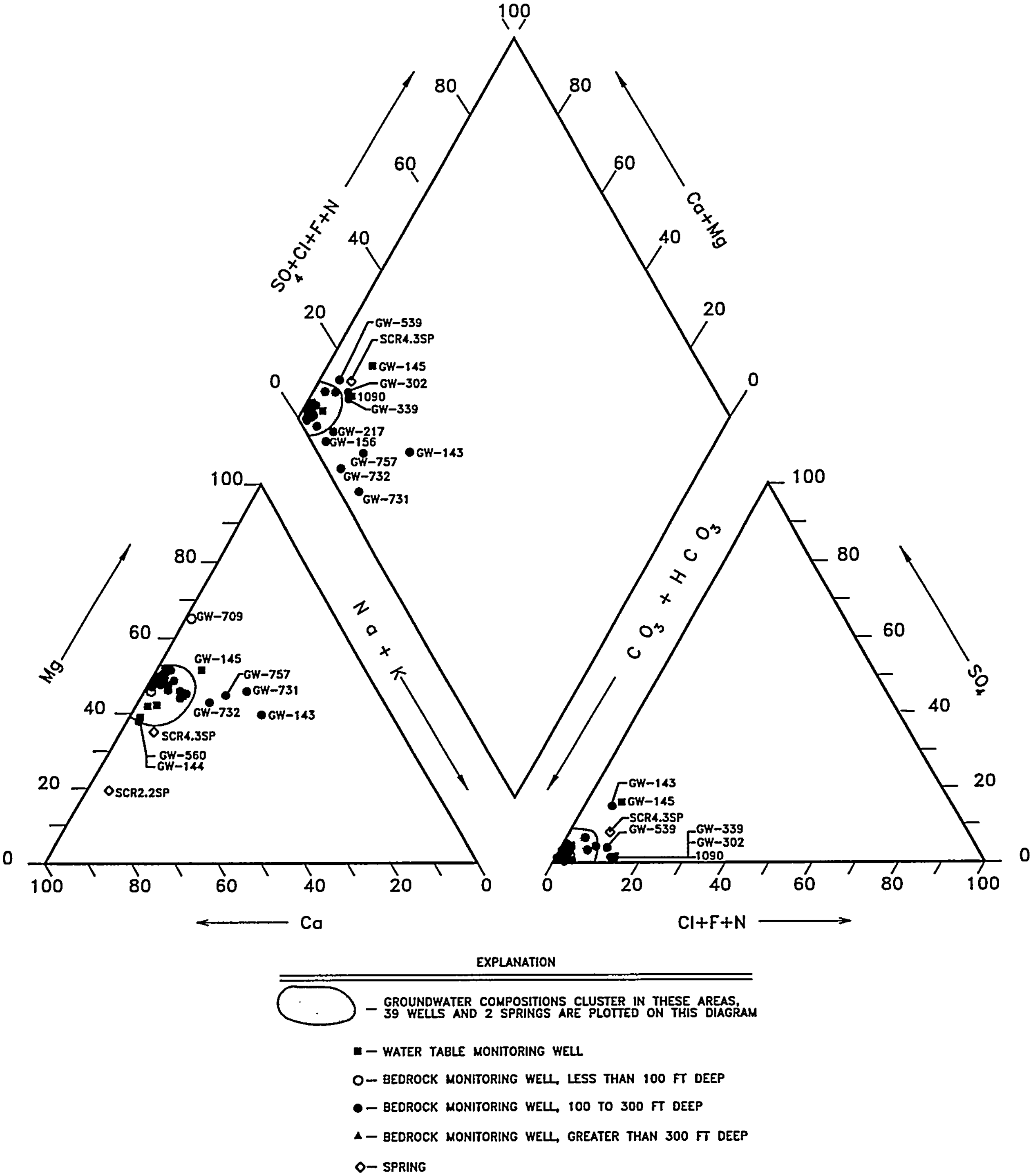

PREPARED FOR: *LOCKHEED MARTIN ENERGY SYSTEMS, INC.*	LOCATION:	Y-12 PLANT OAK RIDGE, TN.	FIGURE 6
PREPARED BY: *AJA TECHNICAL SERVICES, INC.*	DOC NUMBER:	MVM64V/2	GROUNDWATER GEOCHEMISTRY IN THE CHESTNUT RIDGE REGIME
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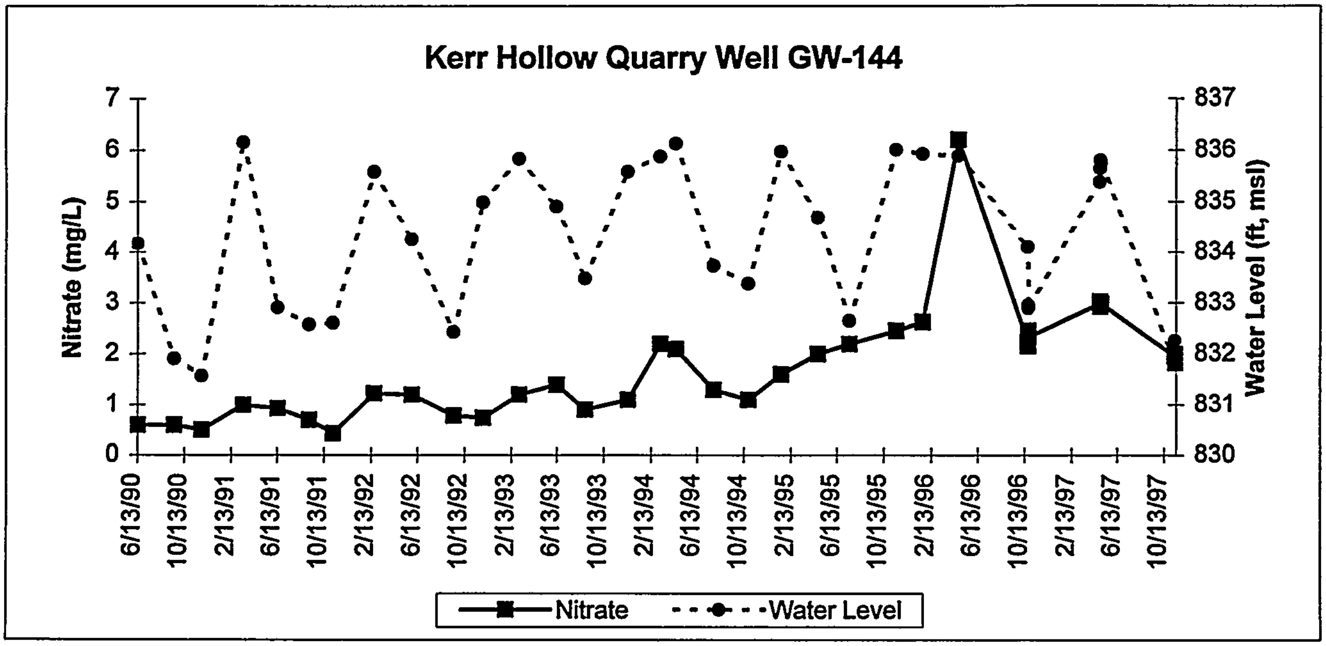
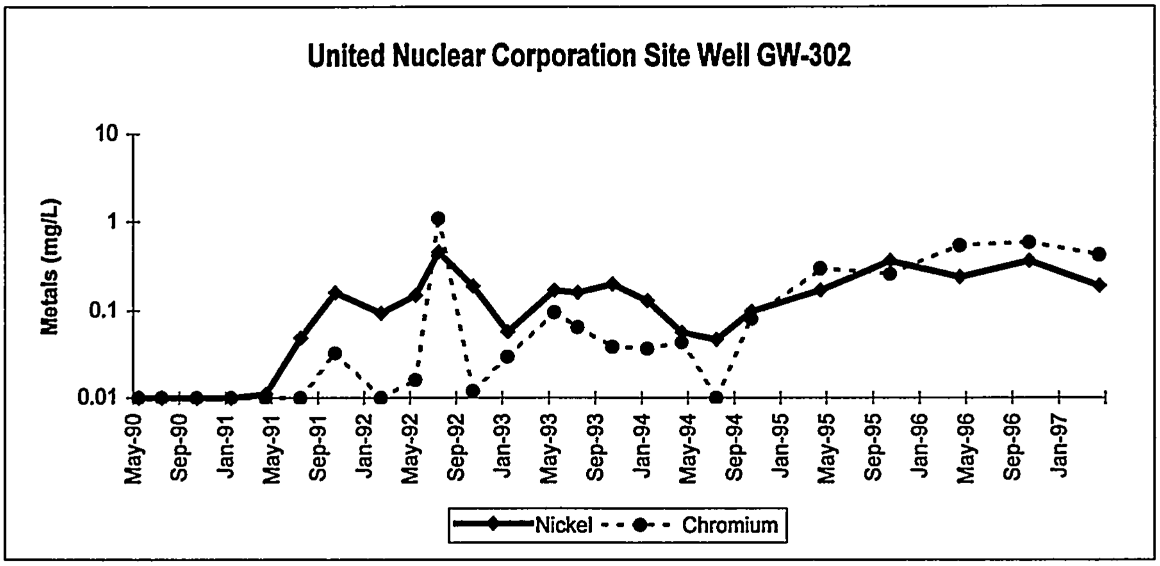
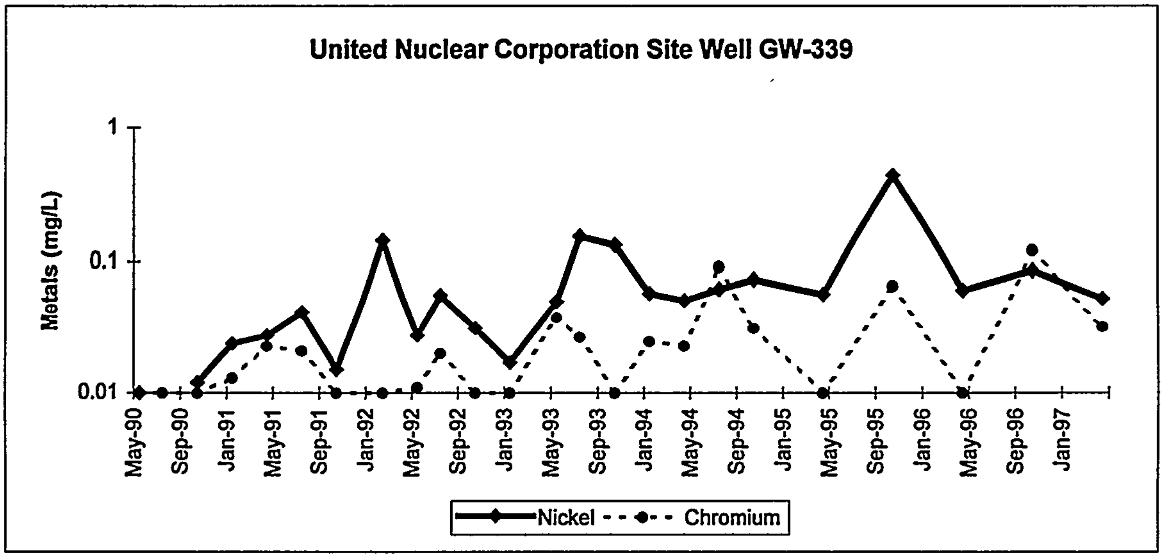
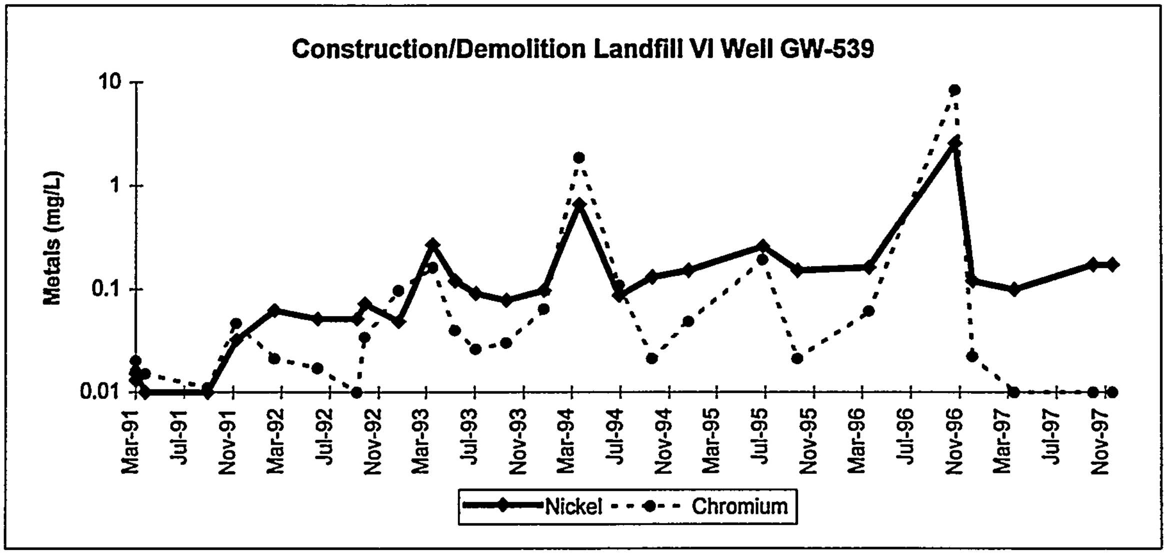
	DATE:	6-29-98	



PREPARED FOR: *LOCKHEED MARTIN ENERGY SYSTEMS, INC.*	LOCATION:	Y-12 PLANT OAK RIDGE, TN.	FIGURE 7	
PREPARED BY: *AJA TECHNICAL SERVICES, INC.*	DOC No.:	MVM64V/2	NITRATE CONCENTRATION TRENDS IN GROUNDWATER AT WELL GW-144	
	DWG ID.:	CR PT297		
	DATE:	6/18/98		

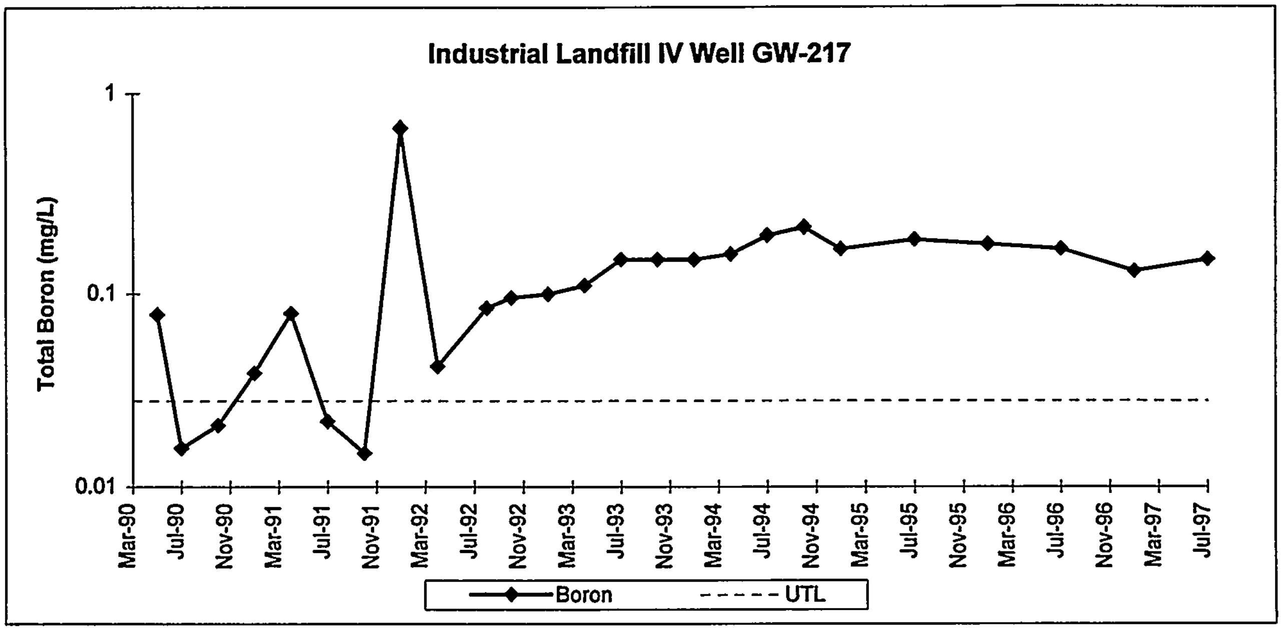






Note: Maximum Contaminant Level for Nickel and Chromium = 0.1 mg/L.

PREPARED FOR: *LOCKHEED MARTIN ENERGY SYSTEMS, INC.*	LOCATION:	Y-12 PLANT OAK RIDGE, TN.	FIGURE 8
PREPARED BY: *AJA TECHNICAL SERVICES, INC.*	DOC No.:	MVM64V/2	CHROMIUM AND NICKEL CONCENTRATION TRENDS IN GROUNDWATER AT WELLS GW-302, GW-339, AND GW-539
	DWG ID.:	CR PT297	
	DATE:	6/18/98	



