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INTEC Groundwater Monitoring Report (2006)

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ABSTRACT

This report summarizes 2006 perched water and groundwater monitoring activities at the Idaho Nuclear Technology and Engineering Center (INTEC) located at the Idaho National Laboratory (INL).

During 2006, groundwater samples were collected from a total of 22 Snake River Plain Aquifer (SRPA) monitoring wells, plus six aquifer wells sampled for the Idaho CERCLA Disposal Facility (ICDF) monitoring program. In addition, perched water samples were collected from 21 perched wells and 19 suction lysimeters. Groundwater and perched water samples were analyzed for a suite of radionuclides and inorganic constituents. Laboratory results in this report are compared to drinking water maximum contaminant levels (MCLs). Such comparison is for reference only and it should be noted that the Operable Unit 3-13 Record of Decision does not require that perched water comply with drinking water standards.

Sr-90, Tc-99, and nitrate exceeded their respective drinking water MCLs in one or more of the aquifer monitoring wells at or near INTEC, with Sr-90 exceeding its MCL by the greatest margin. Sr-90 concentrations remain above the MCL at nine of the 22 monitoring wells sampled. Only one aquifer well located southeast of INTEC showed an increase in Sr-90 from the previous year.

As in 2005, Tc-99 was detected above the MCL in two aquifer wells. The highest Tc-99 level was at the ICPP-MON-A-230 monitoring well (2,150 pCi/L) located north of the INTEC tank farm. USGS-67 was the only aquifer monitoring well that showed an increase in Tc-99 from 2005 to 2006, although still below the MCL. I-129 concentrations were below the MCL at all aquifer locations. None of the aquifer wells showed increases in I-129.

Tritium concentrations have been below the MCL in all wells sampled during 2003–2006. Tritium concentrations in groundwater have continued to decline during the period from 2000 through 2006.

Pu-238, Pu-239/240, and Am-241 were detected in a single groundwater sample from well USGS-112, located south of INTEC. However, the concentrations were all below the gross alpha MCL of 15 pCi/L. In addition, Pu-241 (beta emitter) was detected in the groundwater sample from a single aquifer well inside of INTEC, but the concentration was below the derived MCL for Pu-241. Np-237 was not detected in any of the groundwater samples collected during 2006.

Mercury was detected in SRPA groundwater at a single location inside of INTEC at a concentration far below the MCL. Only one aquifer well slightly exceeded the MCL for nitrate-nitrogen.

Perched water was observed primarily at two depths beneath INTEC: the shallow perched zone at 100- to 150-ft depth, and the deep perched zone at 380- to 400-ft depth. A total of 21 perched water monitoring wells contained enough water for sampling in 2006, and 18 of these are completed in the shallow perched zone. The majority of deep perched monitoring wells were dry during 2006.

Perched water monitoring results indicate that Sr-90 was the principal radionuclide detected in shallow perched water. Sr-90 concentrations exceeded the MCL in 16 of the 21 wells sampled, with wells at and southeast of the tank farm displaying the highest Sr-90 activities. The maximum Sr-90 level observed in perched water was 197,000 pCi/L. At most well locations, 2006 Sr-90 concentrations remained about the same as in 2005.

Cs-137 was detected in shallow perched water at a single well located in the tank farm, but at a concentration somewhat lower than detected in this same well during 2005. None of the Cs-137 results exceeded the MCL.

As with Sr-90, the highest levels of Tc-99 in shallow perched water were observed in monitoring wells located southeast of the tank farm. However, as in the past, none of the perched water samples collected during 2006 exceeded the MCL for Tc-99 (900 pCi/L). In the majority of perched water wells, Tc-99 concentrations in 2006 were similar to or slightly lower than those observed in 2005.

Tritium concentrations slightly exceeded the MCL of 20,000 pCi/L in two of the perched water wells, one of which is completed in the deep perched zone. In the majority of perched water wells, tritium concentrations in 2006 were similar to or slightly lower than those observed in 2005.

I-129 was detected in only one of the perched water wells sampled. The I-129 concentration reported in well ICPP-2018 (5.22 pCi/L) located south of the tank farm was higher than that reported in this same well in 2005, and was the highest concentration reported in any well in recent years. At all other monitoring locations, I-129 concentration trends were either relatively constant or slowly declining over time.