PREPARED FOR: *LOCKHEED MARTIN ENERGY SYSTEMS, INC.*	LOCATION:	Y-12 PLANT OAK RIDGE, TN.	FIGURE 9
PREPARED BY: *AJA TECHNICAL SERVICES, INC.*	DOC No.:	MVM64V/2	BORON CONCENTRATION TRENDS IN GROUNDWATER AT WELL GW-217
	DWG ID.:	CR PT297	
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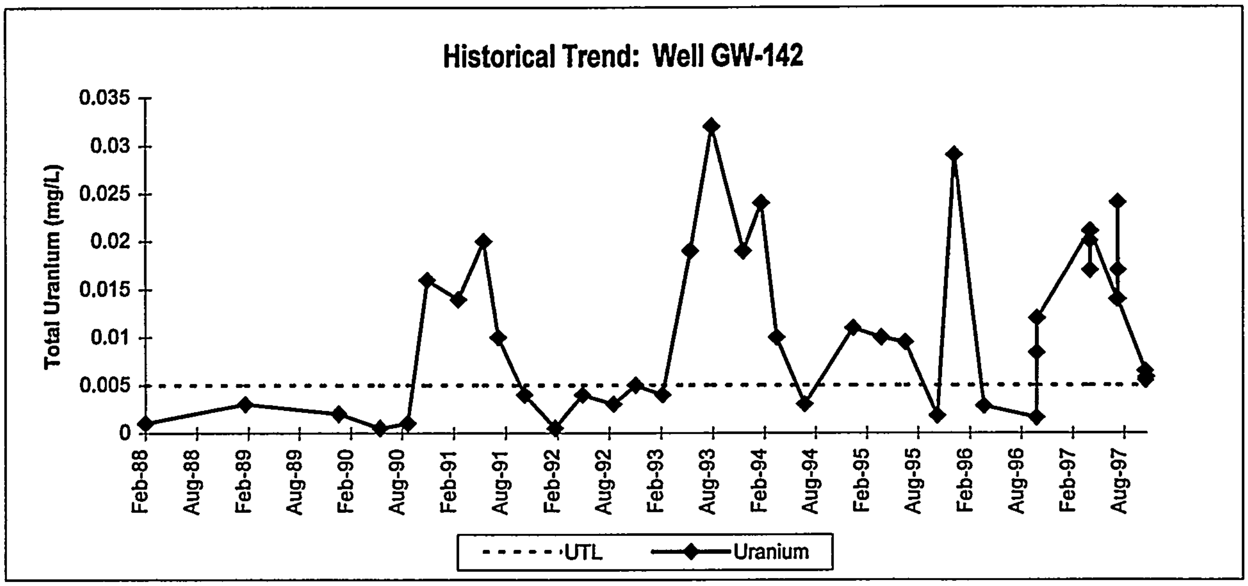
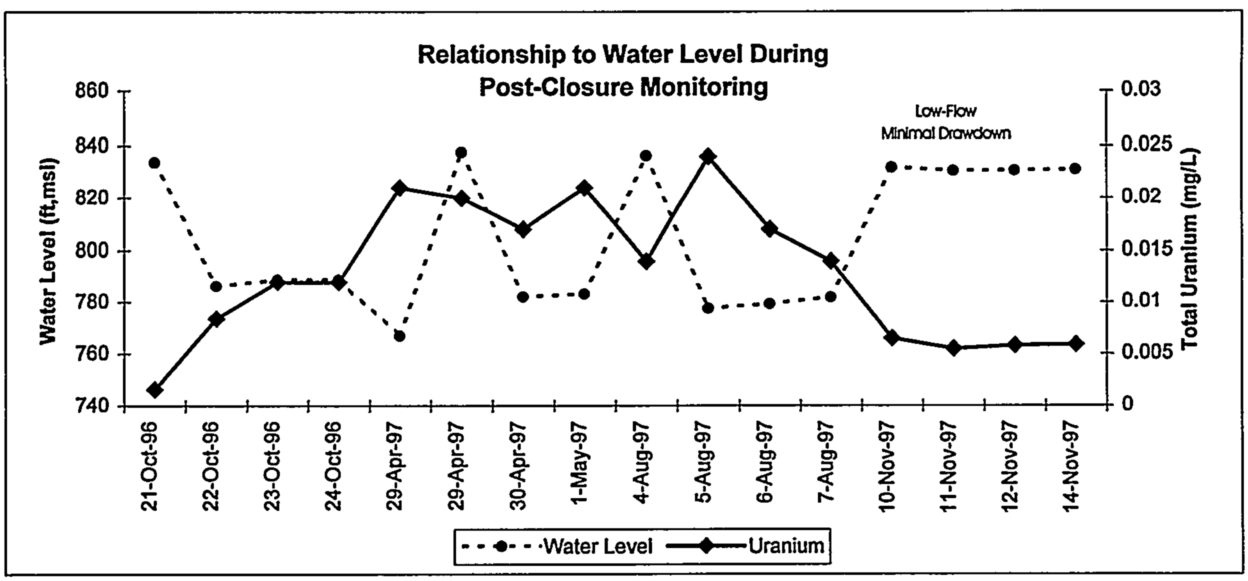
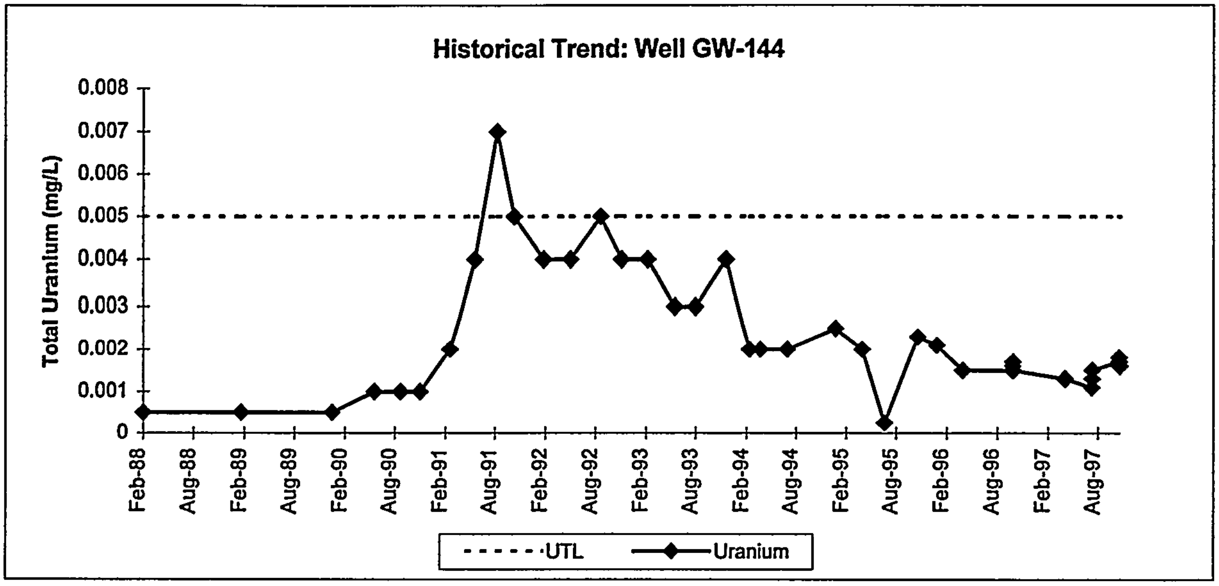
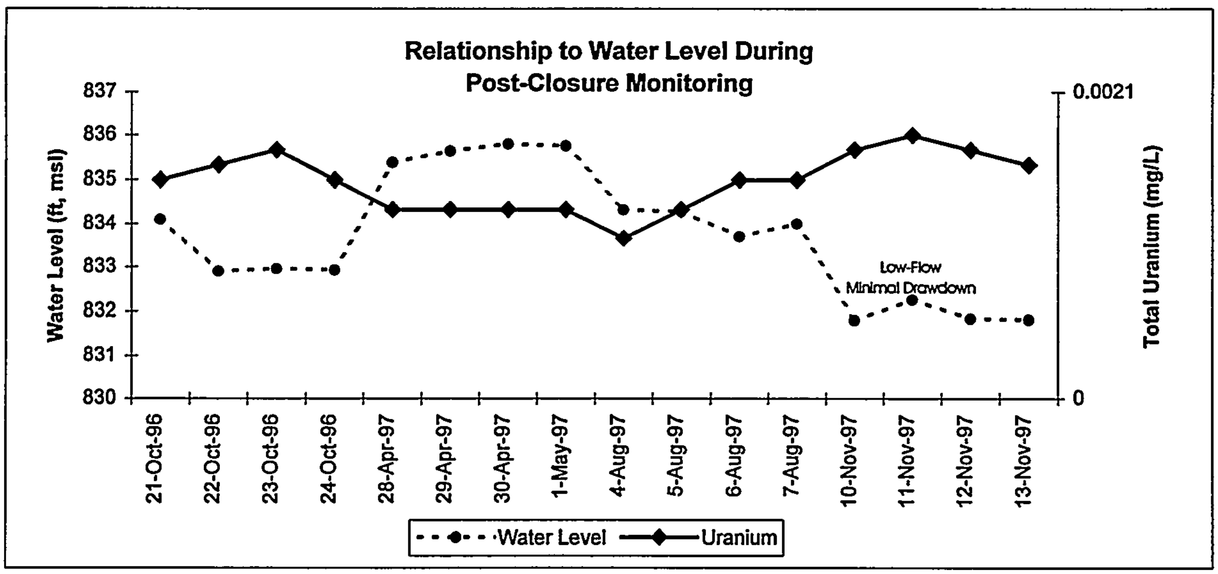




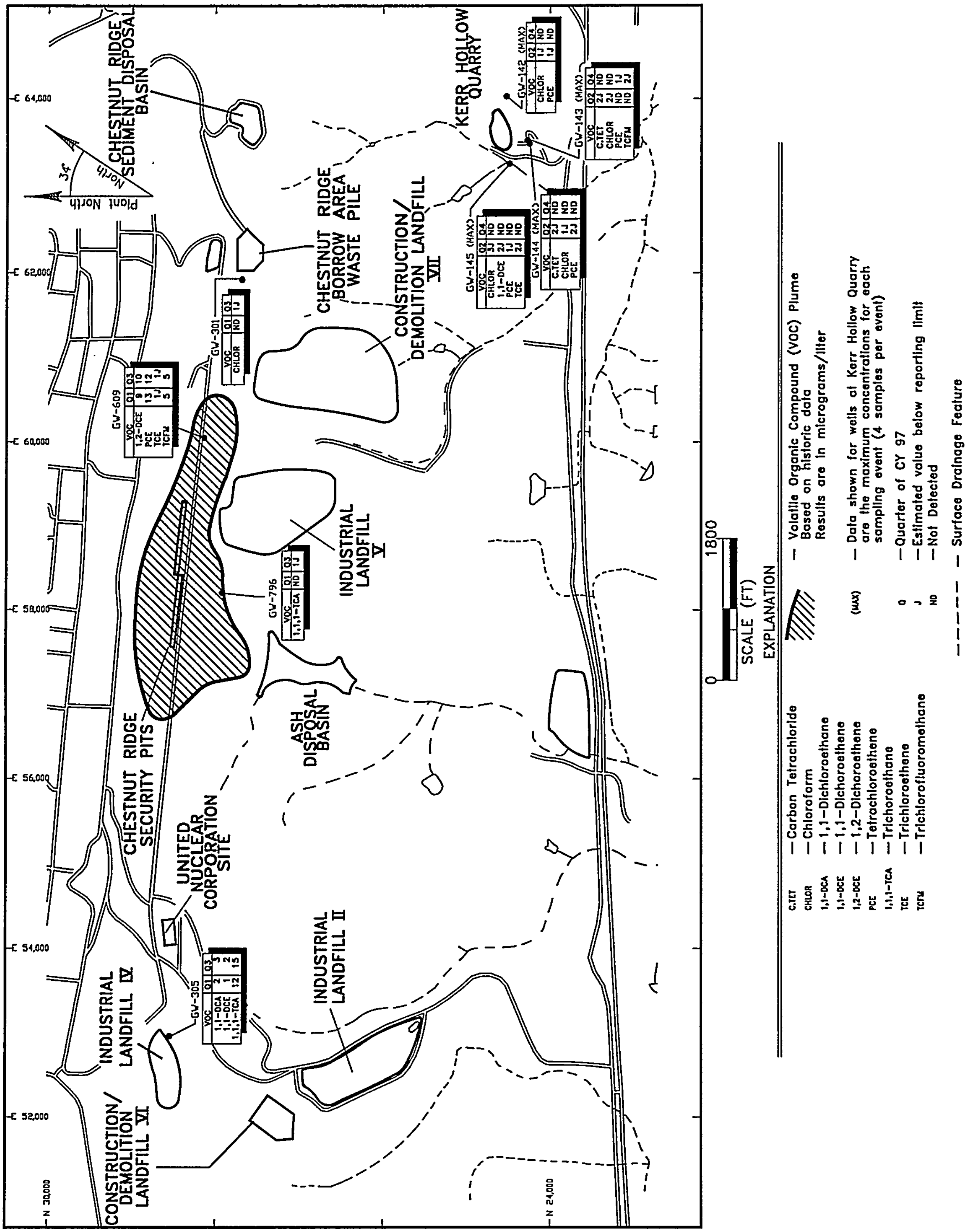
PREPARED FOR: *LOCKHEED MARTIN ENERGY SYSTEMS, INC.*	LOCATION:	Y-12 PLANT OAK RIDGE, TN.	**FIGURE 10**
PREPARED BY: *AJA TECHNICAL SERVICES, INC.*	DOC No.:	MVM64V/2	**URANIUM CONCENTRATION TRENDS IN GROUNDWATER AT WELL GW-142**
	DWG ID.:	CR_PT297	
	DATE:	6/18/98	



Note: Nondetects plotted as one-half the detection limit.



PREPARED FOR: *LOCKHEED MARTIN ENERGY SYSTEMS, INC.*	LOCATION:	Y-12 PLANT OAK RIDGE, TN.	FIGURE 11
PREPARED BY: *AJA TECHNICAL SERVICES, INC.*	DOC No.:	MVM64V/2	URANIUM CONCENTRATION TRENDS IN GROUNDWATER AT WELL GW-144
	DWG ID.:	CR_PT297	
	DATE:	6/18/98	



PREPARED FOR: *LOCKHEED MARTIN ENERGY SYSTEMS, INC.*	LOCATION:	Y-12 PLANT OAK RIDGE, TN.	FIGURE 12
PREPARED BY: *AJA TECHNICAL SERVICES, INC.*	DOC NUMBER:	MVM64V/2	VOLATILE ORGANIC COMPOUNDS IN GROUNDWATER IN THE CHESTNUT RIDGE HYDROGEOLOGIC REGIME
	DWG ID.:	HJC98-004	
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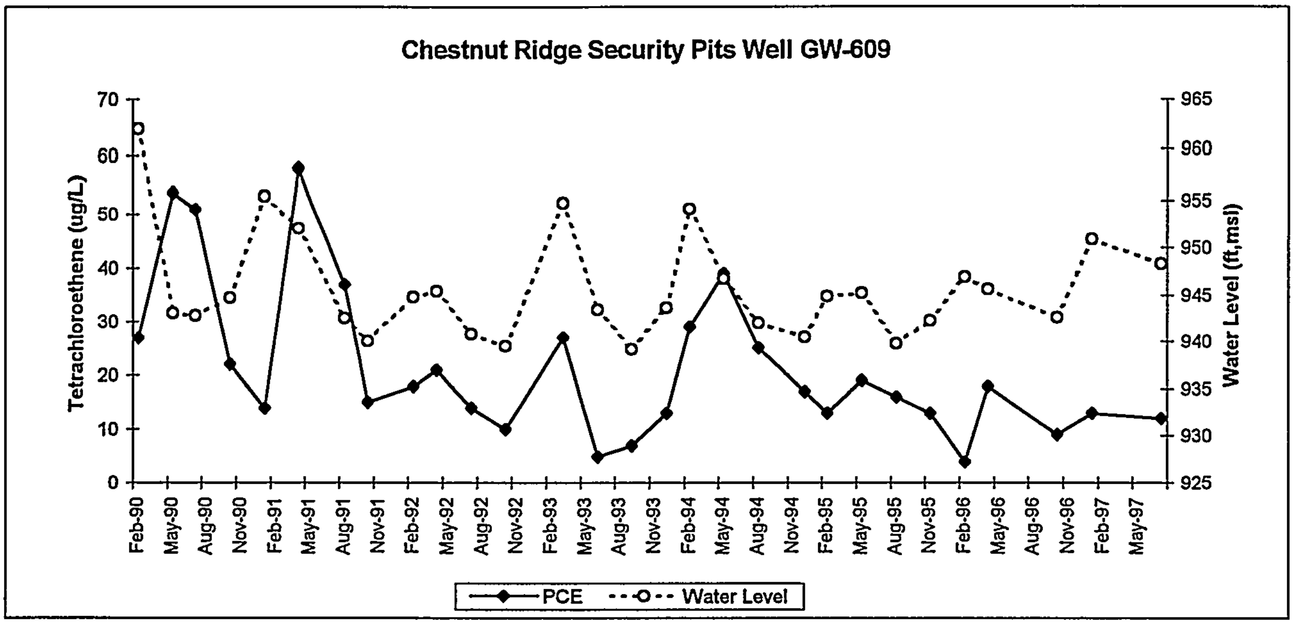
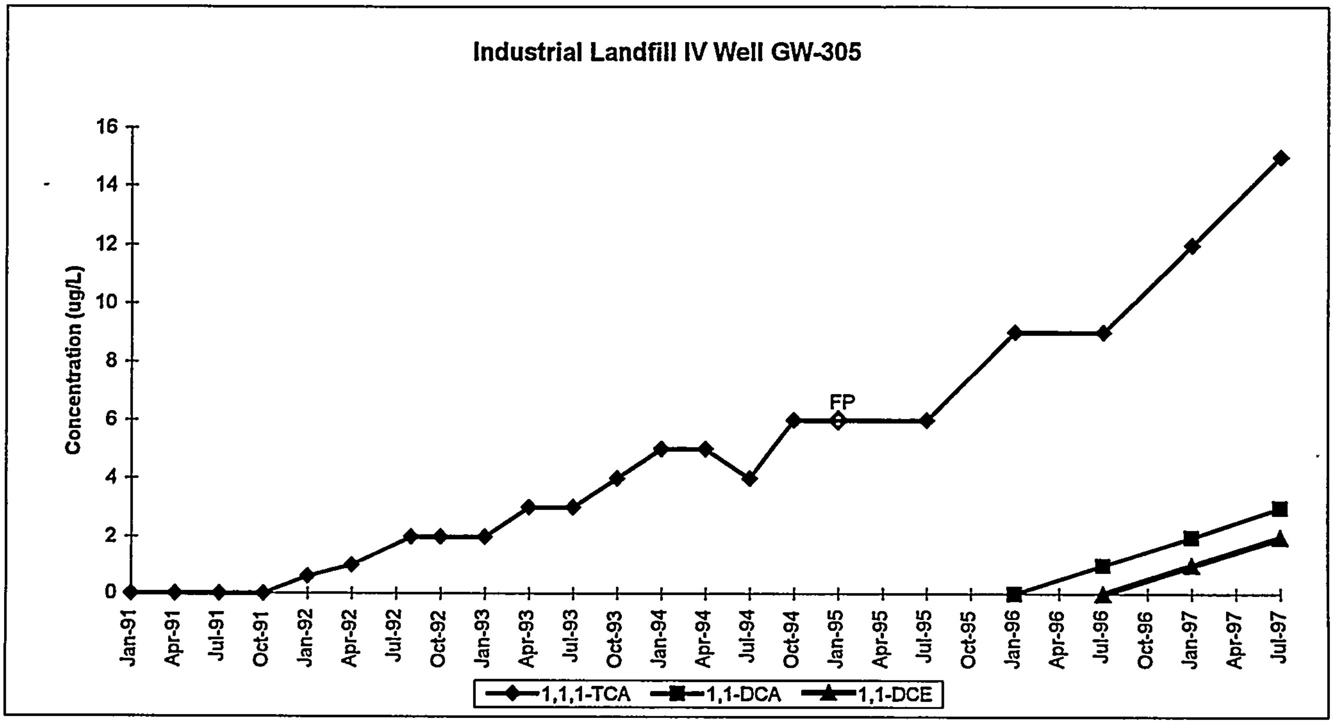


Note: PCE MCL = 5 ug/L

PREPARED FOR: *LOCKHEED MARTIN ENERGY SYSTEMS, INC.*	LOCATION:	Y-12 PLANT OAK RIDGE, TN.	FIGURE 13
PREPARED BY: *AJA TECHNICAL SERVICES, INC.*	DOC No.:	MVM64V/2	PCE CONCENTRATION TRENDS IN GROUNDWATER AT WELL GW-609
	DWG ID.:	CR PT297	
	DATE:	8/12/98	



Notes: 1,1,1-TCA MCL = 200 ug/L
1,1-DCA MCL = not applicable
1,1-DCE MCL = 7 ug/L
FP = False-Positive Result

PREPARED FOR: *LOCKHEED MARTIN ENERGY SYSTEMS, INC.*	LOCATION:	Y-12 PLANT OAK RIDGE, TN.	FIGURE 14
PREPARED BY: *AJA TECHNICAL SERVICES, INC.*	DOC No.:	MVM64V/2	VOC CONCENTRATION TRENDS IN GROUNDWATER AT WELL GW-305
	DWG ID.:	CR_PT297	
	DATE:	8/12/98	

APPENDIX B

TABLES

Table 1.
Waste Management Sites and Associated Groundwater Monitoring Programs in the Chestnut Ridge Hydrogeologic Regime

GROUNDWATER MONITORING PROGRAM						DOE Order 5400.1 Monitoring [5]	CERCLA Record of Decision Monitoring [4]	SWDF Detection Monitoring [3]	RCRA Post-Closure Detection Monitoring [2]	RCRA Post-Closure Corrective Action Monitoring [1]
Waste Management Site	**Regulatory Classification**	**General Waste Inventory**	**Status**							
			Operation	**Active**	**Closed**					
Chestnut Ridge Sediment Disposal Basin	RCRA/ CERCLA	Approximately 11,100 yd^3 of sediments and soils from the Y-12 Plant containing heavy metals; approximately 100,000 gallons of methanol-brine waste (70/30% water/methyl alcohol); and 55-110 gallons of toluene.	1973-1987		●				●	
East Chestnut Ridge Waste Pile	RCRA/ CERCLA	Contaminated soil from the Y-12 Plant.	1987	●		●				
Kerr Hollow Quarry	RCRA/ CERCLA	Approximately 50 tons of water-reactive materials (alkali metals, metal hydrides); unstable organic materials (picric acid, ethers, peroxides, and hydrazone); reactive metals (phosphorous and magnesium); potentially explosive materials (e.g., gas cylinders); ammonia; and inorganic acids.	1951-1988		●		●		●	
Chestnut Ridge Security Pits	RCRA/ CERCLA	Metals (lead); reactive materials (lithium hydride, lithium deuteride, zirconium); corrosive materials (acids); ignitable materials (alcohols); and chlorinated solvents.	1973-1988		●					●
Filled Coal Ash Pond (formerly the Ash Disposal Basin)	CERCLA	Coal fly-ash slurry from the Y-12 Steam Plant.	1955-1967		●		●			
United Nuclear Corporation Site	CERCLA	Approximately 11,000 drums (55-gallon) of sludge fixed in cement, 18,000 drums of contaminated soil, and 288 boxes of contaminated process and demolition material.	1982-1992		●		●			

Table 1 (cont'd)

Waste Management Site	Regulatory Classification	General Waste Inventory	Status: Operation	Status: Active	Status: Closed	DOE Order 5400.1 Monitoring [5]	CERCLA Record of Decision Monitoring [4]	SWDF Detection Monitoring [3]	RCRA Post-Closure Detection Monitoring [2]	RCRA Post-Closure Corrective Action Monitoring [1]
Rogers Quarry	CERCLA	Coal fly-ash slurry that bypassed the Ash Disposal Basin via spillway into McCoy Branch.	1967-1993		●	●				
Chestnut Ridge Borrow Area Waste Pile	CERCLA	Soils removed from the Oak Ridge Civic Center properties and the Oak Ridge Sewer Line Beltway contaminated with mercury and other metals, and possibly some organic compounds, that originated from the Y-12 Plant.	Mid-1980	●		●				
Industrial Landfill II	SWDF	Combustible and decomposable solid waste and construction spoil material including scrap metal, glass, paper products, plastics, wood, organic garbage, textile products, asphalt roofing materials, and special wastes such as asbestos and beryllium oxide.	1983-1996		●			●		
Industrial Landfill IV	SWDF	Approximately 12,000 ft^3 per year of non-hazardous, nonradioactive industrial wastes including: cardboard, plastics, rubber, scrap metal, wood, paper, and special waste.	1989-	●				●		
Industrial Landfill V	SWDF	Combustible/decomposable solid wastes.	1994-	●				●		
Construction/Demolition Landfill VI	SWDF	Construction spoil: concrete, wood, metal, plastic, roofing materials, and soil.	1994-	●				●		
Construction/Demolition Landfill VII	SWDF	No wastes emplaced to date.	1994-					●		
Receptor Media	Not Regulated	Groundwater and surface water exiting the Chestnut Ridge Hydrogeologic Regime.	Not Applicable			●				

Table 1 (cont'd)

Notes:

1. Resource Conservation and Recovery Act (RCRA) post-closure corrective action monitoring in accordance with the requirements specified in the RCRA post-closure permit for the Chestnut Ridge Regime (Permit No. TNHW-088).

2. RCRA post-closure detection monitoring in accordance with the applicable requirements of the RCRA post-closure permit for the Chestnut Ridge Regime (Permit No. TNHW-088).

3. Detection monitoring in accordance with operating permits issued by the Tennessee Department of Environment and Conservation for the specified non-hazardous solid waste disposal facility and applicable TDEC solid waste management regulations.

4. Monitoring in accordance with the Comprehensive Environmental Response, Compensation, and Liability Act Record of Decision for the specified facility.

5. Monitoring performed in accordance with U.S. Department of Energy Order 5400.1 Surveillance Monitoring and Exit Pathway/Perimeter Monitoring.

Table 2.
Depth-to-Water Measurements and Water-Level Elevations for Selected Monitoring Wells in the Chestnut Ridge Hydrogeologic Regime

Well No.[1]	Location[2]	Measuring Point Elevation[3] (ft msl)	Depth-to-Water (ft below Top of Well Casing) March 31 - April 4, 1997	Depth-to-Water (ft below Top of Well Casing) October 6 - 9, 1997	Seasonal Fluctuation (+/- ft)	Water-Level Elevation (ft above mean sea level) March 31 - April 4, 1997	Water-Level Elevation (ft above mean sea level) October 6 - 9, 1997
1082	ORSF	837.28	24.5	25.6	-1.1	812.78	811.68
1084	ORSF	965.40	60.6	62.6	-2.0	904.80	902.80
1090	UNCS	1103.90	43.4	57.4	-14.0	1060.50	1046.50
GW-141	LIV	1186.10	93.8	97.1	-3.3	1092.30	1089.00
GW-142	KHQ	970.35	133.1	138.5	-5.4	837.25	831.85
GW-143	KHQ	913.18	77.5	81.6	-4.1	835.68	831.58
GW-144	KHQ	913.34	78.1	81.7	-3.6	835.24	831.64
GW-145	KHQ	840.04	3.5	7.6	-4.1	836.54	832.44
GW-146	KHQ	838.16	8.3	4.3	4.0	829.86	833.86
GW-147	KHQ	851.62	14.4	19.0	-4.6	837.22	832.62
GW-156	CRSDB	1049.10	142.4	143.6	-1.2	906.70	905.50
GW-158	CRSDB	983.05	40.3	47.1	-6.8	942.75	935.95
GW-159	CRSDB	1051.20	116.4	118.0	-1.6	934.80	933.20
GW-160	CRBAWP	1093.10	142.1	149.7	-7.6	951.00	943.40
GW-161	CRBAWP	1093.50	156.3	161.5	-5.2	937.20	932.00
GW-173	CRSP	1115.00	NM[4]	152.2	NA[4]	NA	962.80
GW-174	CRSP	1116.50	105.1	123.6	-18.5	1011.40	992.90
GW-175	CRSP	1084.00	112.3	122.7	-10.4	971.73	961.30
GW-176	CRSP	1125.30	116.2	116.4	-0.2	1009.10	1008.90
GW-177	CRSP	1158.00	NM	118.1	NA	NA	1039.90
GW-178	CRSP	1143.50	89.6	94.2	-4.6	1053.90	1049.30
GW-179	CRSP	1128.00	116.2	116.4	-0.2	1011.80	1011.60
GW-180	CRSP	1104.00	95.5	121.3	-25.8	1008.50	982.70
GW-184	RQ	927.63	109.9	110.3	-0.4	817.73	817.33
GW-186	RQ	831.32	14.0	14.8	-0.8	817.32	816.52
GW-203	UNCS	1105.30	63.7	73.8	-10.1	1041.60	1031.50
GW-205	UNCS	1104.00	61.5	72.2	-10.7	1042.50	1031.80
GW-217	LIV	1176.90	104.6	114.8	-10.2	1072.30	1062.10
GW-221	UNCS	1106.00	65.8	74.9	-9.1	1040.20	1031.10
GW-231	KHQ	849.47	12.3	17.1	-4.8	837.17	832.37
GW-241	CRSDB	982.64	33.8	48.6	-14.8	948.84	934.04
GW-292	ECRWP	1073.00	110.8	115.1	-4.3	962.20	957.90

Table 2 (cont'd)

Well No.[1]	Location[2]	Measuring Point Elevation[3] (ft msl)	Depth-to-Water (ft below Top of Well Casing) March 31 - April 4, 1997	Depth-to-Water (ft below Top of Well Casing) October 6 - 9, 1997	Seasonal Fluctuation (+/- ft)	Water-Level Elevation (ft above mean sea level) March 31 - April 4, 1997	Water-Level Elevation (ft above mean sea level) October 6 - 9, 1997
GW-293	ECRWP	1063.90	113.2	117.4	-4.2	950.70	946.50
GW-298	CRBAWP	1049.00	103.5	109.7	-6.2	945.50	939.30
GW-299	CRBAWP	1053.90	88.6	97.1	-8.5	965.30	956.80
GW-300	CRBAWP	1073.10	99.9	110.7	-10.8	973.20	962.40
GW-301	CRBAWP	1086.40	122.3	134.0	-11.7	964.10	952.40
GW-302	UNCS	1141.70	92.7	104.4	-11.7	1049.00	1037.30
GW-303	CRSDB	1007.20	84.7	88.5	-3.8	922.50	918.70
GW-304	CRSDB	1045.50	116.4	118.2	-1.8	929.10	927.30
GW-305	LIV	1183.60	115.5	124.9	-9.4	1068.10	1058.70
GW-322	CRSP	1134.30	136.0	159.2	-23.2	998.30	975.10
GW-339	UNCS	1124.60	64.9	77.7	-12.8	1059.70	1046.90
GW-511	CRSP	1093.20	81.9	108.5	-26.6	1011.30	984.70
GW-512	FCAP	1001.50	14.5	25.0	-10.5	987.00	976.50
GW-514	FCAP	1001.20	13.3	25.4	-12.1	987.90	975.80
GW-521	LIV	1182.70	80.7	85.9	-5.2	1102.00	1096.80
GW-522	LIV	1175.30	93.5	106.3	-12.8	1081.80	1069.00
GW-539	LII	1093.00	97.0	105.8	-8.8	996.00	987.20
GW-540	CDLVI	1072.10	74.6	82.1	-7.5	997.50	990.00
GW-541	CDLVI	1058.40	63.3	63.4	-0.1	995.10	995.00
GW-542	CDLVI	1051.60	69.6	70.8	-1.2	982.00	980.80
GW-543	CDLVI	1023.80	63.0	65.3	-2.3	960.80	958.50
GW-544	CDLVI	1045.00	63.4	67.2	-3.8	981.60	977.80
GW-546	CDLVI	1072.20	75.5	82.1	-6.6	996.70	990.10
GW-557	LV	1081.20	112.2	117.0	-4.8	969.00	964.20
GW-558	SSCR	983.97	37.5	48.8	-11.3	946.47	935.17
GW-559	SSCR	1102.80	128.4	136.0	-7.6	974.40	966.80
GW-560	CDLVII	948.85	34.8	41.5	-6.7	914.05	907.35
GW-562	CDLVII	934.49	NM	4.9	NA	NA	929.59
GW-564	CDLVII	937.77	6.3	10.7	-4.4	931.47	927.07
GW-608	CRSP	1074.00	116.6	135.7	-19.1	957.40	938.30
GW-609	CRSP	1112.10	164.2	170.6	-6.4	947.90	941.50
GW-610	CRSP	1059.40	81.0	89.9	-8.9	978.40	969.50
GW-611	CRSP	1048.40	98.3	106.3	-8.0	950.10	942.10
GW-612	CRSP	1131.00	118.6	126.3	-7.7	1012.40	1004.70

Table 2 (cont'd)

Well No.[1]	Location[2]	Measuring Point Elevation[3] (ft msl)	Depth-to-Water (ft below Top of Well Casing) March 31 - April 4, 1997	Depth-to-Water (ft below Top of Well Casing) October 6 - 9, 1997	Seasonal Fluctuation (+/- ft)	Water-Level Elevation (ft above mean sea level) March 31 - April 4, 1997	Water-Level Elevation (ft above mean sea level) October 6 - 9, 1997
GW-673	FCAP	882.01	7.1	9.9	-2.8	874.91	872.11
GW-674	FCAP	883.79	6.4	9.1	-2.7	877.39	874.69
GW-676	FCAP	846.50	2.8	6.0	-3.2	843.70	840.50
GW-677	FCAP	1030.40	24.6	28.4	-3.8	1005.80	1002.00
GW-679	FCAP	1026.90	46.9	52.8	-5.9	980.00	974.10
GW-709	LII	906.60	28.9	29.8	-0.9	877.70	876.80
GW-731	CRSDB	1049.20	123.2	124.8	-1.6	926.00	924.40
GW-732	CRSDB	1064.10	156.9	157.9	-1.0	907.20	906.20
GW-743	CRSP	1100.40	100.0	129.3	-29.3	1000.40	971.10
GW-757	LII	961.43	84.2	84.8	-0.6	877.25	876.63
GW-796	LV	1052.40	52.0	77.5	-25.5	1000.41	974.90
GW-797	LV	1059.80	66.2	70.5	-4.3	993.62	989.30
GW-798	CDLVII	1005.80	65.6	77.3	-11.7	940.18	928.50
GW-799	CDLVII	981.09	6.3	13.7	-7.4	974.76	967.39
GW-801	LV	1096.96	94.9	106.2	-11.3	1002.10	990.76
GW-827	CDLVI	1051.39	34.5	39.8	-5.3	1016.85	1011.59

Notes:

1 Wells sampled during CY 1997 are denoted with bold typeface and shading.

2 CDLVI = Construction/Demolition Landfill VI
CDLVII = Construction/Demolition Landfill VII
CRBAWP = Chestnut Ridge Borrow Area Waste Pile
CRSDB = Chestnut Ridge Sediment Disposal Basin
CRSP = Chestnut Ridge Security Pits
ECRWP = East Chestnut Ridge Waste Pile
FCAP = Filled Coal Ash Pond (formerly known as Ash Disposal Basin)
KHQ = Kerr Hollow Quarry
LII = Industrial Landfill II
LIV = Industrial Landfill IV
LV = Industrial Landfill V
ORSF = Oak Ridge Sludge Farm
RQ = Rogers Quarry
SSCR = South Side Chestnut Ridge
UNCS = United Nuclear Corporation Site

Table 2 (cont'd)

Notes: (cont'd)

3 Measuring point (top of well casing) elevation (ft above mean sea level) as reported in Jones et al. (1995).

4 NM = Not Measured
NA = Not Applicable

Table 3.
CY 1997 Sampling Dates for Monitoring Wells and Springs

Groundwater Monitoring Program[1]										
Sampling Point	Sampling Location[2]	Sampling Date[3] 1st Quarter	2nd Quarter	3rd Quarter	4th Quarter	DOE Order 5400.1 Monitoring	CERCLA Record of Decision Monitoring	SWDF Detection Monitoring	RCRA Post-Closure Detection Monitoring	RCRA Post-Closure Corrective Action Monitoring
1090	UNCS	.	04/16/97D	.	.		●			
GW-141	LIV	01/07/97D 02/27/97	.	07/23/97D	.			●		
GW-142	KHQ	.	04/29-05/01/97	08/04-07/97	11/10-14/97D				●	
GW-143	KHQ	.	04/28-05/01/97	08/04-07/97	11/10-13/97				●	
GW-144	KHQ	.	04/28-05/01/97D	08/04-07/97D	11/10-13/97				●	
GW-145	KHQ	.	04/28-05/01/97	08/04-07/97	11/10-13/97				●	
GW-156	CRSDB	.	04/21-24/97	.	10/20-28/97D				●	
GW-159	CRSDB	.	04/21-24/97	.	10/20-23/97				●	
GW-203	UNCS	.	04/14/97	.	.		●			
GW-205	UNCS	.	04/14/97	.	.		●			
GW-217	LIV	01/06/97	.	07/17/97	.			●		
GW-221	UNCS	.	04/15/97	.	.		●			
GW-231	KHQ	.	04/28-05/01/97	08/04-07/97	11/10 - 13/97D				●	
GW-301	CRBAWP	01/07/97	.	07/24/97	.					●
GW-302	UNCS	.	04/15/97	.	.		●			
GW-305	LIV	01/08/97	.	07/22/97	.			●		
GW-339	UNCS	.	04/15/97	.	.		●			
GW-521	LIV	01/07/97	.	07/21/97	.			●		●
GW-522	LIV	01/08/97	.	07/21/97	.			●		
GW-539	LII	.	04/02/97	.	10/16/97 12/04/97			●		
GW-542	CDLVI	.	04/01/97	.	DRY			●		
GW-543	CDLVI	.	04/01/97D	.	10/15/97			●		
GW-544	CDLVI	.	04/02/97	.	10/16/97			●		
GW-557	LV	01/08/97D	.	07/09/97	.			●		●
GW-560	CDLVII	01/15/97	.	07/14/97	.			●		
GW-562	CDLVII	01/15/97	.	07/14/97D	.			●		
GW-564	CDLVII	01/16/97D	.	07/15/97	.			●		
GW-609	CRSP	01/14/97	.	07/24/97	.					●
GW-709	LII	.	04/02/97	.	10/16/97			●		
GW-731	CRSDB	.	04/21-24/97D	.	10/20-23/97D				●	
GW-732	CRSDB	.	04/21-24/97	.	10/20-23/97				●	

Table 3 (cont'd)

Groundwater Monitoring Program[1]						DOE Order 5400.1 Monitoring	CERCLA Record of Decision Monitoring	SWDF Detection Monitoring	RCRA Post-Closure Detection Monitoring	RCRA Post-Closure Corrective Action Monitoring
Sampling Point	Sampling Location[2]	Sampling Date[3] 1st Quarter	2nd Quarter	3rd Quarter	4th Quarter					
GW-757	LII	.	04/03/97D	.	10/16/97			●		
GW-796	LV	01/09/97	.	07/10/97	.			●		●
GW-797	LV	01/09/97	.	07/09/97	.			●		
GW-798	CDLVII	01/16/97	.	07/15/97	.			●		●
GW-799	CDLVII	01/08/97	.	07/09/97	.			●		●
GW-801	LV	01/15/97	.	07/10/97D	.			●		●
GW-827	CDLVI	.	04/01/97	.	10/14/97D			●		
GW-831	FCAP	01/06/97	.	07/23/97	.					●
SCR2.2SP	EXP	01/16/97	.	07/31/97	.	●				
SCR4.3SP	CDLVII	01/15/97	.	07/14/97	.			●		
Outfall 301	KHQ	.	04/30/97	.	.		●			

Notes:

1 See Table 4 for the list of field measurements and laboratory analytes associated with each monitoring program.

2 CDLVI = Construction/Demolition Landfill VI
CDLVII = Construction/Demolition Landfill VII
CRBAWP = Chestnut Ridge Borrow Area Waste Pile
CRSDB = Chestnut Ridge Sediment Disposal Basin
CRSP = Chestnut Ridge Security Pits
EXP = Exit Pathway
FCAP = Filled Coal Ash Pond
KHQ = Kerr Hollow Quarry
LII = Industrial Landfill II
LIV = Industrial Landfill IV
LV = Industrial Landfill V
UNCS = United Nuclear Corporation Site

3 Shaded dates show samples that were collected with dedicated sampling equipment (Well Wizard™). All fourth quarter groundwater samples were collected using the low-flow minimal drawdown purging/sampling method.

"." = Not Sampled.
D = Duplicate sample collected on specified date.