Nitrate, the predominant inorganic contaminant in the perched water, exceeded the MCL (10 mg/L NO₃-N) in several shallow and deep perched wells in the northern part of INTEC. Nitrate concentrations were generally consistent with historical levels.

Kerosene or diesel fuel hydrocarbons were detected in shallow perched water at one monitoring well located south of the tank farm. The presence of fuel hydrocarbons is believed to be attributable to past leakage from an aboveground fuel tank or associated piping.

The 2006 groundwater contour map is similar in shape to the maps prepared for 2003–2005. Groundwater levels declined during 2000-2005 as a result of drought during this time period. However, as a result of above-normal precipitation during 2005 and 2006 and corresponding periods of flow of the Big Lost River (BLR) during those 2 years, the aquifer well hydrographs show a slight rise in groundwater levels during 2006.

The BLR flowed past INTEC from April 16 until July 3, 2006, but the effect of streamflow infiltration on perched water levels was only evident at the BLR wellset monitoring wells located closest to the river. Little or no obvious water level response was observed in wells located further from the river. Although the BLR loses much water to streambed infiltration, BLR infiltration appears to have little influence on the shallow perched water further away from the river. Rather, a combination of precipitation infiltration (rainfall and snowmelt) and discharges and leaks of water from facility pipelines appears to account for continued recharge of the perched water beneath the northern part of INTEC. As a result of wetter conditions during the past 2 years, the extent of shallow perched water beneath the northern part of INTEC expanded eastward during 2005-2006, primarily due to an increase in on-Site precipitation infiltration.

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ACRONYMS

BLR	Big Lost River
CERCLA	Comprehensive Environmental Response, Compensation and Liability Act
CFA	Central Facilities Area
CS	central set
DQO	data quality objective
EC	electrical conductivity
FFA/CO	Federal Facility Agreement and Consent Order
GEL	General Engineering Laboratories, LLC
ICDF	Idaho CERCLA Disposal Facility
INL	Idaho National Laboratory
INTEC	Idaho Nuclear Technology and Engineering Center
MCL	maximum contaminant level
MSIP	Monitoring System and Installation Plan
NAPL	nonaqueous phase liquid
ORP	oxidation-reduction potential
OU	operable unit
PE	performance evaluation
PEW	process equipment waste
PID	photoionization detector
PP	percolation pond set
RESL	Radiological and Environmental Sciences Laboratory
ROD	Record of Decision
SRPA	Snake River Plain Aquifer
STL	sewage treatment lagoon
SWRI	Southwest Research Institute

TF	tank farm set
USGS	United States Geological Survey
WAG	waste area group
WCF	Waste Calcining Facility

INTEC Groundwater Monitoring Report (2006)

1. INTRODUCTION

This report summarizes 2006 perched water and Snake River Plain Aquifer (SRPA) groundwater monitoring results for the Idaho Nuclear Technology and Engineering Center (INTEC). Included in this report are monitoring well water levels and laboratory results for water samples collected February through June 2006, as required by the Waste Area Group (WAG) 3, Operable Unit (OU) 3-13, perched water and groundwater monitoring programs. The *Long-Term Monitoring Plan for OU 3-13, Group 4 - Perched Water* (DOE-ID 2005a) and the *Long-Term Monitoring Plan for OU 3-13, Group 5 - Snake River Plain Aquifer* (DOE-ID 2004a) specify the wells to be sampled and the required field and laboratory parameters, based on the requirements in the OU 3-13 Record of Decision (ROD) (DOE-ID 1999). The data quality objectives (DQOs) for perched water and groundwater sampling are described in the Monitoring System and Installation Plans (MSIP) for Group 4 and Group 5 (DOE-ID 2005b, 2002, respectively). This document includes the following appendices:

- Appendix A – Figures
- Appendix B – Tables
- Appendix C – Perched Water Hydrographs
- Appendix D – Perched Water Temperature and Electrical Conductivity Plots
- Appendix E – Tensiometer Graphs
- Appendix F – INTEC Quarterly Water Balance Reports.