Table 4.
Laboratory Analytes and Field Measurements for CY 1997 Groundwater and Surface Water Samples

GROUNDWATER MONITORING PROGRAM	Analytical Method[3]	RCRA Target List[4]	Sample Type[5] Filtered	Sample Type[5] Unfiltered	DOE Order 5400.1 Monitoring	CERCLA Record of Decision Monitoring[2]	SWDF Detection Monitoring	RCRA Post-Closure Detection Monitoring	RCRA Post-Closure Corrective Action Monitoring[1]
PRINCIPAL IONS									
Alkalinity - bicarbonate	EPA-310.1	.	.	●	●	●	●	●	●
Alkalinity - carbonate	EPA-310.1	.	.	●	●	●	●	●	●
Calcium	EPA-6010A	.	●	●	●	●	●	●	●
Chloride	EPA-300.0	.	.	●	●	●	●	●	●
Fluoride	EPA-340.2	.	.	●	●	●	●	●	●
Magnesium	EPA-6010A	.	●	●	●	●	●	●	●
Nitrate (as N)	EPA-300.0	.	.	●	●	●	●	●	●
Potassium	EPA-6010A	.	●	●	●	●	●	●	●
Sodium	EPA-6010A	.	●	●	●	●	●	●	●
Sulfate	EPA-300.0	.	.	●	●	●	●	●	●
TRACE METALS	Analytical Method[3]	RCRA Target List[4]	Sample Type[5] Filtered	Sample Type[5] Unfiltered					
Aluminum	EPA-6010A	.	●	●	●	●	●	●	●
Antimony	EPA-6010A	.	●	●	●	●	●	●	●
Arsenic	EPA-200.8	.	●	●	●	●	●	●	●
Barium	EPA-6010A	.	●	●	●	●	●	●	●
	EPA-200.8	.	.	●	.	●	.	.	.
Beryllium	EPA-6010A	.	●	●	●	●	●	●	●
	EPA-200.8	.	.	●	.	●	.	.	.
Boron	EPA-6010A	●	●	●	●	●	●	●	●
Cadmium	EPA-6010A	●	●	●	●	●	●	●	●
	EPA-200.8	.	.	●	.	●	.	.	.
Cerium	EPA-200.8	.	.	●	.	●	.	.	.
Chromium	EPA-6010A	●	●	●	●	●	●	●	●
	EPA-200.8	.	.	●	.	●	.	.	.
Cobalt	EPA-6010A	.	●	●	●	●	●	●	●
	EPA-200.8	.	.	●	.	●	.	.	.
Copper	EPA-6010A	.	●	●	●	●	●	●	●
	EPA-200.8	.	.	●	.	●	.	.	.
Gallium	EPA-200.8	.	.	●	.	●	.	.	.
Iron	EPA-6010A	.	●	●	●	●	●	●	●
Lead	EPA-200.8	●	●	●	●	●	●	●	●

Table 4 (cont'd)

GROUNDWATER MONITORING PROGRAM					DOE Order 5400.1 Monitoring	CERCLA Record of Decision Monitoring [2]	SWDF Detection Monitoring	RCRA Post-Closure Detection Monitoring	RCRA Post-Closure Corrective Action Monitoring [1]
TRACE METALS (cont'd)	Analytical Method [3]	RCRA Target List [4]	Sample Type [5] Filtered	Sample Type [5] Unfiltered					
Lithium	EPA-6010A	.	●	●	●	●	●	●	●
	EPA-200.8	.	.	●	.	●	.	.	.
Manganese	EPA-6010A	.	●	●	●	●	●	●	●
	EPA-200.8	.	.	●	.	●	.	.	.
Mercury	EPA-7470	●	●	●	●	●	●	●	●
Molybdenum	EPA-6010A	.	●	●	●	●	●	●	●
	EPA-200.8	.	.	●	.	●	.	.	.
Nickel	EPA-6010A	●	●	●	●	●	●	●	●
	EPA-200.8	.	.	●	.	●	.	.	.
Selenium	EPA-6010A	.	●	●	●	●	●	●	●
	EPA-200.8	.	.	●	.	●	.	.	.
Silver	EPA-6010A	●	●	●	●	●	●	●	●
	EPA-200.8	.	.	●	.	●	.	.	.
Strontium	EPA-6010A	●	●	●	●	●	●	●	●
	EPA-200.8	.	.	●	.	●	.	.	.
Thallium	EPA-200.8	.	●	●	●	●	●	●	●
Thorium	EPA-6010A	.	●	●	●	●	●	●	●
	EPA-200.8	.	.	●	.	●	.	.	.
Titanium	EPA-200.8	.	.	●	.	●	.	.	.
Uranium	EPA-200.8	●	●	●	●	●	●	●	●
Vanadium	EPA-6010A	.	●	●	●	●	●	●	●
Zinc	EPA-6010A	.	●	●	●	●	●	●	●
Zirconium	EPA-6010A	.	.	●	.	●	.	.	.
VOLATILE ORGANIC COMPOUNDS	Analytical Method [3]	RCRA Target List [4]	Sample Type [5] Filtered	Sample Type [5] Unfiltered					
Acetone	EPA-8260	.	.	●	●	●	●	●	●
Acrolein	EPA-8260	.	.	●	●	●	●	●	●
Acrylonitrile	EPA-8260	.	.	●	●	●	●	●	●
Benzene	EPA-8260	●	.	●	●	●	●	●	●
Bromochloromethane	EPA-8260	.	.	●	●	●	●	●	●
Bromodichloromethane	EPA-8260	.	.	●	●	●	●	●	●
Bromoform	EPA-8260	●	.	●	●	●	●	●	●
Bromomethane	EPA-8260	.	.	●	●	●	●	●	●

Table 4 (cont'd)

GROUNDWATER MONITORING PROGRAM / VOLATILE ORGANIC COMPOUNDS (cont'd)	Analytical Method [3]	RCRA Target List [4]	Sample Type [5]: Filtered	Sample Type [5]: Unfiltered	DOE Order 5400.1 Monitoring	CERCLA Record of Decision Monitoring [2]	SWDF Detection Monitoring	RCRA Post-Closure Detection Monitoring	RCRA Post-Closure Corrective Action Monitoring [1]
2-Butanone	EPA-8260	.	.	●	●	●	●	●	●
Carbon Disulfide	EPA-8260	.	.	●	●	●	●	●	●
Carbon Tetrachloride	EPA-8260	●	.	●	●	●	●	●	●
Chlorobenzene	EPA-8260	.	.	●	●	●	●	●	●
Chloroethane	EPA-8260	.	.	●	●	●	●	●	●
2-Chloroethyl vinyl ether	EPA-8260	.	.	●	●	●	●	●	●
Chloroform	EPA-8260	●	.	●	●	●	●	●	●
Chloromethane	EPA-8260	.	.	●	●	●	●	●	●
Dibromochloromethane	EPA-8260	.	.	●	●	●	●	●	●
1,2-Dibromo-3-chloropropane	EPA-8260	.	.	●	●	●	●	●	●
1,2-Dibromoethane	EPA-8260	.	.	●	●	●	●	●	●
Dibromomethane	EPA-8260	.	.	●	●	●	●	●	●
1,2-Dichlorobenzene	EPA-8260	.	.	●	●	●	●	●	●
1,4-Dichlorobenzene	EPA-8260	.	.	●	●	●	●	●	●
1,4-Dichloro-2-butene	EPA-8260	.	.	●	●	●	●	●	●
trans-1,4-Dichloro-2-butene	EPA-8260	.	.	●	●	●	●	●	●
Dichlorodifluoromethane	EPA-8260	.	.	●	●	●	●	●	●
1,1-Dichloroethane	EPA-8260	●	.	●	●	●	●	●	●
1,2-Dichloroethane	EPA-8260	●	.	●	●	●	●	●	●
1,1-Dichloroethene	EPA-8260	●	.	●	●	●	●	●	●
1,2-Dichloroethene	EPA-8260	●	.	●	●	●	●	●	●
cis-1,2-Dichloroethene	EPA-8260	.	.	●	●	●	●	●	●
trans-1,2-Dichloroethene	EPA-8260	●	.	●	●	●	●	●	●
1,2-Dichloropropane	EPA-8260	.	.	●	●	●	●	●	●
cis-1,3-Dichloropropene	EPA-8260	.	.	●	●	●	●	●	●
trans-1,3-Dichloropropene	EPA-8260	.	.	●	●	●	●	●	●
Dimethylbenzene	EPA-8260	.	.	●	●	●	●	●	●
Ethanol	EPA-8260	.	.	●	●	●	●	●	●
Ethylbenzene	EPA-8260	.	.	●	●	●	●	●	●
Ethyl methacrylate	EPA-8260	.	.	●	●	●	●	●	●
2-Hexanone	EPA-8260	.	.	●	●	●	●	●	●
Iodomethane	EPA-8260	.	.	●	●	●	●	●	●
4-Methyl-2-Pentanone	EPA-8260	.	.	●	●	●	●	●	●
Methylene Chloride	EPA-8260	.	.	●	●	●	●	●	●
Styrene	EPA-8260	.	.	●	●	●	●	●	●

Table 4 (cont'd)

GROUNDWATER MONITORING PROGRAM	Analytical Method [3]	RCRA Target List [4]	Sample Type [5]		DOE Order 5400.1 Monitoring	CERCLA Record of Decision Monitoring [2]	SWDF Detection Monitoring	RCRA Post-Closure Detection Monitoring	RCRA Post-Closure Corrective Action Monitoring [1]
VOLATILE ORGANIC COMPOUNDS (cont'd)	**Analytical Method [3]**	**RCRA Target List [4]**	**Filtered**	**Unfiltered**					
1,1,1,2-Tetrachloroethane	EPA-8260	.	.	●	●	●	●	●	●
1,1,2,2-Tetrachloroethane	EPA-8260	.	.	●	●	●	●	●	●
Tetrachloroethene	EPA-8260	●	.	●	●	●	●	●	●
Toluene	EPA-8260	.	.	●	●	●	●	●	●
1,1,1-Trichloroethane	EPA-8260	●	.	●	●	●	●	●	●
1,1,2-Trichloroethane	EPA-8260	.	.	●	●	●	●	●	●
Trichloroethene	EPA-8260	●	.	●	●	●	●	●	●
Trichlorofluoromethane	EPA-8260	.	.	●	●	●	●	●	●
1,2,3-Trichloropropane	EPA-8260	.	.	●	●	●	●	●	●
Vinyl Acetate	EPA-8260	.	.	●	●	●	●	●	●
Vinyl Chloride	EPA-8260	.	.	●	●	●	●	●	●
RADIOLOGICAL ANALYTES	**Analytical Method [3]**	**RCRA Target List [4]**	**Filtered**	**Unfiltered**					
Gross Alpha	EPA-900.0	●	.	●	●	●	●	●	●
Gross Beta	EPA-900.0	●	.	●	●	●	●	●	●
Americium-241	AC-MM-2-22012	.	.	●	.	●	.	.	●
Iodine-129	EPA-901.1	.	.	●	.	.	.	.	●
Neptunium-237	Y/P65-7206	.	.	●	.	●	.	.	●
Plutonium-238	AC-MM-2-22012	.	.	●	.	.	.	.	●
Plutonium-239/240	AC-MM-2-22012	.	.	●	.	.	.	.	●
Radium-223/224/226	Y/P65-7163	.	.	●	.	●	.	.	.
Radium-228	Y/P65-7165	.	.	●	.	●	.	.	.
Strontium- 89/90	EPA-905.0	.	.	●	.	●	.	.	●
Technetium-99	Y/P65-7154	.	.	●	.	●	.	.	●
Tritium	EPA-906.0	.	.	●	.	●	.	.	●
Thorium-(228,230,232,234)	Y/P65-7160	.	.	●	.	●	.	.	.
Uranium-(234,235,238)	AC-MM-2-22012	.	.	●	.	●	.	●	●
MISC. LABORATORY ANALYTES	**Analytical Method [3]**	**RCRA Target List [4]**	**Filtered**	**Unfiltered**					
pH	EPA-9040	.	.	●	●	●	●	●	●
Conductivity	EPA-9050	.	.	●	●	●	●	●	●
Total Dissolved Solids	EPA-160.1	.	.	●	●	●	●	●	●
Total Suspended Solids	EPA-160.2	.	.	●	●	●	●	●	●
Turbidity	EPA-180.1	.	.	●	●	●	●	●	●

Table 4 (cont'd)

GROUNDWATER MONITORING PROGRAM					DOE Order 5400.1 Monitoring	CERCLA Record of Decision Monitoring [2]	SWDF Detection Monitoring	RCRA Post-Closure Detection Monitoring	RCRA Post-Closure Corrective Action Monitoring [1]
FIELD MEASUREMENTS	Analytical Method [3]	RCRA Target List [4]	Sample Type [5]: Filtered	Sample Type [5]: Unfiltered					
Depth to Water	ESP 302-1	.	.	.	.	●	●	●	●
Water Temperature	ESP 307-1	.	.	●	●	●	●	●	●
pH	ESP 307-2	.	.	●	●	●	●	●	●
Conductivity	ESP 307-8	.	.	●	●	●	●	●	●
Dissolved Oxygen	ESP 307-5	.	.	●	●	●	●	●	●
Oxidation/Reduction Potential	ESP 307-5	.	.	●	●	●	●	●	●

Notes:

1 Only the groundwater samples collected from well GW-521 at Industrial Landfill IV were analyzed for radionuclides because this well also serves as a background well for the Bear Creek Hydrogeologic Regime. These radionuclides are required by the RCRA post-closure permit for the Bear Creek Hydrogeologic Regime (Permit No. TNHW-087). Gross alpha activity and gross beta activity are the only radiological analytes required by the RCRA post-closure permit for the Chestnut Ridge Hydrogeologic Regime (Permit No. TNHW-088).

2 Groundwater samples collected from wells at the United Nuclear Corporation Site (see Table 5) were analyzed for specified trace metals (unfiltered and filtered samples) using Inductively Coupled Plasma (ICP) Spectroscopy (EPA-6010A), all the specified principal ions and VOCs, gross alpha, gross beta, and strontium-89/90. Surface water samples collected from Outfall 301 at Kerr Hollow Quarry were analyzed only for specific trace metals (unfiltered samples only) using Plasma Mass Spectroscopy (EPA-200.8) and ICP to achieve very low detection limits, major cations, and radiological analytes.

3 Analytical/field methods and procedures from:

- *Test Methods for Evaluating Solid Waste Physical/Chemical Methods* (U.S. Environmental Protection Agency 1986)
- *Methods for Chemical Analysis of Water and Wastes* (U.S. Environmental Protection Agency 1983)
- *Environmental Surveillance Procedures Quality Control Program* (Martin Marietta Energy Systems, Inc. 1988)
- Lockheed Martin Energy Systems ASO radiological methods

4 Target compound required by the RCRA post-closure-permit (Permit No. TNHW-088), as specified individually for the Chestnut Ridge Sediment Disposal Basin, Kerr Hollow Quarry, and the Chestnut Ridge Security Pits.

5 Groundwater samples collected with a Bennett Pump™ or Well Wizard ™ were filtered in the field; groundwater samples collected with bailers were filtered in the laboratory.

Table 5.
Summary of VOC Results for CY 1997 QA/QC Samples

Compounds[1]	Number of Detected Results by Sample Type			
	Lab Blanks	Trip Blanks	Rinsates	Field Blanks
Groundwater Artifacts				
Acetone	17	34	10	1
2-Butanone	16	22	6	0
1,2-Dichloroethane	0	4	0	0
Dimethylbenzene	1	0	1	0
Ethylbenzene	2	0	0	0
2-Hexanone	2	1	1	0
Methylene chloride	5	10	1	0
Miscellaneous Compounds				
Acrolein	1	0	0	0
Acrylonitrile	1	0	1	0
Bromochloromethane	0	1	0	0
Bromoform	1	0	0	0
Chlorobenzene	1	0	0	0
1,2-Dibromo-3-chloropropane	0	0	1	0
1,4-Dichloro-2-butene	1	0	0	0
trans-1,4-Dichloro-2-butene	1	0	0	0
trans-1,2-Dichloroethene	1	0	0	0
Ethanol	1	0	1	0
Ethyl methacrylate	1	0	0	0
4-Methyl-2-pentanone	2	1	1	0
Styrene	1	0	0	0
1,1,2,2-Tetrachloroethane	1	0	0	0
Toluene	1	2	0	0
1,1,2-Trichloroethane	1	0	0	0
1,2,3-Trichloropropane	2	0	0	0
Plume Constituents				
Chloroform	0	18	11	2
1,2-Dichloroethene	1	0	0	0
cis-1,2-Dichloroethene	1	0	0	0
Tetrachloroethene	2	0	1	0
Total Number of Samples	**31**	**54**	**14**	**2**
Samples With VOCs[2]	**19**	**43**	**13**	**2**
Percent Contaminated	**61**	**80**	**93**	**100**

Table 5 (cont'd)

Notes:

1 Groundwater artifacts were commonly introduced into groundwater samples from the laboratory environment and screened as false positives.

Miscellaneous compounds were never detected in groundwater samples.

Plume constituents were commonly detected in groundwater samples from wells located downgradient of waste management sites.

2 Some samples had more than one compound detected.

APPENDIX C

SUMMARY OF CY 1997 DATA THAT MEET APPLICABLE DQOs

EXPLANATION

SAMPLING POINT:

SCR	-	Spring sampling location (south Chestnut Ridge)
OUTFALL301	-	Surface water outlet at Kerr Hollow Quarry

LOCATION:

CDLVI	-	Construction/Demolition Landfill VI
CDLVII	-	Construction/Demolition Landfill VII
CRBAWP	-	Chestnut Ridge Borrow Area Waste Pile
CRSDB	-	Chestnut Ridge Sediment Disposal Basin
CRSP	-	Chestnut Ridge Security Pits
EXP	-	Exit Pathway
FCAP	-	Filled Coal Ash Pond
KHQ	-	Kerr Hollow Quarry
LII	-	Industrial Landfill II
LIV	-	Industrial Landfill IV
LV	-	Industrial Landfill V
UNCS	-	United Nuclear Corporation Site

UNITS:

ft	-	feet (water-level elevation is in feet above mean sea level)
mg/L	-	milligrams per liter
ug/L	-	micrograms per liter
pCi/L	-	picoCuries per liter

DATA QUALIFIERS:

.	-	Not detected or not analyzed.
FLD DUP	-	Field Duplicate Sample differs by at least an order of magnitude.
TOT<DIS	-	Total concentration (unfiltered sample) is at least an order of magnitude less than the dissolved concentration (filtered sample).
FP	-	False-positive VOC result, screened by data from the associated laboratory blank (FP1) or trip blank (FP2) sample.
<MDA	-	Reported activity is less than the Minimum Detectable Activity.
<CE	-	Reported activity is greater than the MDA, but less than the associated counting error.

EXPLANATION (cont'd)

NOTES:

Only unfiltered results that meet data quality objectives of the Y-12 Plant Groundwater Protection Program for the constituents detected at least once in CY 1997 are presented in this appendix. All of the analytical results for groundwater and surface water samples collected in 1997 are available in the Annual Groundwater Monitoring Report (AJA Technical Services, Inc. 1998).

Miscellaneous:

TSS - Total Suspended Solids

Major Ions:

The relative percent difference (RPD) between summed positive and negative charges (Charge Balance) is used to evaluate the accuracy of the data. Results for major ions are considered qualitative if the Charge Balance RPD is greater than 20 or less than -20.

Trace Metals:

The Cluster Designation reflects a group (summarized below) based on similar geochemical characteristics assigned to each sampling location (HSW Environmental Consultants, Inc. 1995).

Cluster	Description
1	Shallow groundwater with variable calcium-magnesium-bicarbonate geochemistry.
2	Shallow calcium-magnesium-bicarbonate groundwater with very low TDS.
3	Shallow groundwater with fairly uniform calcium-magnesium-bicarbonate.
4	Calcium-magnesium bicarbonate groundwater with equal or nearly equal proportions of calcium and magnesium.
6	Intermediate depth sodium-bicarbonate groundwater.
10	Deep sodium-chloride bicarbonate groundwater with very high TDS.

Data for wells that comprise clusters 5, 7, 8, and 9 were excluded from upper tolerance level (UTL) calculations because groundwater from these wells had elevated nitrate concentrations and may include contamination from the S-3 Site metals plume. For comparison to UTLs, wells that comprise clusters 5, 7, 8, and 9 were assigned to one of the above clusters as a "surrogate" group based on selected well construction information and water quality data. The following table provides the UTLs that represent trace metal background levels for the wells in the clusters (1, 3, and 4) that apply to CY 1997 monitoring locations in the Chestnut Ridge Regime.

Trace Metal	Upper Tolerance Limit (mg/L)		
	Cluster 1	Cluster 3	Cluster 4
Aluminum	2.4	2.4	2.4
Antimony	0.05	0.05	0.05
Arsenic	0.05	0.05	0.05
Barium	0.71	0.79	0.34
Beryllium	0.00045	0.00045	0.00045
Boron	0.12	0.041	0.028
Cadmium	0.002	0.002	0.002
Chromium	0.029	0.041	0.029
Cobalt	0.019	0.019	0.019
Copper	0.012	0.012	0.012
Iron	8.7	8.7	4.6
Lead	0.0096	0.0096	0.0096
Manganese	1.7	1.7	0.13
Mercury	0.0003	0.0003	0.0003
Molybdenum	0.018	0.018	0.018
Nickel	0.06	0.02	0.02
Selenium	0.05	0.05	0.05
Silver	0.006	0.006	0.006
Strontium	4.4	0.92	0.079
Thorium	0.2	0.2	0.2
Uranium	0.012	0.005	0.005
Vanadium	0.005	0.005	0.005
Zinc	0.041	0.041	0.041

All metals analyses were performed using the inductively coupled plasma (ICP) spectroscopy method unless otherwise noted.

PMS - Plasma Mass Spectroscopy
CVAA - Cold Vapor Atomic Absorption

Organics:

Trans-1,2-dichloroethene (DCE) was not detected in any samples; therefore the cis-1,2-DCE equals the total 1,2-DCE concentration.

ND - Summed VOCs not determined (all results not detected).

APPENDIX C
Summary of CY 1997 Data That Meet Applicable DQOs

Sampling Point	1090	GW-141			GW-142					
Location	UNCS	LIV			KHQ					
Date Sampled	04/16/97	01/07/97	02/27/97	07/23/97	04/29/97	04/29/97	04/30/97	05/01/97	08/04/97	08/05/97
MISCELLANEOUS										
Water-Level Elevation	1055.23	1094.74	1094.60	1096.22	837.80	767.09	782.25	783.37	836.40	777.75
Water in Well (ft)	.	67.24	67.1	68.72	.	93.8	108.96	110.08	163.11	104.46
TSS (mg/L)	2	590	.	10.8	8	3	4	8	134	62
pH (Field)	7.6	6.8	6.9	7	7.8	7.8	7.9	7.6	7.6	7.7
MAJOR IONS (mg/L)										
CHARGE BALANCE (RPD)	-1.5	-5.6	100	1.1	.	-1.9	1	0.1	100	100
Calcium	57	77	46	49	46	45	45	46	45	49
Magnesium	33	47	28	31	31	31	31	31	31	34
Potassium	.	3.2	0.64	0.86	3.7	3.5	3.7	3.7	3.7	4
Sodium	12	0.97	0.95	0.97	0.87	0.9	0.85	0.88	1	0.99
Alkalinity-HCO3	264	238	.	234	240	248	240	236	.	.
Alkalinity-CO3	.	.	.	.	.	.	.	.	.	.
Chloride	28.1	1.76	.	1.25	1.37	1.24	1.12	1.21	.	.
Fluoride	.	.	.	.	0.62	0.63	0.63	0.62	.	.
Sulfate	4.93	3.25	.	3.05	5.49	5.31	4.85	5.62	.	.
Nitrate-N	0.958	0.669	.	0.62	0.06	0.48	0.594	0.805	.	.
METALS (mg/L)										
CLUSTER DESIGNATION	4	4	4	4	4	4	4	4	4	4
Aluminum	0.027	26	1.3	1.9	0.027	0.024	0.027	.	0.12	0.12
Arsenic (PMS)	.	0.0084	.	.	.	.	.	.	.	.
Barium	0.029	0.075	0.02	0.02	0.46	0.43	0.48	0.45	0.48	0.51
Beryllium	.	0.014	.	0.00053	.	.	.	.	.	.
Boron	.	0.0044	0.022	0.017	0.051	0.052	0.052	0.057	0.049	0.048
Chromium	.	0.022	.	.	.	.	.	.	0.014	.
Cobalt	.	0.01	.	.	.	.	.	.	0.0056	.
Copper	.	0.032	0.0092	.	0.0061	0.0087	0.01	0.023	0.077	0.034
Iron	0.02	15	0.69	1	5.5	2.5	4.3	1.4	32	32
Lead (PMS)	0.00096	0.075	0.0013	0.00097	0.0023	.	.	0.001	0.019	0.0073
Lithium	.	0.037	.	.	0.022	0.021	0.023	0.026	0.027	0.026
Manganese	0.0058	0.69	0.015	0.019	0.056	0.029	0.031	0.025	0.22	0.15
Mercury (CVAA)	.	0.00034	.	.	.	.	.	.	.	.
Molybdenum	.	.	.	.	.	.	.	.	.	.
Nickel	.	0.053	.	.	.	.	.	.	0.015	0.013
Strontium	0.025	0.031	0.018	0.02	0.52	0.52	0.57	0.69	0.55	0.58
Thallium (PMS)	.	0.0006	.	.	.	.	.	.	.	.
Uranium (PMS)	.	0.0014	.	.	0.02	0.021	0.017	0.021	0.014	0.024
Vanadium	.	0.064	.	.	.	.	.	.	.	.
Zinc	0.0034	0.59	0.032	0.031	0.0056	0.0097	0.0034	.	0.037	0.015
ORGANICS (ug/L)										
SUMMED VOCs	ND	ND	.	ND	2	2	ND	ND	.	.
Carbon tetrachloride	.	.	.	.	.	.	.	.	.	.
Chloroform	.	.	.	.	1	1	FP2	.	.	.
1,1-Dichloroethane	.	.	.	.	.	.	.	.	.	.
1,1-Dichloroethene	.	.	.	.	.	.	.	.	.	.
1,2-Dichloroethene	.	.	.	.	.	.	.	.	.	.
cis-1,2-Dichloroethene	.	.	.	.	.	.	.	.	.	.
Tetrachloroethene	.	.	.	.	1	1	.	.	.	.
1,1,1-Trichloroethane	.	.	.	.	.	.	.	.	.	.
Trichloroethene	.	.	.	.	.	.	.	.	.	.
Trichlorofluoromethane	.	.	.	.	.	.	.	.	.	.
RADIOACTIVITY (pCi/L)										
Gross Alpha	<MDA	17	<MDA	<MDA	10	15	15	11	.	.
Gross Beta	<MDA	35	<MDA	<MDA	<MDA	<MDA	<MDA	<MDA	.	.

(CONTINUED)

APPENDIX C
Summary of CY 1997 Data That Meet Applicable DQOs

Sampling Point	GW-142						GW-143			
Location	KHQ						KHQ			
Date Sampled	08/06/97	08/07/97	11/10/97	11/11/97	11/12/97	11/14/97	04/28/97	04/29/97	04/30/97	05/01/97
MISCELLANEOUS										
Water-Level Elevation	779.45	782.00	831.90	830.75	830.80	831.20	835.70	736.43	739.59	736.34
Water in Well (ft)	106.16	108.71	158.61	157.46	157.51	157.91	177.66	78.39	81.55	78.3
TSS (mg/L)	19.5	4	4	4	1	4	1	.	7	4
pH (Field)	7.4	7.5	7.7	7.6	7.7	7.7	8.2	7.9	7.9	7.8
MAJOR IONS (mg/L)										
CHARGE BALANCE (RPD)	100	100	0.6	-1	0.4	-1.4	-3.5	-3	-1.8	-1.5
Calcium	45	39	44	44	45	45	30	31	30	31
Magnesium	31	26	31	32	32	31	24	24	24	24
Potassium	3.8	3.1	4	4.1	4.3	4.2	17	17	17	17
Sodium	1	0.78	1	1.1	1.2	1	25	24	24	25
Alkalinity-HCO3	.	.	238	244	242	244	214	208	204	204
Alkalinity-CO3	.	.	.	.	.	.	.	.	.	.
Chloride	.	.	1.34	1.38	1.28	1.41	6.79	6.97	6.88	6.75
Fluoride	.	.	0.62	0.64	0.63	0.64	3.22	3.12	3.08	3.02
Sulfate	.	.	6.8	6.29	6.43	6.44	34.2	35.2	35.7	35.4
Nitrate-N	.	.	.	.	0.028	.	.	.	0.04	0.04
METALS (mg/L)										
CLUSTER DESIGNATION	4	4	4	4	4	4	1	1	1	1
Aluminum	0.021	0.035	.	.	.	.	0.027	0.049	0.045	0.041
Arsenic (PMS)	.	.	.	.	.	.	.	.	.	.
Barium	0.48	0.43	0.49	0.49	0.52	0.48	0.027	0.029	0.028	0.029
Beryllium	.	.	.	.	.	.	.	.	.	.
Boron	0.04	0.031	0.052	0.051	0.053	0.033	0.91	0.92	0.9	0.91
Chromium	.	.	.	.	.	.	.	.	.	.
Cobalt	.	.	.	.	.	.	.	.	.	.
Copper	0.0049	0.0044	.	.	0.006	.	.	0.01	.	.
Iron	2.2	5.6	5.1	2	1.9	2.5	1.1	0.69	0.26	0.34
Lead (PMS)	0.0011	0.00057	.	.	.	.	0.00059	.	.	.
Lithium	0.024	0.018	0.026	0.027	0.028	0.026	0.29	0.28	0.28	0.29
Manganese	0.035	0.047	0.079	0.072	0.071	0.071	0.028	0.013	0.0062	0.0091
Mercury (CVAA)	.	.	.	.	.	.	.	.	.	.
Molybdenum	.	.	.	.	.	.	.	.	.	.
Nickel	.	0.011	.	.	.	.	.	.	.	.
Strontium	0.54	0.49	0.59	0.6	0.6	0.58	2.6	2.6	2.6	2.6
Thallium (PMS)	.	.	.	.	.	.	.	.	.	.
Uranium (PMS)	0.017	0.014	0.0065	0.0055	0.0058	0.0059	0.00093	0.0023	0.002	0.0019
Vanadium	.	.	.	.	.	.	.	.	.	.
Zinc	0.011	0.011	0.0024	0.02	0.0035	.	0.0087	0.013	0.003	0.0025
ORGANICS (ug/L)										
SUMMED VOCs	.	.	ND	ND	ND	ND	1	2	2	2
Carbon tetrachloride	.	.	.	.	.	.	.	.	2	2
Chloroform	.	.	.	.	.	.	1	2	FP2	FP2
1,1-Dichloroethane	.	.	.	.	.	.	.	.	.	.
1,1-Dichloroethene	.	.	.	.	.	.	.	.	.	.
1,2-Dichloroethene	.	.	.	.	.	.	.	.	.	.
cis-1,2-Dichloroethene	.	.	.	.	.	.	.	.	.	.
Tetrachloroethene	.	.	.	.	.	FP1	.	.	.	.
1,1,1-Trichloroethane	.	.	.	.	.	.	.	.	.	.
Trichloroethene	.	.	.	.	.	.	.	.	.	.
Trichlorofluoromethane	.	.	.	.	.	.	.	.	.	.
RADIOACTIVITY (pCi/L)										
Gross Alpha	.	.	7.3	3.3	5.7	<MDA	<MDA	<MDA	5.5	3.2
Gross Beta	.	.	<MDA	<MDA	<MDA	<MDA	<MDA	<MDA	21	<MDA

(CONTINUED)

APPENDIX C
Summary of CY 1997 Data That Meet Applicable DQOs

Sampling Point	GW-143								GW-144	
Location	KHQ								KHQ	
Date Sampled	08/04/97	08/05/97	08/06/97	08/07/97	11/10/97	11/11/97	11/12/97	11/13/97	04/28/97	04/29/97
MISCELLANEOUS										
Water-Level Elevation	835.12	729.83	728.65	731.87	831.62	831.20	830.98	830.98	835.39	835.65
Water in Well (ft)	177.08	71.79	70.61	73.83	173.58	173.16	172.94	172.94	119.91	120.17
TSS (mg/L)	.	2.5	.	.	.	.	1	1	.	.
pH (Field)	7.1	7.7	7.8	7.4	8.5	8.3	8.3	8.3	7.8	7.9
MAJOR IONS (mg/L)										
CHARGE BALANCE (RPD)	100	100	100	100	-2.3	-4.1	-2.8	-3.3	-1.2	-2.5
Calcium	30	34	29	26	33	32	32	31	43	41
Magnesium	26	27	26	21	26	26	25	24	15	15
Potassium	19	18	18	14	18	19	19	18	1.7	1.5
Sodium	26	22	24	18	23	24	27	25	1.2	0.91
Alkalinity-HCO3	.	.	.	.	208	214	214	210	152	154
Alkalinity-CO3	.	.	.	.	.	.	.	.	.	.
Chloride	.	.	.	.	7	7.58	6.17	6.19	2.21	2
Fluoride	.	.	.	.	3.1	3.18	2.92	2.76	0.1	0.11
Sulfate	.	.	.	.	44.5	45.3	37.1	39.4	6.17	5.62
Nitrate-N	.	.	.	.	.	.	.	.	2.99	3.03
METALS (mg/L)										
CLUSTER DESIGNATION	1	1	1	1	1	1	1	1	4	4
Aluminum	0.026	0.031	.	.	.	0.036	.	0.024	0.039	0.029
Arsenic (PMS)	.	.	.	.	.	.	.	.	.	.
Barium	0.031	0.047	0.035	0.032	0.045	0.046	0.036	0.032	0.044	0.041
Beryllium	.	.	.	.	.	.	.	.	.	.
Boron	0.95	0.82	0.88	0.66	0.86	0.84	0.9	0.89	0.024	0.019
Chromium	.	.	.	.	.	.	.	.	.	.
Cobalt	.	.	.	.	.	.	.	.	.	.
Copper	.	.	.	.	.	.	.	.	0.014	.
Iron	0.79	1.3	0.31	0.11	0.57	0.4	0.97	1.1	0.0081	0.0059
Lead (PMS)	0.00068	.	.	.	.	.	.	.	.	.
Lithium	0.32	0.28	0.28	0.22	0.28	0.27	0.29	0.29	0.025	0.021
Manganese	0.022	0.01	0.0067	0.0043	0.023	0.022	0.041	0.045	.	.
Mercury (CVAA)	.	.	.	.	.	.	.	.	.	.
Molybdenum	.	.	.	.	.	.	.	.	.	.
Nickel	.	.	.	.	.	.	.	.	.	.
Strontium	2.8	3.5	2.9	2.5	3.2	3.1	2.9	2.8	0.097	0.074
Thallium (PMS)	.	.	.	.	.	.	.	.	.	.
Uranium (PMS)	0.0014	0.0016	0.0022	0.0016	0.0012	0.0013	0.001	0.001	0.0013	0.0013
Vanadium	.	.	.	.	.	.	.	.	.	.
Zinc	0.0022	0.0024	0.0024	0.0057	0.0032	0.0072	0.002	.	0.016	0.0039
ORGANICS (ug/L)										
SUMMED VOCs	.	.	.	.	3	ND	ND	ND	1	2
Carbon tetrachloride	.	.	.	.	.	.	.	.	.	2
Chloroform	.	.	.	.	.	.	.	.	1	FP2
1,1-Dichloroethane	.	.	.	.	.	.	.	.	.	.
1,1-Dichloroethene	.	.	.	.	.	.	.	.	.	.
1,2-Dichloroethene	.	.	.	.	.	.	.	.	.	.
cis-1,2-Dichloroethene	.	.	.	.	.	.	.	.	.	.
Tetrachloroethene	.	.	.	.	1	.	.	.	.	.
1,1,1-Trichloroethane	.	.	.	.	.	.	.	.	.	.
Trichloroethene	.	.	.	.	.	.	.	.	.	.
Trichlorofluoromethane	.	.	.	.	2	.	.	.	.	.
RADIOACTIVITY (pCi/L)										
Gross Alpha	.	.	.	.	5.7	<MDA	<MDA	3.3	<MDA	<MDA
Gross Beta	.	.	.	.	<MDA	16	16	44	<MDA	<MDA

(CONTINUED)