Perched water monitoring results for the previous year (2005) were published in the *Annual INTEC Water Monitoring Report for Group 4–Perched Water (2005)* (DOE-ID 2006a). Similar results for the SRPA were published in the *Annual INTEC Groundwater Monitoring Report for Group 5 – Snake River Plain Aquifer (2005)* (DOE-ID 2006b).

1.1 Regulatory Background

The Idaho National Laboratory (INL) is divided into 10 WAGs to manage environmental operations mandated under the *Federal Facility Agreement and Consent Order* (FFA/CO) (DOE-ID 1991). INTEC, formerly the Idaho Chemical Processing Plant, is designated as WAG 3. Operable Unit 3-13 encompasses the entire INTEC facility.

In October 1999, the ROD was issued for OU 3-13 (DOE-ID 1999) and specified remedial actions for the INTEC perched water (Group 4) and groundwater (Group 5). The remedy selected for perched water (Group 4) was institutional controls with aquifer recharge controls (DOE-ID 1999). Specific tasks called out in the ROD to control surface water recharge to perched water beneath INTEC were

- Relocate percolation ponds (away from INTEC) by December 2003
- Minimize recharge to the perched water from lawn irrigation (if necessary)
- Line Big Lost River (BLR) channel segment (if necessary)

- Implement additional infiltration controls if drain out of perched water does not occur within 5 years of removing the percolation ponds (Phase II to Group 4 remedy)
- Measure moisture content and contaminant of concern concentration(s) in the perched water zones to determine if water contents and contaminant fluxes are decreasing as predicted.

As of the end of 2006, activities completed to implement the remedy and reduce recharge include

- Percolation ponds permanently taken out of service on August 26, 2002, reducing water infiltration at INTEC by ~1 mgd.
- Sewage effluent redirected to new percolation ponds on December 2, 2004, reducing infiltration by ~40,000 gpd.
- Tank Farm Interim Action project installed concrete-lined ditches around the tank farm to reduce water infiltration (2003–2004).
- Subsurface injection of steam condensate was reduced from ~2,013 gpd (1997) to ~80 gpd (2003).
- Lawn watering was eliminated in 2006.

In 2006, a report was prepared entitled “Methods to Reduce Water Infiltration and Recharge of the Northern Shallow Perched Water Zone at INTEC” (EDF-6868). This document assessed various methods to reduce precipitation infiltration and leakage of anthropogenic water, and 10 of these methods were recommended for implementation:

1. Capture roof run-off from selected existing building downspouts within the secondary recharge control zone and route water to lined ditches and evaporation pond
2. Perform pipeline valve isolation tests and/or pipeline hydrostatic tests to identify leaks in suspect areas
3. Eliminate lawn watering
4. Eliminate steam condensate drip-leg discharges to ground
5. Conduct regular water balance calculations to highlight changes in system flows that could indicate leaks
6. Install asphalt or concrete in unlined north ditch to eliminate infiltration
7. Install two additional flow meters to improve confidence in water balance calculations
8. Install telemetry for real-time water level monitoring in selected perched water monitoring wells
9. Extend pavement and/or lined ditches to reduce storm water infiltration
10. Improve surface water drainage along Olive Avenue to reduce or eliminate ponding and infiltration.

These 10 actions are being considered as part of the OU 3-14 remedy, and the OU 3-14 ROD is currently in review. The quarterly water balance reports for 2006 (Task 5 above) are included in Appendix F of this report.

1.2 Site Background

The INL Site is a government-owned facility managed by the Department of Energy and is located 52 km (32 mi) west of Idaho Falls, Idaho. It occupies approximately 2,305 km² (890 mi²) of the northwestern portion of the Eastern Snake River Plain in southeast Idaho, and the INTEC facility includes an area of approximately 0.39 km² (0.15 mi²) in the south-central area of the INL Site (Figure A-1). (All figures are provided in Appendix A.)

In operation since 1952, INTEC stored and reprocessed spent nuclear fuel to recover fissile uranium. The Department of Energy phased out the reprocessing operations in 1992 and redirected INTEC's mission to include (1) receipt and temporary storage of spent nuclear fuel and other radioactive wastes for future disposition, (2) management of current and past wastes, and (3) performance of remedial actions.