APPENDIX C
Summary of CY 1997 Data That Meet Applicable DQOs

Sampling Point	GW-144									
Location	KHQ									
Date Sampled	04/30/97	05/01/97	08/04/97	08/05/97	08/06/97	08/07/97	11/10/97	11/11/97	11/12/97	11/13/97
MISCELLANEOUS										
Water-Level Elevation	835.81	835.76	834.34	834.29	833.71	834.01	831.81	832.27	831.85	831.83
Water in Well (ft)	120.33	120.28	118.86	118.81	118.23	118.53	116.33	116.79	116.37	116.35
TSS (mg/L)	1	2	2	.	.	.	16	3	.	4
pH (Field)	7.9	7.8	7.6	7.6	7.6	7.5	7.62	7.56	7.42	7.36
MAJOR IONS (mg/L)										
CHARGE BALANCE (RPD)	-0.9	-2.7	100	100	100	100	-1.2	-2	1.1	0.6
Calcium	41	41	34	39	45	44	51	44	46	43
Magnesium	16	15	12	14	16	16	16	16	17	17
Potassium	1.3	1.4	1.3	1.6	1.6	1.4	1.6	1.5	1.6	1.4
Sodium	0.86	0.91	0.98	1	1.1	1.1	0.94	0.91	1	0.94
Alkalinity-HCO3	156	152	.	.	.	.	164	164	160	162
Alkalinity-CO3	.	.	.	.	.	.	.	.	.	.
Chloride	1.94	1.94	.	.	.	.	1.74	1.88	1.79	1.83
Fluoride	.	0.1	.	.	.	.	.	.	.	.
Sulfate	5.61	5.74	.	.	.	.	5.24	5.46	5.36	5.67
Nitrate-N	2.93	2.99	.	.	.	.	1.96	2.01	1.99	1.83
METALS (mg/L)										
CLUSTER DESIGNATION	4	4	4	4	4	4	4	4	4	4
Aluminum	0.042	0.043	.	.	0.026	0.034	.	0.026	0.046	0.038
Arsenic (PMS)	.	.	.	.	.	.	.	.	.	.
Barium	0.042	0.043	0.037	0.043	0.047	0.046	0.047	0.046	0.05	0.048
Beryllium	.	.	.	.	.	.	.	.	.	.
Boron	0.019	0.021	0.016	0.016	0.0099	0.0077	0.019	0.018	0.019	0.017
Chromium	.	.	.	.	.	.	.	.	.	.
Cobalt	.	.	.	.	.	.	.	.	.	.
Copper	.	.	.	.	.	.	.	.	.	.
Iron	0.013	0.0076	0.0078	.	0.011	0.0053	0.017	0.0063	0.012	0.0064
Lead (PMS)	.	.	.	0.00074	.	.	0.0016	.	.	.
Lithium	0.02	0.021	0.022	0.025	0.024	0.023	0.023	0.022	0.023	0.024
Manganese	.	.	.	.	.	.	0.0025	.	0.0024	.
Mercury (CVAA)	.	.	.	.	.	.	.	.	.	.
Molybdenum	.	.	.	.	.	.	.	.	.	.
Nickel	.	.	.	.	.	.	.	.	.	.
Strontium	0.072	0.075	0.083	0.082	0.084	0.083	0.093	0.08	0.083	0.077
Thallium (PMS)	.	.	.	.	.	.	.	.	.	.
Uranium (PMS)	0.0013	0.0013	0.0011	0.0013	0.0015	0.0015	0.0017	0.0018	0.0017	0.0016
Vanadium	.	.	.	.	.	.	.	.	.	.
Zinc	FLD DUP	0.0021	0.0024	0.0022	0.0036	0.0087	0.0034	0.0026	0.0035	.
ORGANICS (ug/L)										
SUMMED VOCs	3	1	.	.	.	.	ND	ND	ND	ND
Carbon tetrachloride	1	.	.	.	.	.	.	.	.	.
Chloroform	FP2	FP2	.	.	.	.	.	.	.	.
1,1-Dichloroethane	.	.	.	.	.	.	.	.	.	.
1,1-Dichloroethene	.	.	.	.	.	.	.	.	.	.
1,2-Dichloroethene	.	.	.	.	.	.	.	.	.	.
cis-1,2-Dichloroethene	.	.	.	.	.	.	.	.	.	.
Tetrachloroethene	2	1	.	.	.	.	.	.	.	.
1,1,1-Trichloroethane	.	.	.	.	.	.	.	.	.	.
Trichloroethene	.	.	.	.	.	.	.	.	.	.
Trichlorofluoromethane	.	.	.	.	.	.	.	.	.	.
RADIOACTIVITY (pCi/L)										
Gross Alpha	<MDA	<MDA	.	.	.	.	<MDA	4.2	<MDA	<MDA
Gross Beta	<MDA	<MDA	.	.	.	.	<MDA	<MDA	<MDA	<MDA

(CONTINUED)

Sampling Point	GW-145									
Location	KHQ									
Date Sampled	04/28/97	04/29/97	04/30/97	05/01/97	08/04/97	08/05/97	08/06/97	08/07/97	11/10/97	11/11/97
MISCELLANEOUS										
Water-Level Elevation	836.53	810.28	813.81	803.31	835.75	799.93	806.79	810.05	832.53	832.04
Water in Well (ft)	109.24	82.99	86.52	76.02	108.46	72.64	79.5	82.76	105.24	104.75
TSS (mg/L)	13	4	31	6	11	27	3.5	63	1	.
pH (Field)	7.9	8	8	7.9	7.8	7.7	7.7	7.4	7.8	7.77
MAJOR IONS (mg/L)										
CHARGE BALANCE (RPD)	-6	-1.6	-1.1	-2.8	100	100	100	100	-3.2	-2.8
Calcium	46	44	50	43	46	24	45	50	45	45
Magnesium	37	36	39	35	37	19	37	38	37	37
Potassium	12	11	12	11	13	6.2	12	11	12	13
Sodium	7.5	4.8	4.9	4.2	8.2	2.6	4.8	4.3	5.8	6.1
Alkalinity-HCO3	242	222	218	230	.	.	.	.	236	236
Alkalinity-CO3	.	.	.	.	.	.	.	.	.	.
Chloride	12	12.6	12.7	12.3	.	.	.	.	13.7	13.7
Fluoride	2.52	2.44	2.52	2.38	.	.	.	.	2.48	2.32
Sulfate	52.4	44.2	42.7	42	.	.	.	.	49.2	47
Nitrate-N	0.113	0.04	0.03	0.06	.	.	.	.	0.17	0.17
METALS (mg/L)										
CLUSTER DESIGNATION	1	1	1	1	1	1	1	1	1	1
Aluminum	0.39	0.03	0.56	0.047	0.064	0.21	0.076	0.39	.	.
Arsenic (PMS)	.	.	.	.	.	.	.	.	.	.
Barium	0.08	0.075	0.081	0.073	0.11	0.065	0.084	0.081	0.085	0.087
Beryllium	.	.	.	.	.	.	.	.	.	.
Boron	0.24	0.25	0.25	0.24	0.26	0.12	0.24	0.22	0.24	0.25
Chromium	.	.	.	.	.	0.011	.	.	.	.
Cobalt	.	.	.	.	.	.	.	.	.	.
Copper	0.0048	.	.	.	.	0.0058	.	.	.	.
Iron	0.23	0.037	0.46	0.055	0.047	0.26	0.065	0.34	0.018	0.0065
Lead (PMS)	0.0011	0.00083	0.0011	0.00092	0.00096	0.0018	0.0015	0.0011	0.0006	.
Lithium	0.097	0.097	0.1	0.096	0.11	0.056	0.1	0.093	0.1	0.1
Manganese	0.019	0.0099	0.03	0.016	0.0096	0.028	0.011	0.032	.	.
Mercury (CVAA)	.	.	.	.	.	.	.	.	.	.
Molybdenum	0.015	.	0.011	.	0.015	.	0.011	0.014	0.01	0.01
Nickel	.	.	.	.	.	.	.	.	.	.
Strontium	7	7.1	7.1	7	8.5	4.1	7.3	7	7.2	7.5
Thallium (PMS)	.	.	.	.	.	.	.	.	.	.
Uranium (PMS)	0.014	0.013	0.013	0.012	0.011	0.0055	0.013	0.012	0.012	0.011
Vanadium	.	.	.	.	.	.	.	.	.	.
Zinc	0.0086	.	0.023	.	0.0031	0.0098	0.0042	0.0089	0.0039	0.0027
ORGANICS (ug/L)										
SUMMED VOCs	8	ND	ND	ND	.	.	.	.	ND	ND
Carbon tetrachloride	.	.	.	.	.	.	.	.	.	.
Chloroform	3	.	.	.	.	.	.	.	.	.
1,1-Dichloroethane	.	.	.	.	.	.	.	.	.	.
1,1-Dichloroethene	2	.	.	.	.	.	.	.	.	.
1,2-Dichloroethene	.	.	.	.	.	.	.	.	.	.
cis-1,2-Dichloroethene	.	.	.	.	.	.	.	.	.	.
Tetrachloroethene	1	.	.	.	.	.	.	.	.	.
1,1,1-Trichloroethane	.	.	.	.	.	.	.	.	.	.
Trichloroethene	2	.	.	.	.	.	.	.	.	.
Trichlorofluoromethane	.	.	.	.	.	.	.	.	.	.
RADIOACTIVITY (pCi/L)										
Gross Alpha	16	16	9.7	8.7	.	.	.	.	12	8.7
Gross Beta	<MDA	<MDA	<MDA	22	.	.	.	.	<MDA	14

(CONTINUED)

APPENDIX C
Summary of CY 1997 Data That Meet Applicable DQOs

Sampling Point	GW-145		GW-156							
Location	KHQ		CRSDB							
Date Sampled	11/12/97	11/13/97	04/21/97	04/22/97	04/23/97	04/24/97	10/20/97	10/22/97	10/27/97	10/28/97
MISCELLANEOUS										
Water-Level Elevation	831.91	832.18	906.38	906.12	906.33	906.22	905.44	905.45	905.47	905.14
Water in Well (ft)	104.62	104.89	16.48	16.22	16.43	16.32	15.54	15.55	15.57	15.24
TSS (mg/L)	.	.	28	.	1	3	.	.	1	4
pH (Field)	7.71	7.81	7.3	7.6	7.5	7.5	7.3	7.3	6.9	7.3
MAJOR IONS (mg/L)										
CHARGE BALANCE (RPD)	-3.5	-4.9	0.1	7.1	3.7	-0.6	1.3	0.6	1.2	1.6
Calcium	46	43	210	70	69	66	69	68	66	69
Magnesium	37	35	120	43	43	39	41	41	40	42
Potassium	13	13	21	19	15	9.9	21	18	17	14
Sodium	6.4	6.1	5.4	5.4	4.3	2.9	6.2	5.1	4.4	3.6
Alkalinity-HCO3	234	238	366	344	340	340	346	346	340	332
Alkalinity-CO3	.	.	.	.	.	.	.	.	.	.
Chloride	13.3	13.4	3.2	0.88	2.06	2.24	2.68	2.38	2.2	2.13
Fluoride	2.2	2.58	.	.	.	.	.	.	.	.
Sulfate	47.9	51.5	11.6	7.22	7	6.21	9.28	8.32	7.91	6.45
Nitrate-N	0.17	0.17	0.395	0.352	0.36	0.31	0.48	0.34	0.34	0.32
METALS (mg/L)										
CLUSTER DESIGNATION	1	1	4	4	4	4	4	4	4	4
Aluminum	.	.	10	0.11	0.049	0.083	.	0.031	.	0.085
Arsenic (PMS)	.	.	0.012	.	.	.	.	.	.	.
Barium	0.091	0.087	0.062	0.042	0.037	0.026	0.035	0.031	0.028	0.027
Beryllium	.	.	0.00094	.	0.0012	.	.	.	.	.
Boron	0.25	0.23	0.066	0.056	0.042	0.022	0.013	0.018	0.01	0.011
Chromium	.	.	.	.	.	.	.	.	.	.
Cobalt	.	.	0.0073	.	.	.	.	.	.	.
Copper	.	.	0.029	0.008	.	.	.	.	.	.
Iron	.	.	12	0.056	0.033	0.091	.	0.021	0.043	0.11
Lead (PMS)	.	.	0.044	0.0025	0.0011	0.0016	.	0.0014	.	0.0009
Lithium	0.1	0.1	0.0081	.	.	.	0.0043	0.0064	0.0042	.
Manganese	.	.	0.28	0.0031	0.0017	0.0037	.	0.0019	.	0.0038
Mercury (CVAA)	.	.	.	.	.	.	.	.	.	.
Molybdenum	0.011	0.011	.	.	.	.	.	.	.	.
Nickel	.	.	0.027	.	.	.	.	.	.	.
Strontium	7.4	7	0.077	0.033	0.031	0.028	0.03	0.03	0.028	0.029
Thallium (PMS)	.	.	.	.	.	0.00066	.	.	.	.
Uranium (PMS)	0.012	0.012	0.0027	0.0021	0.002	0.0019	0.0023	0.0019	0.0017	0.0015
Vanadium	.	.	0.025	.	.	.	.	.	.	.
Zinc	0.0034	0.0031	0.18	0.018	0.0071	0.0077	0.0093	0.02	0.015	0.023
ORGANICS (ug/L)										
SUMMED VOCs	ND	ND	.	.	.	.	.	.	.	.
Carbon tetrachloride	.	.	.	.	.	.	.	.	.	.
Chloroform	.	.	.	.	.	.	.	.	.	.
1,1-Dichloroethane	.	.	.	.	.	.	.	.	.	.
1,1-Dichloroethene	.	.	.	.	.	.	.	.	.	.
1,2-Dichloroethene	.	.	.	.	.	.	.	.	.	.
cis-1,2-Dichloroethene	.	.	.	.	.	.	.	.	.	.
Tetrachloroethene	.	.	.	.	.	.	.	.	.	.
1,1,1-Trichloroethane	.	.	.	.	.	.	.	.	.	.
Trichloroethene	.	.	.	.	.	.	.	.	.	.
Trichlorofluoromethane	.	.	.	.	.	.	.	.	.	.
RADIOACTIVITY (pCi/L)										
Gross Alpha	11	12	.	.	.	.	.	.	.	.
Gross Beta	17	16	.	.	.	.	.	.	.	.

(CONTINUED)

Sampling Point	GW-159								GW-203	GW-205
Location	CRSDB								UNCS	UNCS
Date Sampled	04/21/97	04/22/97	04/23/97	04/24/97	10/20/97	10/21/97	10/22/97	10/23/97	04/14/97	04/14/97
MISCELLANEOUS										
Water-Level Elevation	934.46	911.43	906.82	907.00	933.08	931.93	930.91	931.00	1040.96	1039.93
Water in Well (ft)	42.66	19.63	15.02	15.2	41.28	40.13	39.11	39.2	94.66	102.43
TSS (mg/L)	1	36	2	3	.	.	1	.	.	34
pH (Field)	7.8	7.9	7.5	7.6	8	7.9	8.1	7.9	8.3	7.9
MAJOR IONS (mg/L)										
CHARGE BALANCE (RPD)	1.8	0.7	4.5	-2.1	1.1	0.6	1.1	2.2	-4.9	-2.9
Calcium	37	41	39	42	39	40	40	41	30	38
Magnesium	26	31	27	28	25	25	25	26	17	22
Potassium	2.6	3	2.3	2.1	1.8	1.7	1.7	1.8	.	.
Sodium	0.63	0.64	0.69	0.7	0.5	0.52	0.51	0.55	0.47	0.74
Alkalinity-HCO3	196	200	198	196	194	190	192	192	146	162
Alkalinity-CO3	.	.	.	.	.	.	.	.	.	.
Chloride	1.13	1.15	1	1.15	1.01	0.99	1	0.98	1.28	2.4
Fluoride	.	.	.	.	.	.	.	.	.	.
Sulfate	9.89	10.2	9.04	9.25	9.69	11.2	9.62	9.45	1.08	5
Nitrate-N	0.176	0.187	0.21	0.181	0.18	0.2	0.18	0.16	1.32	0.285
METALS (mg/L)										
CLUSTER DESIGNATION	4	4	4	4	4	4	4	4	4	4
Aluminum	0.12	0.18	0.089	0.18	.	.	.	.	0.026	0.43
Arsenic (PMS)	.	.	.	.	.	.	.	.	.	.
Barium	0.019	0.024	0.018	0.018	0.017	0.016	0.016	0.017	0.0075	0.02
Beryllium	.	.	0.00037	.	.	.	.	.	.	.
Boron	0.034	0.042	0.029	0.02	0.0067	0.0059	0.0061	0.0068	.	.
Chromium	.	.	.	.	.	.	.	.	.	.
Cobalt	.	.	.	.	.	.	.	.	.	.
Copper	.	.	0.0045	.	.	.	.	.	.	.
Iron	0.14	0.47	0.12	0.27	0.0072	0.0055	0.021	0.0088	0.015	1.7
Lead (PMS)	0.002	0.0021	0.0021	0.00096	.	.	.	.	0.00092	0.0056
Lithium	.	.	.	.	.	.	.	.	.	.
Manganese	0.0071	0.017	0.0076	0.012	.	.	.	.	0.0014	0.093
Mercury (CVAA)	.	.	.	.	.	.	.	.	.	.
Molybdenum	.	.	.	.	.	.	.	.	.	.
Nickel	.	.	.	.	.	.	.	.	.	.
Strontium	0.027	0.027	0.024	0.023	0.024	0.021	0.022	0.022	0.011	0.013
Thallium (PMS)	.	.	.	.	.	.	.	.	0.00062	.
Uranium (PMS)	0.0013	0.0011	0.0015	0.0014	0.0016	0.0015	0.0016	0.0013	.	0.00093
Vanadium	.	.	.	.	.	.	.	.	.	.
Zinc	0.0066	0.007	.	.	0.0025	.	.	0.004	.	0.0077
ORGANICS (ug/L)										
SUMMED VOCs	.	.	.	.	.	.	.	.	ND	ND
Carbon tetrachloride	.	.	.	.	.	.	.	.	.	.
Chloroform	.	.	.	.	.	.	.	.	.	.
1,1-Dichloroethane	.	.	.	.	.	.	.	.	.	.
1,1-Dichloroethene	.	.	.	.	.	.	.	.	.	.
1,2-Dichloroethene	.	.	.	.	.	.	.	.	.	.
cis-1,2-Dichloroethene	.	.	.	.	.	.	.	.	.	.
Tetrachloroethene	.	.	.	.	.	.	.	.	.	.
1,1,1-Trichloroethane	.	.	.	.	.	.	.	.	.	.
Trichloroethene	.	.	.	.	.	.	.	.	.	.
Trichlorofluoromethane	.	.	.	.	.	.	.	.	.	.
RADIOACTIVITY (pCi/L)										
Gross Alpha	.	.	.	.	.	.	.	.	<MDA	<MDA
Gross Beta	.	.	.	.	.	.	.	.	<MDA	<MDA

(CONTINUED)

APPENDIX C
Summary of CY 1997 Data That Meet Applicable DQOs

Sampling Point	GW-217		GW-221	GW-231						
Location	LIV		UNCS	KHQ						
Date Sampled	01/06/97	07/17/97	04/15/97	04/28/97	04/29/97	04/30/97	05/01/97	08/04/97	08/05/97	08/06/97
MISCELLANEOUS										
Water-Level Elevation	1072.15	1067.57	1039.54	837.23	837.53	837.73	837.77	835.99	835.82	835.62
Water in Well (ft)	77.85	73.27	94.14	25.33	25.63	25.83	25.87	24.09	23.92	23.72
TSS (mg/L)	21.5	4	.	.	.	.	1	.	.	.
pH (Field)	8	7.2	8	7.5	7.7	7.5	7.4	7.2	7.3	7.3
MAJOR IONS (mg/L)										
CHARGE BALANCE (RPD)	-5.4	0.4	-4.7	-6.7	-1.6	-0.9	-3	100	100	100
Calcium	31	30	30	36	36	35	35	40	39	39
Magnesium	19	19	18	18	18	18	18	20	20	20
Potassium	3.8	2.9	0.66	0.93	0.95	0.98	0.91	0.93	1	0.92
Sodium	4.7	4.9	0.51	0.74	0.71	0.66	0.68	0.81	0.86	0.79
Alkalinity-HCO3	172	166	162	178	160	158	162	.	.	.
Alkalinity-CO3	.	.	.	.	.	.	.	.	.	.
Chloride	2.24	2.01	1.35	1.7	1.64	1.7	1.6	.	.	.
Fluoride	.	.	.	.	.	.	.	.	.	.
Sulfate	7.84	6.42	1.26	3.88	3.97	3.54	3.81	.	.	.
Nitrate-N	0.409	0.39	0.628	0.933	0.974	0.866	0.963	.	.	.
METALS (mg/L)										
CLUSTER DESIGNATION	4	4	4	4	4	4	4	4	4	4
Aluminum	0.32	0.021	0.035	0.042	0.028	0.022	0.1	0.023	.	0.033
Arsenic (PMS)	.	.	.	.	.	.	.	.	.	.
Barium	0.027	0.027	0.0077	0.07	0.067	0.067	0.069	0.082	0.085	0.082
Beryllium	.	.	.	.	.	.	.	.	.	.
Boron	0.13	0.15	.	0.016	0.013	0.015	0.017	0.013	0.013	0.0075
Chromium	.	.	.	.	.	.	.	.	.	.
Cobalt	.	.	.	.	.	.	.	.	.	.
Copper	0.0086	.	.	0.0077	.	.	.	.	.	.
Iron	0.17	0.018	0.034	0.017	0.022	0.025	0.076	.	.	0.0082
Lead (PMS)	0.0013	.	0.0012	0.00072	.	.	TOT<DIS	.	.	.
Lithium	.	.	.	.	.	.	.	.	.	.
Manganese	0.0077	0.0011	.	0.0011	.	.	.	.	.	.
Mercury (CVAA)	.	.	.	.	.	.	.	.	.	.
Molybdenum	.	.	.	.	.	.	.	.	.	.
Nickel	.	.	.	.	.	.	.	.	.	.
Strontium	0.015	0.013	0.01	0.035	0.036	0.034	0.034	0.038	0.038	0.037
Thallium (PMS)	.	.	.	.	.	.	.	.	.	.
Uranium (PMS)	.	.	.	.	.	.	.	.	.	.
Vanadium	.	.	.	.	.	.	.	.	.	.
Zinc	0.038	0.013	.	0.011	0.024	.	0.0046	0.002	.	0.0075
ORGANICS (ug/L)										
SUMMED VOCs	ND	ND	ND	ND	ND	ND	ND	.	.	.
Carbon tetrachloride	.	.	.	.	.	.	.	.	.	.
Chloroform	.	.	.	.	.	.	.	.	.	.
1,1-Dichloroethane	.	.	.	.	.	.	.	.	.	.
1,1-Dichloroethene	.	.	.	.	.	.	.	.	.	.
1,2-Dichloroethene	.	.	.	.	.	.	.	.	.	.
cis-1,2-Dichloroethene	.	.	.	.	.	.	.	.	.	.
Tetrachloroethene	.	.	.	.	.	.	.	.	.	.
1,1,1-Trichloroethane	.	.	.	.	.	.	.	.	.	.
Trichloroethene	.	.	.	.	.	.	.	.	.	.
Trichlorofluoromethane	.	.	.	.	.	.	.	.	.	.
RADIOACTIVITY (pCi/L)										
Gross Alpha	<MDA	<MDA	<MDA	<MDA	<MDA	< CE	<MDA	.	.	.
Gross Beta	<MDA	<MDA	<MDA	<MDA	<MDA	<MDA	<MDA	.	.	.