Liquid wastes generated from past activities were stored in underground stainless-steel tanks at the INTEC tank farm. Numerous Comprehensive Environmental Response, Compensation and Liability Act (CERCLA) sites are located at and near the tank farm and adjacent to the process equipment waste evaporator. Contaminants found in soils at the tank farm are the result of accidental releases and leaks from process piping, valve boxes, and sumps. There is no evidence indicating that the waste tanks have leaked. Contaminated soils at the tank farm compose about 95% of the known contaminant inventory at INTEC. The Comprehensive Remedial Investigation/Feasibility Study for OU 3-13 (DOE-ID 1997a, 1997b, 1998) and the OU 3-14 Remedial Investigation/Baseline Risk Assessment (DOE-NE-ID 2006) contain detailed discussions of the nature and extent of contamination.

1.3 Environmental Setting

The land surface at INTEC is relatively flat, with an average elevation of 1,498 m (4,914 ft) above mean sea level. Mean annual precipitation in the vicinity of INTEC is approximately 22.1 cm/yr (8.7 in./yr), and approximately 30% of total precipitation occurs as snowfall (DOE-ID 1989). The BLR, an intermittent stream located adjacent to the northwest corner of INTEC (Figure A-2), constitutes a significant source of recharge to the aquifer. Flow in the BLR adjacent to INTEC depends on winter snowpack conditions and the magnitude and duration of controlled releases from Mackay Reservoir. When the BLR does flow onto the INL Site, much of the water infiltrates and eventually recharges the SRPA, which lies at a depth of approximately 137 m (450 ft) below ground surface (bgs) at INTEC.

Perched water zones exist at various depths within the 137-m (450-ft) -thick vadose zone beneath INTEC. Recharge sources to these perched water zones include (1) infiltration of water beneath the BLR channel, (2) infiltration of rain and snowmelt, and (3) water losses from the INTEC raw water and potable water distribution systems. Past recharge sources that no longer exist include (1) service wastewater discharges from the former INTEC injection well (ceased in 1986), (2) infiltration of service wastewater from the former percolation ponds located near the southern boundary of INTEC (discharges ceased in August 2002), (3) infiltration of treated wastewater effluent at the former Sewage Treatment Plant infiltration galleries (discharges ceased in December 2004), and (4) infiltration from lawn irrigation (ceased in 2005).

2. MONITORING PROGRAM AND RESULTS

Monitoring activities consisted of perched water and groundwater sampling, manual water level measurements, automated (data logger) water level and temperature measurements, and automated tensiometer water potential measurements. SRPA groundwater samples were collected during February–March 2006, and perched water and vadose zone water sampling were performed during April 2006. Table B-1 lists the sampling dates for each well.

Manual perched water level measurements were recorded monthly during 2006. In addition, selected perched monitoring wells were equipped with pressure transducers and data loggers that recorded water levels every 30 minutes (if the well contained water). The data loggers were downloaded quarterly. Due to above-normal precipitation, the BLR flowed briefly past INTEC during April 16–July 3, 2006. The groundwater and perched water sampling results, water level data, and tensiometer data are described in the following sections.

2.1 SRPA Groundwater Sampling Laboratory Results

During 2006, the WAG 3 program collected groundwater samples from a total of 22 SRPA monitoring wells, plus an additional six aquifer wells sampled as part of the Idaho CERCLA Disposal Facility (ICDF) monitoring program. Most of these groundwater samples were collected during February–March 2006. However, four of the wells could not be sampled during the initial sampling event due to inoperative pumps and were sampled later during May–June 2006. Monitoring well locations are shown in Figures A-2 and A-4. Groundwater samples were analyzed for a suite of radionuclides and inorganic constituents in accordance with the Long-Term Monitoring Plan (DOE-ID 2004a). Table B-1 lists the wells that were sampled and the laboratory analytes. Complete laboratory results are included on the data CD at the back of this report.

The following discussion focuses on tritium, I-129, Tc-99, and Sr-90, because these radionuclides have historically been the principal contaminants of concern in groundwater downgradient of INTEC. Concentration trends discussed in this report focus on the period following the OU 3-13 ROD (2000–2006). Groundwater quality trends over the entire history of INTEC were included in the *Monitoring Report/Decision Summary for Operable Unit 3-13, Group 5, Snake River Plain Aquifer* (DOE-ID 2004b).