(CONTINUED)

APPENDIX C
Summary of CY 1997 Data That Meet Applicable DQOs

Sampling Point	GW-231					GW-301		GW-302	GW-305	
Location	KHQ					CRBAWP		UNCS	LIV	
Date Sampled	08/07/97	11/10/97	11/11/97	11/12/97	11/13/97	01/07/97	07/24/97	04/15/97	01/08/97	07/22/97
MISCELLANEOUS										
Water-Level Elevation	835.42	832.49	832.47	832.44	832.41	960.44	959.54	1047.16	1068.70	1062.65
Water in Well (ft)	23.52	20.59	20.57	20.54	20.51	40.04	39.14	42.36	67.2	61.15
TSS (mg/L)	.	.	.	.	.	14	3	4	7	.
pH (Field)	7.2	7.6	7.7	7.6	7.3	6.5	7.8	7.5	7.8	7.9
MAJOR IONS (mg/L)										
CHARGE BALANCE (RPD)	100	-0.1	-0.9	-1.8	-0.7	-3.3	-3.3	-1.1	-5.6	-1
Calcium	39	47	45	46	46	35	32	51	28	28
Magnesium	20	24	23	24	23	23	20	31	17	18
Potassium	1.5	1.3	1.2	1.3	1.7	.	0.61	.	0.89	.
Sodium	0.78	0.88	0.82	0.9	0.82	0.47	0.66	9.9	1.2	1.2
Alkalinity-HCO3	.	216	214	212	212	182	170	240	148	146
Alkalinity-CO3	.	.	.	.	.	.	.	.	.	.
Chloride	.	1.7	1.71	1.62	1.65	0.88	0.93	25.5	2.26	1.96
Fluoride	.	.	.	.	.	.	.	.	.	.
Sulfate	.	4.03	3.96	3.83	3.95	2.52	2.09	3.47	1.1	0.78
Nitrate-N	.	0.1	0.13	0.12	0.11	0.398	0.34	0.983	0.287	0.27
METALS (mg/L)										
CLUSTER DESIGNATION	4	4	4	4	4	4	4	4	4	4
Aluminum	0.02	.	.	0.021	.	0.24	0.069	0.14	0.039	0.039
Arsenic (PMS)	.	.	.	.	.	.	.	.	.	.
Barium	0.08	0.091	0.094	0.098	0.091	0.021	0.019	0.023	0.0096	0.0091
Beryllium	.	.	.	.	.	.	.	.	.	.
Boron	0.0092	0.017	0.015	0.016	.	0.0089	0.0095	.	0.0049	0.019
Chromium	.	.	.	.	.	.	.	0.42	0.013	.
Cobalt	.	.	.	.	.	.	.	.	.	.
Copper	.	.	.	.	.	0.0083	.	.	.	.
Iron	.	0.014	.	0.011	0.0069	0.55	0.11	2	0.18	0.0085
Lead (PMS)	.	0.0089	.	.	0.0006	0.002	0.0023	0.0018	0.0013	.
Lithium	.	.	.	.	.	.	.	.	.	.
Manganese	.	0.044	0.03	0.029	0.033	0.017	0.0047	0.041	0.0097	.
Mercury (CVAA)	.	.	.	.	.	.	.	.	.	.
Molybdenum	.	.	.	.	.	.	.	.	.	.
Nickel	.	.	.	.	.	.	.	0.19	0.029	0.014
Strontium	0.037	0.044	0.042	0.043	0.043	0.02	0.018	0.019	0.013	0.012
Thallium (PMS)	.	.	.	.	.	.	.	.	.	.
Uranium (PMS)	.	.	.	.	.	.	.	.	.	.
Vanadium	.	.	.	.	.	.	.	.	.	.
Zinc	0.0084	0.0027	.	0.0025	.	0.04	0.0029	0.0027	0.023	0.013
ORGANICS (ug/L)										
SUMMED VOCs	.	ND	ND	ND	ND	ND	1	ND	15	20
Carbon tetrachloride	.	.	.	.	.	.	.	.	.	.
Chloroform	.	.	.	.	.	.	1	.	.	.
1,1-Dichloroethane	.	.	.	.	.	.	.	.	2	3
1,1-Dichloroethene	.	.	.	.	.	.	.	.	1	2
1,2-Dichloroethene	.	.	.	.	.	.	.	.	.	.
cis-1,2-Dichloroethene	.	.	.	.	.	.	.	.	.	.
Tetrachloroethene	.	.	.	.	.	.	.	.	.	.
1,1,1-Trichloroethane	.	.	.	.	.	.	.	.	12	15
Trichloroethene	.	.	.	.	.	.	.	.	.	.
Trichlorofluoromethane	.	.	.	.	.	.	.	.	.	.
RADIOACTIVITY (pCi/L)										
Gross Alpha	.	<MDA	<MDA	<MDA	4.3	<MDA	<MDA	<MDA	<MDA	2.1
Gross Beta	.	<MDA	<MDA	<MDA	<MDA	<MDA	<MDA	<MDA	<MDA	<MDA

(CONTINUED)

APPENDIX C
Summary of CY 1997 Data That Meet Applicable DQOs

Sampling Point	GW-339	GW-521		GW-522		GW-539			GW-542	GW-543
Location	UNCS	LIV		LIV		LII			CDLVI	CDLVI
Date Sampled	04/15/97	01/07/97	07/21/97	01/08/97	07/21/97	04/02/97	10/16/97	12/04/97	04/01/97	04/01/97
MISCELLANEOUS										
Water-Level Elevation	1055.60	1102.16	1100.61	1081.80	1074.89	996.00	986.18	986.95	982.26	960.69
Water in Well (ft)	47.4	58.66	57.11	105.1	98.19	61.6	51.78	52.55	9.76	33.09
TSS (mg/L)	.	.	.	63	18	4	.	.	6	.
pH (Field)	7.8	7.7	7.5	7.5	7.3	7.3	8.5	7.9	6.9	7.6
MAJOR IONS (mg/L)										
CHARGE BALANCE (RPD)	-4.4	-5.6	-2.2	-3.7	-2.6	-1.7	-1.8	77.6	1.6	-0.7
Calcium	56	29	27	39	33	37	36	35	27	46
Magnesium	32	18	18	23	20	22	22	21	12	27
Potassium	0.63	1	0.69	1.4	0.79	1	1.4	1.9	2.3	0.76
Sodium	12	0.73	0.86	0.46	0.49	2.3	2.6	2.4	1.1	0.93
Alkalinity-HCO3	278	158	146	144	136	166	160	.	114	240
Alkalinity-CO3	.	.	.	.	.	.	.	.	.	.
Chloride	27.5	1.3	1.18	1.89	1.31	14.6	12.5	9.95	1.13	2.15
Fluoride	.	.	.	.	.	.	.	.	.	.
Sulfate	4.59	1.41	1.06	0.56	0.53	6.6	7.75	7	5.32	3.73
Nitrate-N	0.928	0.251	0.2	0.497	0.4	0.508	0.55	0.51	0.271	0.255
METALS (mg/L)										
CLUSTER DESIGNATION	4	4	4	4	4	4	4	4	4	4
Aluminum	.	0.031	0.13	0.85	0.39	0.044	.	.	0.31	0.077
Arsenic (PMS)	.	.	.	.	.	.	.	.	.	.
Barium	0.019	0.0076	0.0075	0.0081	0.0088	0.013	0.0099	0.01	0.018	0.0097
Beryllium	.	.	.	0.00047	.	.	.	.	.	.
Boron	.	.	0.013	0.0041	0.018	0.011	0.012	.	0.017	0.02
Chromium	0.033	.	.	.	.	.	.	.	.	.
Cobalt	.	.	.	.	.	.	.	.	.	.
Copper	.	.	.	.	.	0.006	.	0.0046	0.0041	.
Iron	0.18	.	0.1	0.48	0.35	0.26	0.049	0.021	0.34	0.099
Lead (PMS)	0.00068	0.00054	.	0.0055	0.00096	0.00094	.	.	0.00082	.
Lithium	.	.	.	.	.	.	.	.	.	.
Manganese	0.0077	.	0.0029	0.023	0.011	0.006	0.0013	.	0.11	0.0017
Mercury (CVAA)	.	.	.	.	.	.	.	.	.	.
Molybdenum	.	.	.	.	.	.	.	.	.	.
Nickel	0.055	.	.	.	.	0.1	0.17	0.17	.	.
Strontium	0.023	0.0099	0.01	0.013	0.012	0.022	0.02	0.019	0.033	0.024
Thallium (PMS)	.	.	.	.	.	0.0005	.	.	.	.
Uranium (PMS)	.	.	.	.	.	0.00051	.	.	.	.
Vanadium	.	.	.	.	.	.	.	.	.	.
Zinc	0.0052	0.003	0.0086	0.034	0.02	0.015	0.0034	0.0072	0.023	0.012
ORGANICS (ug/L)										
SUMMED VOCs	ND	ND	ND	ND	ND	ND	ND	.	ND	ND
Carbon tetrachloride	.	.	.	.	.	.	.	.	.	.
Chloroform	.	.	.	.	.	.	.	.	.	.
1,1-Dichloroethane	.	.	.	.	.	.	.	.	.	.
1,1-Dichloroethene	.	.	.	.	.	.	.	.	.	.
1,2-Dichloroethene	.	.	.	.	.	.	.	.	.	.
cis-1,2-Dichloroethene	.	.	.	.	.	.	.	.	.	.
Tetrachloroethene	.	.	.	.	.	.	.	.	.	.
1,1,1-Trichloroethane	.	.	.	.	.	.	.	.	.	.
Trichloroethene	.	.	.	.	.	.	.	.	.	.
Trichlorofluoromethane	.	.	.	.	.	.	.	.	.	.
RADIOACTIVITY (pCi/L)										
Gross Alpha	<MDA	<MDA	<MDA	<MDA	<MDA	<MDA	<MDA	.	<MDA	<MDA
Gross Beta	<MDA	<MDA	<MDA	<MDA	<MDA	<MDA	<MDA	.	<MDA	<MDA

(CONTINUED)

APPENDIX C
Summary of CY 1997 Data That Meet Applicable DQOs

Sampling Point	GW-543	GW-544		GW-557		GW-560		GW-562		GW-564
Location	CDLVI	CDLVI		LV		CDLVII		CDLVII		CDLVII
Date Sampled	10/15/97	04/02/97	10/16/97	01/08/97	07/09/97	01/15/97	07/14/97	01/15/97	07/14/97	01/16/97
MISCELLANEOUS										
Water-Level Elevation	958.31	981.33	977.64	964.69	968.23	903.68	901.87	932.92	933.49	930.20
Water in Well (ft)	30.71	48.13	44.44	24.09	27.63	36.51	34.7	61.06	61.63	76.08
TSS (mg/L)	.	.	.	.	1.2	.	.	1	6	.
pH (Field)	7.2	7.6	7.8	7.5	7.1	7.8	4.3	7.9	3.9	6.9
MAJOR IONS (mg/L)										
CHARGE BALANCE (RPD)	-1.8	-2.8	-1.5	-3.3	1.1	-6.1	-1.3	-4.3	2.1	-7.4
Calcium	42	47	48	36	38	34	38	37	41	28
Magnesium	25	28	28	20	22	14	15	21	24	13
Potassium	1.4	1	1.5	1.3	1.4	1.9	1.3	0.96	.	1.9
Sodium	1.1	4.6	4.9	0.56	0.54	0.48	0.46	0.64	0.68	0.54
Alkalinity-HCO3	218	226	220	178	176	160	160	192	190	132
Alkalinity-CO3	.	.	.	.	.	.	.	.	.	.
Chloride	1.68	13.6	11.6	1.39	1.13	1.13	0.92	1.75	1.61	1.16
Fluoride	.	.	.	.	.	.	.	.	.	.
Sulfate	5.23	10.3	10.6	1.57	1.43	2.22	1.85	2.08	1.74	1.14
Nitrate-N	0.27	0.709	0.87	0.985	0.69	0.14	0.13	0.384	0.34	0.377
METALS (mg/L)										
CLUSTER DESIGNATION	4	4	4	4	4	4	4	4	4	4
Aluminum	0.025	0.037	.	0.038	0.076	0.048	0.028	0.19	0.08	0.093
Arsenic (PMS)	.	.	.	.	.	.	.	.	.	.
Barium	0.0092	0.0096	0.01	0.011	0.011	0.21	0.23	0.012	0.011	0.012
Beryllium	.	.	.	.	.	.	.	.	.	.
Boron	0.014	0.016	0.014	0.013	0.0095	.	0.0082	0.0054	0.011	0.005
Chromium	.	.	.	.	.	.	.	.	.	.
Cobalt	.	.	.	.	.	.	.	.	.	.
Copper	.	.	.	0.0052	.	.	0.0042	.	.	0.0042
Iron	0.014	0.16	0.012	0.045	0.13	0.012	0.016	0.24	0.076	0.045
Lead (PMS)	.	0.00051	.	.	0.0033	0.0006	0.001	0.00088	.	0.00084
Lithium	.	.	.	.	.	.	.	.	.	.
Manganese	.	0.0043	.	.	.	.	.	0.0066	0.0067	.
Mercury (CVAA)	.	.	.	.	.	.	.	.	.	.
Molybdenum	.	.	.	.	.	.	.	.	.	.
Nickel	.	.	.	.	.	.	.	.	.	.
Strontium	0.023	0.024	0.023	0.017	0.017	0.022	0.025	0.018	0.02	0.017
Thallium (PMS)	.	.	.	.	0.00087	.	.	.	.	.
Uranium (PMS)	.	0.00076	0.0006	.	.	.	.	.	.	.
Vanadium	.	.	.	.	.	.	.	.	.	.
Zinc	0.0099	0.03	0.0077	0.017	0.0068	0.019	0.046	0.012	0.0051	0.021
ORGANICS (ug/L)										
SUMMED VOCs	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
Carbon tetrachloride	.	.	.	.	.	.	.	.	.	.
Chloroform	.	.	.	.	.	.	.	.	.	.
1,1-Dichloroethane	.	.	.	.	.	.	.	.	.	.
1,1-Dichloroethene	.	.	.	.	.	.	.	.	.	.
1,2-Dichloroethene	.	.	.	.	.	.	.	.	.	.
cis-1,2-Dichloroethene	.	.	.	.	.	.	.	.	.	.
Tetrachloroethene	.	.	.	.	.	.	.	.	.	.
1,1,1-Trichloroethane	.	.	.	.	.	.	.	.	.	.
Trichloroethene	.	.	.	.	.	.	.	.	.	.
Trichlorofluoromethane	.	.	.	.	.	.	.	.	.	.
RADIOACTIVITY (pCi/L)										
Gross Alpha	<MDA	2.9	<MDA	<MDA	<MDA	<MDA	2.5	<MDA	1.4	<MDA
Gross Beta	<MDA	<MDA	<MDA	<MDA	<MDA	<MDA	<MDA	<MDA	<MDA	<MDA

(CONTINUED)

APPENDIX C
Summary of CY 1997 Data That Meet Applicable DQOs

Sampling Point	GW-564	GW-609		GW-709		GW-731				
Location	CDLVII	CRSP		LII		CRSDB				
Date Sampled	07/15/97	01/14/97	07/24/97	04/02/97	10/16/97	04/21/97	04/22/97	04/23/97	04/24/97	10/20/97
MISCELLANEOUS										
Water-Level Elevation	929.33	950.90	948.34	877.60	876.80	925.50	927.20	926.05	925.85	924.33
Water in Well (ft)	75.21	110.2	107.64	54.36	53.56	58.4	60.1	58.95	58.75	57.23
TSS (mg/L)	.	.	.	.	.	3	4	3	10	.
pH (Field)	7.2	7.6	6.5	8.5	9.6	8.4	8.4	8.4	8.4	10
MAJOR IONS (mg/L)										
CHARGE BALANCE (RPD)	0.4	-1.1	-0.7	-1	-0.4	-0.6	-6	-3.8	-2.8	3.9
Calcium	33	38	42	37	10	25	25	25	30	12
Magnesium	15	24	25	23	28	15	15	14	17	17
Potassium	1.2	1	0.81	0.79	1	2.9	3.2	3.1	3.7	36
Sodium	0.53	0.55	0.75	0.48	0.65	1.8	1.8	1.5	2	6.6
Alkalinity-HCO3	142	206	202	178	102	134	132	128	130	92
Alkalinity-CO3	.	.	.	.	40	.	.	.	.	52
Chloride	1.11	1.73	1.6	1.74	1.59	0.94	0.98	0.6	0.872	0.96
Fluoride	.	.	.	.	.	.	.	.	.	.
Sulfate	0.9	2.89	2.22	2.44	2.42	4.68	4.64	4.68	4.39	4.36
Nitrate-N	0.41	1.3	1.2	0.153	0.15	0.235	0.239	0.23	0.23	0.21
METALS (mg/L)										
CLUSTER DESIGNATION	4	4	4	4	4	4	4	4	4	4
Aluminum	0.025	0.037	.	0.045	0.025	0.057	0.088	0.1	0.067	.
Arsenic (PMS)	.	.	.	.	.	.	.	.	.	.
Barium	0.012	0.012	0.012	0.27	0.19	0.0074	0.0082	0.0085	0.011	0.0033
Beryllium	.	.	.	.	.	.	.	.	.	.
Boron	0.011	0.0073	0.013	0.014	0.015	0.035	0.033	0.0093	0.021	0.0041
Chromium	.	.	.	.	.	.	.	.	.	.
Cobalt	.	.	.	.	.	.	.	.	.	.
Copper	.	.	.	.	.	.	.	.	0.0048	.
Iron	0.014	0.02	0.012	0.071	0.0086	0.029	0.03	0.039	0.074	0.0068
Lead (PMS)	.	.	0.0019	.	.	0.0027	0.0016	0.0031	0.0009	0.0009
Lithium	.	.	.	.	.	.	.	.	.	0.035
Manganese	.	.	.	0.0015	.	0.0049	0.0016	0.0026	0.0033	.
Mercury (CVAA)	.	.	.	.	.	.	.	.	.	.
Molybdenum	.	.	.	.	.	.	.	.	.	.
Nickel	.	.	.	.	.	.	.	.	.	.
Strontium	0.02	0.013	0.015	0.033	0.018	0.021	0.027	0.026	0.033	0.0054
Thallium (PMS)	.	.	.	.	.	.	.	.	.	.
Uranium (PMS)	.	.	.	.	.	.	.	0.00054	.	.
Vanadium	.	.	.	.	.	.	.	.	.	.
Zinc	0.016	0.01	0.0049	0.0063	0.0028	0.0081	0.0031	.	0.0041	0.0026
ORGANICS (ug/L)										
SUMMED VOCs	ND	28	28	ND	ND	.	.	.	.	.
Carbon tetrachloride	.	.	.	.	.	.	.	.	.	.
Chloroform	.	.	.	.	.	.	.	.	.	.
1,1-Dichloroethane	.	.	.	.	.	.	.	.	.	.
1,1-Dichloroethene	.	.	.	.	.	.	.	.	.	.
1,2-Dichloroethene	.	9	10	.	.	.	.	.	.	.
cis-1,2-Dichloroethene	.	9	10	.	.	.	.	.	.	.
Tetrachloroethene	.	13	12	.	.	.	.	.	.	.
1,1,1-Trichloroethane	.	.	.	.	.	.	.	.	.	.
Trichloroethene	.	1	1	.	.	.	.	.	.	.
Trichlorofluoromethane	.	5	5	.	.	.	.	.	.	.
RADIOACTIVITY (pCi/L)										
Gross Alpha	<MDA	<MDA	2.7	<MDA	<MDA	.	.	.	.	.
Gross Beta	<MDA	<MDA	<MDA	<MDA	<MDA	.	.	.	.	.