Radionuclide concentrations (activities) are shown without the associated analytical uncertainties throughout the text of this report. However, consideration of analytical uncertainties is important when evaluating radionuclide results, and the reader is referred to the tables in Appendix B and the data CD for the uncertainties associated with each sample. In the following subsections, groundwater quality results are compared to maximum contaminant levels (MCLs) for drinking water. However, it should be noted that the monitoring wells are not used for drinking water, institutional controls prevent the use of contaminated groundwater, and comparison with MCLs is for reference only.

2.1.1 Field Parameters for SRPA Groundwater

Table B-2 summarizes field measurements of groundwater temperature, pH, electrical conductivity, dissolved oxygen, and oxidation-reduction potential (ORP) measured at the wellhead with a Hydrolab Quanta instrument during well purging. SRPA groundwater temperatures ranged from 11 to 15°C. The warmest temperature (15.5°C) was recorded at aquifer well MW-18-4, located near the former Waste Calcining Facility (WCF). This well has shown slightly elevated water temperatures over the past few years. However, it should be noted that the temperatures shown in Table B-2 were not measured

downhole, but, rather, at the wellhead, and a slight warming or cooling of the water could have occurred during flow through the pump discharge line. Indeed, the downhole temperatures recorded by the Solinst Levelogger in well MW-18-4 were near 13°C, which is similar to most other aquifer wells.

Groundwater pH ranged from 7.7 to 8.3, with most of the values close to a pH of 7.9. The observed pH values are similar to those observed previously and are consistent with the presence of calcite (CaCO₃) within the aquifer matrix, which tends to buffer the pH in the observed range.

Electrical conductivity (EC) ranged from a minimum of 0.35 mS/cm at the USGS-123 well to a maximum value of 0.75 mS/cm at USGS-51. Both of these wells are located near the former INTEC percolation ponds. Elevated EC observed at USGS-51 (0.75 mS/cm) and USGS-67 (0.63 mS/cm) may be attributable to drain-out of higher-salinity perched water impacted by previous service waste discharges to the former percolation ponds. In addition, EC generally appears to be slightly higher in aquifer skimmer wells with short screen lengths (e.g., LF3-08, MW-18-4, ICPP-2020, and ICPP-2021), as compared with the older United States Geological Survey (USGS) monitoring wells with longer open intervals. An exception was USGS-123 (skimmer well), which had the lowest EC during both 2005 and 2006.

Dissolved oxygen concentrations in groundwater ranged from 4.1 mg/L (USGS-123) to 7.6 mg/L (USGS-47). Most of the wells had dissolved oxygen concentrations exceeding 5 mg/L, which indicate that the groundwater is close to saturation with dissolved oxygen. During 2005, the dissolved oxygen concentration at well ICPP-2020 (1.9 mg/L) was much lower than the other aquifer wells. In 2006, however, the dissolved oxygen concentration at ICPP-2020 was 5.8 mg/L, which was nearly as high as most of the other aquifer wells.

2.1.2 Strontium-90 in SRPA Groundwater

Concentrations of Sr-90 in groundwater during 2006 are shown in Figure A-6. Sr-90 was detected at 16 of the 21 wells sampled (Table B-3), and nine of the wells exceeded the Sr-90 MCL (8 pCi/L). As in 2005, the highest Sr-90 concentration occurred at USGS-47 (24.1 pCi/L), but the concentration at this well was somewhat lower than that reported in 2005 (35.3 pCi/L). USGS-47 is located downgradient of the former INTEC injection well. The persistence of Sr-90 at USGS-47 near the former injection well is believed attributable to a combination of gradual desorption of Sr-90 from the aquifer matrix and drain-out of contaminated perched water that was impacted by past service waste disposal to the injection well. The next highest Sr-90 levels were observed at monitoring wells MW-18-4 (18.7 pCi/L) and ICPP-2021 (14.7 pCi/L) located near the binsets.

Figure A-12 shows observed changes in Sr-90 concentrations in groundwater during 2000–2006, and Figure A-13 shows Sr-90 concentration trends in selected wells during 2004–2006. Of the 16 monitoring wells shown in Figure A-13, 10 of the wells showed declining Sr-90 concentrations from 2005 to 2006; three wells showed increases in Sr-90 (USGS-42, -57, and -67); and Sr-90 was not detected in three of the wells. However, when the analytical uncertainty is taken into account, the Sr-90 results for nine of the 16 wells overlap at the ± 2 -sigma level and are therefore indistinguishable. Using the ± 2 -sigma criterion, six of the wells showed Sr-90 declines between 2005 and 2006, and only one well showed an increase (USGS-67). The sharp decline in the concentration of Sr-90 in well USGS-123 observed between 2004 and 2005 corresponds with the deepening of this well that occurred in October 2004. Because the well had gone dry, the well was drilled approximately 40 feet deeper. Following the deepening of the well, the groundwater quality results showed lower concentrations of several constituents. Examination of longer-term trends in selected wells within the Sr-90 plume associated with the former injection well indicates that Sr-90 concentrations are slowly declining at most locations (Figure A-12). Additional

information regarding Sr-90 trends in the SRPA can be found in the Group 5 Monitoring Report/Decision Summary (DOE-ID 2004b).

2.1.3 Technetium-99 in SRPA Groundwater

The distribution of Tc-99 in groundwater during 2006 is shown on Figure A-7. Tc-99 was detected at 16 of 21 locations sampled during 2006 (Table B-3). As in the past, the highest Tc-99 level was at the ICPP-MON-A-230 monitoring well (2,150 pCi/L) located near the INTEC tank farm. The second highest Tc-99 concentration was observed at the ICPP-2021 new aquifer well (1,240 pCi/L) located southeast of the tank farm. These two wells were the only ones that exceeded the Tc-99 MCL of 900 pCi/L. The source of the elevated Tc-99 at these two wells is discussed in the OU 3-14 RI/BRA (DOE-NE-ID 2006).

Observed changes in Tc-99 concentrations in groundwater are shown in Figures A-14 and A-15. Of the 16 monitoring wells shown in Figure A-15, nine of the wells showed declining Tc-99 concentrations from 2005 to 2006; four wells showed increases in Tc-99 (ICPP-2020, USGS-40, USGS-42, and USGS-67); and Tc-99 was not detected in three of the wells. When the analytical uncertainty is taken into account, Tc-99 levels at nine of the 16 wells overlap the results from the previous year. At the ± 2 -sigma level, Tc-99 concentrations declined between 2005 and 2006 at seven of the wells. USGS-67 was the only well that showed an increase in Tc-99 from 2005 to 2006.

Longer-term Tc-99 concentration trends for Group 5 monitoring wells at and downgradient of INTEC are shown in Figure A-14. Gradually increasing concentrations of Tc-99 were observed at USGS-52 and USGS-67 during the late-1990s through 2004. During 2004–2006, Tc-99 concentrations appear to have declined at USGS-52. In contrast, Tc-99 concentrations have continuously increased at USGS-67 over the past several years from 28 pCi/L (2003) to 114 pCi/L (2005) and 146 pCi/L (2006) (Figure A-14). The increase in Tc-99 (a beta emitter) at USGS-67 is confirmed by a concomitant increase in gross beta activity from 34 pCi/L (2003) to 63 pCi/L (2005) and 97 pCi/L (2006).

2.1.4 Tritium in SRPA Groundwater

The distribution of tritium in groundwater during 2006 is shown in Figure A-8. Tritium was detected in nearly all wells sampled in 2006 (Table B-3). As in 2005, tritium was not detected in upgradient well USGS-121, the CPP-01 INTEC water supply well, and well USGS-44. As in previous years, a tritium plume extends from INTEC to the Central Facilities Area (CFA) and beyond; however, concentrations were all below the drinking water MCL of 20,000 pCi/L (Figure A-3). The highest tritium concentration in groundwater during 2006 was at well MW-18-4 (8,930 pCi/L) located near the former WCF.