(CONTINUED)

Sampling Point	GW-731			GW-732						
Location	CRSDB			CRSDB						
Date Sampled	10/21/97	10/22/97	10/23/97	04/21/97	04/22/97	04/23/97	04/24/97	10/20/97	10/21/97	10/22/97
MISCELLANEOUS										
Water-Level Elevation	924.22	924.23	924.29	907.30	909.60	908.35	907.50	906.25	910.80	906.25
Water in Well (ft)	57.12	57.13	57.19	36.6	38.9	37.65	36.8	35.55	40.1	35.55
TSS (mg/L)	.	.	2	86	10	10	8	391	134	72
pH (Field)	10.1	10	9.9	8.3	7.5	7.6	7.4	8.9	10.7	8.9
MAJOR IONS (mg/L)										
CHARGE BALANCE (RPD)	-2.8	1	4.4	-0.8	-1.3	-1.3	-2.9	0.5	-8.8	-3.5
Calcium	11	11	12	31	33	32	35	35	34	27
Magnesium	17	18	18	19	21	20	22	16	12	18
Potassium	38	36	32	2.4	1.4	1.2	2	10	19	6.4
Sodium	7	6.7	6	3.1	0.98	1.1	1.3	18	16	9.5
Alkalinity-HCO3	88	94	96	162	174	168	168	108	58	132
Alkalinity-CO3	72	56	48	.	.	.	.	20	96	16
Chloride	1.04	1.02	0.98	0.84	0.82	0.91	0.873	0.77	0.99	0.83
Fluoride	.	.	.	.	.	.	.	.	.	.
Sulfate	4.45	4.47	4.22	2.61	1.58	1.53	1.47	4.74	4.47	3.47
Nitrate-N	0.21	0.21	0.2	0.262	0.203	0.2	0.206	0.41	0.39	0.33
METALS (mg/L)										
CLUSTER DESIGNATION	4	4	4	4	4	4	4	4	4	4
Aluminum	.	.	.	1	0.42	0.79	0.11	4.9	1.8	7.1
Arsenic (PMS)	.	.	.	.	.	.	.	.	.	.
Barium	0.0045	0.0029	0.0036	0.027	0.014	0.015	0.016	0.098	0.11	0.043
Beryllium	.	.	.	.	.	.	.	0.00079	0.00043	.
Boron	.	.	0.0043	0.02	0.053	0.01	0.021	0.0042	.	0.017
Chromium	.	.	.	.	.	.	.	.	.	.
Cobalt	.	.	.	.	.	.	.	.	.	.
Copper	.	.	.	.	.	.	.	.	.	.
Iron	0.14	0.02	0.065	0.54	0.2	0.24	0.041	1.4	0.52	1.7
Lead (PMS)	.	.	.	0.0044	0.002	0.0016	0.0009	0.0064	0.004	0.0026
Lithium	0.036	0.036	0.032	.	.	.	.	0.018	0.032	0.012
Manganese	.	.	.	0.0077	0.0023	0.0017	0.0015	0.014	0.0054	0.0057
Mercury (CVAA)	.	.	.	.	.	.	.	.	.	.
Molybdenum	.	.	.	.	.	.	.	.	.	.
Nickel	.	.	.	.	.	.	.	.	.	.
Strontium	0.0051	0.0047	0.0054	0.063	0.025	0.029	0.027	0.23	0.22	0.11
Thallium (PMS)	.	.	.	.	.	.	.	.	.	.
Uranium (PMS)	.	.	.	0.0018	.	.	.	0.0054	0.0023	0.0025
Vanadium	.	.	.	.	.	.	.	.	.	.
Zinc	0.0033	0.0021	.	0.011	0.0044	.	0.0049	0.0071	0.0036	0.0041
ORGANICS (ug/L)										
SUMMED VOCs	.	.	.	.	.	.	.	.	.	.
Carbon tetrachloride	.	.	.	.	.	.	.	.	.	.
Chloroform	.	.	.	.	.	.	.	.	.	.
1,1-Dichloroethane	.	.	.	.	.	.	.	.	.	.
1,1-Dichloroethene	.	.	.	.	.	.	.	.	.	.
1,2-Dichloroethene	.	.	.	.	.	.	.	.	.	.
cis-1,2-Dichloroethene	.	.	.	.	.	.	.	.	.	.
Tetrachloroethene	.	.	.	.	.	.	.	.	.	.
1,1,1-Trichloroethane	.	.	.	.	.	.	.	.	.	.
Trichloroethene	.	.	.	.	.	.	.	.	.	.
Trichlorofluoromethane	.	.	.	.	.	.	.	.	.	.
RADIOACTIVITY (pCi/L)										
Gross Alpha	.	.	.	.	.	.	.	.	.	.
Gross Beta	.	.	.	.	.	.	.	.	.	.

(CONTINUED)

APPENDIX C
Summary of CY 1997 Data That Meet Applicable DQOs

Sampling Point	GW-732	GW-757		GW-796		GW-797		GW-798		GW-799
Location	CRSDB	LII		LV		LV		CDLVII		CDLVII
Date Sampled	10/23/97	04/03/97	10/16/97	01/09/97	07/10/97	01/09/97	07/09/97	01/16/97	07/15/97	01/08/97
MISCELLANEOUS										
Water-Level Elevation	906.24	877.21	876.71	988.15	987.43	993.50	992.88	934.60	935.04	973.77
Water in Well (ft)	35.54	85.26	84.76	75.85	75.13	71.5	70.88	67.58	68.02	87.67
TSS (mg/L)	47	.	1	.	1.6	1.5	2.4	.	.	.
pH (Field)	9.5	7.9	9	8.6	7.6	7.9	8.1	7.5	6.9	7.7
MAJOR IONS (mg/L)										
CHARGE BALANCE (RPD)	1.3	1.8	-0.3	0.2	-4.7	-1	-4.6	-4.2	-2.1	-0.9
Calcium	21	30	19	24	21	37	34	27	26	28
Magnesium	16	19	18	15	14	22	20	15	16	15
Potassium	7.4	6.2	9.1	1.6	4	2.3	1.4	2.2	1.3	1.6
Sodium	19	6.7	14	0.89	1.1	1.3	0.64	0.57	0.56	0.6
Alkalinity-HCO3	132	154	150	122	124	164	166	138	134	130
Alkalinity-CO3	.	.	.	.	.	.	.	.	.	.
Chloride	0.89	2	2.22	1.63	2.26	1.53	0.93	0.743	0.79	1.04
Fluoride	.	1.81	1.62	.	.	.	.	.	.	.
Sulfate	4.86	9.9	11.4	1.38	1.2	5.91	1.05	2.7	1.84	0.99
Nitrate-N	0.4	0.059	0.11	0.061	0.06	0.219	0.09	0.721	0.67	1.2
METALS (mg/L)										
CLUSTER DESIGNATION	4	3	3	4	4	4	4	4	4	4
Aluminum	6.7	0.053	.	0.075	.	2.1	0.21	0.16	0.024	0.098
Arsenic (PMS)	.	.	.	.	.	.	.	.	.	.
Barium	0.061	0.23	0.19	0.0098	0.013	0.015	0.0089	0.011	0.0091	0.0055
Beryllium	0.00092	.	.	.	.	.	.	.	.	.
Boron	0.0069	0.016	0.017	0.047	0.011	0.0066	0.013	0.014	0.0079	0.013
Chromium	.	.	0.014	.	.	.	.	.	.	.
Cobalt	.	.	.	.	.	.	.	.	.	.
Copper	.	.	.	.	.	0.006	0.004	0.0096	.	0.01
Iron	1.8	0.04	0.014	0.095	0.016	1.8	0.28	0.06	0.0089	0.17
Lead (PMS)	0.0083	.	.	.	0.003	0.0012	0.0042	0.00058	.	.
Lithium	0.015	0.014	0.018	.	.	.	.	.	.	.
Manganese	0.015	0.0014	.	.	.	0.036	0.0079	.	.	0.0033
Mercury (CVAA)	.	.	.	.	.	.	.	.	.	.
Molybdenum	.	.	.	.	.	.	.	0.011	.	.
Nickel	.	.	.	.	.	.	.	.	.	.
Strontium	0.17	0.7	0.58	0.018	0.032	0.025	0.021	0.016	0.016	0.015
Thallium (PMS)	.	.	.	.	.	.	.	.	.	.
Uranium (PMS)	0.0067	0.0037	0.0041	.	.	.	.	.	.	.
Vanadium	.	.	.	.	.	.	.	.	.	.
Zinc	0.012	0.0059	.	0.0077	0.0021	0.026	0.0077	0.014	0.0039	0.0073
ORGANICS (ug/L)										
SUMMED VOCs	.	ND	ND	ND	1	ND	ND	ND	ND	ND
Carbon tetrachloride	.	.	.	.	.	.	.	.	.	.
Chloroform	.	.	.	.	.	.	.	.	.	.
1,1-Dichloroethane	.	.	.	.	.	.	.	.	.	.
1,1-Dichloroethene	.	.	.	.	.	.	.	.	.	.
1,2-Dichloroethene	.	.	.	.	.	.	.	.	.	.
cis-1,2-Dichloroethene	.	.	.	.	.	.	.	.	.	.
Tetrachloroethene	.	.	.	.	.	.	.	.	.	.
1,1,1-Trichloroethane	.	.	.	.	1	.	.	.	.	.
Trichloroethene	.	.	.	.	.	.	.	.	.	.
Trichlorofluoromethane	.	.	.	.	.	.	.	.	.	.
RADIOACTIVITY (pCi/L)										
Gross Alpha	.	<MDA	<MDA	<MDA	<MDA	<MDA	<MDA	<MDA	<MDA	<MDA
Gross Beta	.	<MDA	<MDA	<MDA	<MDA	<MDA	<MDA	<MDA	<MDA	<MDA

(CONTINUED)

APPENDIX C
Summary of CY 1997 Data That Meet Applicable DQOs

Sampling Point	GW-799	GW-801		GW-827		GW-831		OUTFALL-301	SCR2.2SP	
Location	CDLVII	LV		CDLVI		FCAP		KHQ	EXP	
Date Sampled	07/09/97	01/15/97	07/10/97	04/01/97	10/14/97	01/06/97	07/23/97	04/30/97	01/16/97	07/31/97
MISCELLANEOUS										
Water-Level Elevation	972.35	999.48	997.80	1016.63	1011.22	966.94	967.14	.	.	.
Water in Well (ft)	86.25	94.56	92.88	103.3	97.89	78.5	78.7	.	.	.
TSS (mg/L)	13.2	3	.	.	.	5.6	.	.	1	10
pH (Field)	7.5	7.9	8	7.7	7.8	7.8	6.9	8.1	6.9	6.7
MAJOR IONS (mg/L)										
CHARGE BALANCE (RPD)	-3.3	-3.6	-2.5	-6	-2.3	-6	0.3	.	-8.3	-2.9
Calcium	27	30	28	30	30	37	40	30	45	53
Magnesium	17	18	18	18	19	22	24	14	4.8	11
Potassium	0.99	1.5	0.64	0.98	1.2	1.2	1.7	1.1	1.2	0.89
Sodium	0.45	0.69	0.52	0.57	0.72	0.43	0.7	0.64	2.8	2.2
Alkalinity-HCO3	136	154	146	168	158	202	200	.	136	174
Alkalinity-CO3	.	.	.	.	.	.	.	.	.	.
Chloride	1	1.39	1.1	0.72	0.7	0.7	0.694	.	7.74	3.61
Fluoride	.	.	.	.	.	.	.	.	.	.
Sulfate	1	3.47	2.94	1.56	1.66	2.67	2.24	.	9.46	1.59
Nitrate-N	1	0.097	0.08	0.08	0.06	0.072	0.04	.	1.75	1.1
METALS (mg/L)										
CLUSTER DESIGNATION	4	4	4	4	4	4	4	.	3	3
Aluminum	0.65	0.21	0.042	.	.	0.047	0.077	0.076	0.54	0.21
Arsenic (PMS)	.	.	.	.	.	.	.	.	.	.
Barium	0.0063	0.0028	0.0014	0.008	0.0077	0.018	0.019	.	0.022	0.031
Beryllium	.	.	.	.	.	.	.	.	0.00032	.
Boron	0.0099	0.024	0.017	0.011	0.011	0.011	0.012	0.014	0.011	0.016
Chromium	.	.	.	.	.	.	.	.	.	.
Cobalt	.	.	.	.	.	.	.	.	.	.
Copper	.	.	0.0048	.	.	.	.	.	0.0041	.
Iron	0.87	0.16	0.043	0.0052	0.021	0.015	0.14	0.045	0.6	0.13
Lead (PMS)	0.003	.	0.0017	.	.	0.0015	0.0032	.	0.0006	TOT<DIS
Lithium	.	.	.	.	.	.	.	.	.	.
Manganese	0.027	.	.	.	0.0021	0.019	0.087	.	0.012	0.0079
Mercury (CVAA)	.	.	.	.	.	.	.	.	.	.
Molybdenum	.	.	.	.	.	.	.	.	.	.
Nickel	.	.	.	.	.	.	.	.	.	.
Strontium	0.015	0.016	0.015	0.017	0.016	0.02	0.026	.	0.054	0.071
Thallium (PMS)	.	.	.	.	.	.	0.00087	.	.	.
Uranium (PMS)	.	.	.	0.00051	.	0.00078	0.00072	.	.	0.00099
Vanadium	.	.	.	.	.	.	.	.	.	.
Zinc	0.0097	0.006	0.0029	0.0025	0.0047	0.021	.	0.014	0.011	.
ORGANICS (ug/L)										
SUMMED VOCs	ND	ND	ND	ND	ND	ND	ND	.	ND	ND
Carbon tetrachloride	.	.	.	.	.	.	.	.	.	.
Chloroform	.	.	.	.	.	.	.	.	.	.
1,1-Dichloroethane	.	.	.	.	.	.	.	.	.	.
1,1-Dichloroethene	.	.	.	.	.	.	.	.	.	.
1,2-Dichloroethene	.	.	.	.	.	.	.	.	.	.
cis-1,2-Dichloroethene	.	.	.	.	.	.	.	.	.	.
Tetrachloroethene	.	.	.	.	.	.	.	.	.	.
1,1,1-Trichloroethane	.	.	.	.	.	.	.	.	.	.
Trichloroethene	.	.	.	.	.	.	.	.	.	.
Trichlorofluoromethane	.	.	.	.	.	.	.	.	.	.
RADIOACTIVITY (pCi/L)										
Gross Alpha	<MDA	<MDA	<MDA	<MDA	<MDA	<MDA	<MDA	<MDA	<MDA	<MDA
Gross Beta	<MDA	<MDA	<MDA	<MDA	<MDA	<MDA	<MDA	<MDA	<MDA	<MDA

(CONTINUED)

APPENDIX C
Summary of CY 1997 Data That Meet Applicable DQOs

Sampling Point	SCR4.3SP	
Location	CDLVII	
Date Sampled	01/15/97	07/14/97
MISCELLANEOUS		
Water-Level Elevation	.	.
Water in Well (ft)	.	.
TSS (mg/L)	.	2
pH (Field)	6.7	6.5
MAJOR IONS (mg/L)		
CHARGE BALANCE (RPD)	-0.7	-4.7
Calcium	22	24
Magnesium	8.4	8.4
Potassium	3.1	1.7
Sodium	1.9	1.5
Alkalinity-HCO3	76	98
Alkalinity-CO3	.	.
Chloride	6.33	2.78
Fluoride	.	.
Sulfate	8.72	7.08
Nitrate-N	1.48	0.48
METALS (mg/L)		
CLUSTER DESIGNATION	3	3
Aluminum	5.2	0.13
Arsenic (PMS)	.	.
Barium	0.074	0.071
Beryllium	.	.
Boron	0.037	0.021
Chromium	.	.
Cobalt	.	.
Copper	.	.
Iron	3	0.1
Lead (PMS)	.	0.0012
Lithium	.	.
Manganese	0.025	0.0052
Mercury (CVAA)	.	.
Molybdenum	.	.
Nickel	.	.
Strontium	0.048	0.058
Thallium (PMS)	.	.
Uranium (PMS)	.	.
Vanadium	0.0071	.
Zinc	0.039	0.013
ORGANICS (ug/L)		
SUMMED VOCs	ND	ND
Carbon tetrachloride	.	.
Chloroform	.	.
1,1-Dichloroethane	.	.
1,1-Dichloroethene	.	.
1,2-Dichloroethene	.	.
cis-1,2-Dichloroethene	.	.
Tetrachloroethene	.	.
1,1,1-Trichloroethane	.	.
Trichloroethene	.	.
Trichlorofluoromethane	.	.
RADIOACTIVITY (pCi/L)		
Gross Alpha	<MDA	<MDA
Gross Beta	<MDA	<MDA