The tritium results from the 2006 sampling event were generally lower than the results observed in these same wells when sampled during the previous year. Figures A-16 and A-17 show changes in tritium concentrations in groundwater during 2000–2006. Of the 16 monitoring wells shown in Figure A-17, 10 of the wells showed declines in tritium concentrations from 2005 to 2006, five wells showed increases in tritium, and tritium was not detected in one of the wells. However, when the analytical uncertainty is taken into account, the tritium results for 12 of the 16 wells overlap the 2006 results at the ± 2 -sigma level. Using the ± 2 -sigma criterion, one well showed a tritium increase during this period (USGS-42), and three wells showed declines in tritium (ICPP-2020, USGS-47, and USGS-57). Examination of longer-term trends indicates that tritium concentrations in groundwater have continued to decline during the period from 2000 through 2006 (Figure A-16).

2.1.5 Iodine-129 in SRPA Groundwater

As noted in previous years, a groundwater plume of I-129 extends southward from INTEC to CFA. Figure A-9 shows I-129 concentrations in groundwater during 2006. During 2003 and 2004, all I-129 concentrations were below the MCL of 1 pCi/L. During 2005, however, one well near the former injection well exceeded the I-129 MCL (USGS-47; 1.23 pCi/L). During 2006, I-129 concentrations at all well locations were again less than the MCL, with the highest concentration reported at well USGS-67 (0.65 pCi/L). This is the same well that has shown rising concentrations of Tc-99 over the past several years.

The I-129 concentrations in groundwater have declined significantly from concentrations observed during the 1980s and 1990s (DOE-ID 2004b). Figures A-18 and A-19 show the I-129 trends for selected wells since 2000. Additional details regarding long-term I-129 trends in the SRPA can be found in the Group 5 Monitoring Report/Decision Summary (DOE-ID 2004b). Several wells appear to show a slight rise in I-129 concentrations since 2003, including USGS-40, USGS-47, USGS-52, and USGS-67. It is unknown whether the apparent increase in I-129 concentrations is the result of actual changes in groundwater quality over time or differences in analytical precision and laboratory methods from year to year.

Figure A-19 shows observed changes in I-129 concentrations in groundwater during 2004–2006. Of the 16 monitoring wells shown in Figure A-19, seven of the wells showed declining I-129 concentrations between 2005 and 2006, eight of the wells showed increases, and I-129 was not detected in one of the wells (USGS-121). However, when the analytical uncertainty is taken into account, the I-129 results for 15 of the 16 wells overlapped the results from the previous year. Using the ± 2 -sigma criterion, one well showed a decline in I-129 during this interval (USGS-47). None of the aquifer wells showed increases in I-129.

2.1.6 Cesium-137 in SRPA Groundwater

None of the gamma-emitting radionuclides were detected in groundwater during 2006 (Table B-3). In 2005, Cs-137 was detected at well USGS-40 (10.9 pCi/L), but in 2006 Cs-137 was not detected in the sample from this well. The MCL for Cs-137 is 200 pCi/L. Other gamma emitters analyzed for, but not detected, include Sb-125; Ce-144; Cs-134; Co-60; Eu-152, Eu-154, and Eu-155; Mn-54; Ru-106; Ag-108 and Ag-110; and Zn-65.

2.1.7 Uranium Isotopes in SRPA Groundwater

Uranium-238 was detected at all SRPA well locations, and concentrations ranged from 0.52 to 2.8 pCi/L, with the highest concentration observed at well USGS-112 located midway between INTEC and CFA (Table B-4). With the exception of this well, the reported concentrations of U-238 are generally consistent with background concentrations reported for total uranium in SRPA groundwater (Roback et al. 2001; Knobel, Orr, and Cecil 1992). The gross alpha radiation MCL is 15 pCi/L, and none of the uranium activities exceeded this level.

In addition, U-233/234 also was detected in all samples, with concentrations ranging from 1.2 to 3.7 pCi/L. As with U-238, the highest concentration was reported at well USGS-112. U-234 is the daughter product of alpha decay of the long-lived, naturally occurring U-238. The U-234/U-238 ratios ranged from 1.6 to 2.8; these values are similar to background U-234/U-238 activity ratios of 1.5 to 3.1 reported for the eastern SRPA (Roback et al. 2001). U-235 was not detected in any of the WAG 3, Group 5 aquifer monitoring wells but was reportedly detected in several ICDF aquifer monitoring wells at concentrations ranging from 0.1 to 0.168 pCi/L.

2.1.8 Other Actinides in SRPA Groundwater

Actinide elements are those heavier than actinium on the periodic table, including uranium, neptunium, americium, and plutonium. Pu-238 was detected in a single groundwater sample from well USGS-112 (1.33 pCi/L). Similarly, Pu-239/240 was detected only at well USGS-112 (1.42 pCi/L), as was Am-241 (0.333 pCi/L) (Table B-4). It is unclear why these actinide elements were detected in well USGS-112, as the gross alpha result was nondetect, as were the 2005 actinide results at this well. The gross alpha MCL that applies to Pu isotopes is 15 pCi/L, and none of the samples exceeded the MCL. In addition, Pu-241 (beta emitter) was detected in the groundwater sample from MW-18-4 (5.7 pCi/L). The derived MCL for Pu-241 is 300 pCi/L. Np-237 was not detected in any of the groundwater samples collected during 2006.

2.1.9 Gross Alpha/Gross Beta in SRPA Groundwater

Gross alpha activity was detected at 13 of 21 sampling locations (Table B-3). The highest gross alpha activity reported in 2006 was at well ICPP-2021 (5.3 pCi/L), and the next highest was at well ICPP-MON-A-230 (4.3 pCi/L) located north of the tank farm. The drinking water MCL for gross alpha radiation is 15 pCi/L.

Gross beta activity was detected at all sampling locations except the upgradient well (USGS-121). The highest gross beta levels occurred at well ICPP-MON-A-230 (1,180 pCi/L). The gross beta results generally correlate with the presence of beta-emitting Tc-99 and Sr-90 in the groundwater samples (Table B-3).

2.1.10 Mercury in SRPA Groundwater

Groundwater samples collected during 2006 for mercury analysis were filtered through a 0.45- μ m membrane filter (“total metals–filtered”). Therefore, the results represent concentrations of dissolved mercury and are summarized in Table B-5. Mercury was detected at a single location in the groundwater sample from ICPP-2020 (0.065 μ g/L) located south of the INTEC tank farm. The MCL for mercury is 2 μ g/L. Mercury salts were formerly used as catalysts at INTEC during the dissolution of aluminum-clad fuel elements, and mercury has periodically been detected in groundwater and perched water samples collected in previous years from nearby wells.

2.1.11 Nitrate in SRPA Groundwater

Nitrate was detected in all of the wells sampled during 2006 (Table B-5). Nitrate/nitrite-nitrogen concentrations in groundwater are shown in Figure A-10. The highest concentrations were reported at wells ICPP-2021 (16.4 mg/L as N), ICPP-MON-A-230 (9.5 mg/L), and MW-18-4 (8.4 mg/L). These same wells showed the highest nitrate concentrations during 2005. All of these wells are located relatively close to the tank farm, and all show groundwater quality impacts attributed to past tank farm liquid waste releases. Although the laboratory reported concentrations for combined nitrate/nitrite-nitrogen, these values should be essentially identical to the concentrations of nitrate-nitrogen, because nitrite (NO_2) concentrations are expected to be extremely low (nondetect) under the oxidizing conditions present in the SRPA. The nitrate-nitrogen at ICPP-2021 slightly exceeds the MCL for nitrate-nitrogen of 10 mg/L (as N). The presence of elevated nitrate-nitrogen concentrations southeast of the tank farm may be attributed primarily to impacts from tank farm vadose zone sources. Figure A-20 shows long-term trends for nitrate-nitrogen in selected SRPA wells.

2.1.12 Major Ions in SRPA Groundwater

Concentrations of major ions in groundwater are summarized in Table B-5, and complete results are included on the data CD. Cation-anion charge balance errors were 5% or less for all groundwater samples. The good match between cations and anions indicates that there were no significant laboratory errors in the major ion analyses.

Chloride concentrations in groundwater are shown in Figure A-11 and ranged from a low of 13 mg/L at upgradient well USGS-121 and well USGS-44 to a high of 128 mg/L at USGS-51 located near the former percolation ponds. This same well also had the highest chloride result during 2005 (153 mg/L). Elevated chloride concentrations near and downgradient from the former percolation ponds reflect the elevated salinity of the service waste previously discharged to the ponds. Figure A-21 shows chloride trends in selected SRPA wells. Chloride levels at USGS-51 remain more than five times above background concentrations 4 years after decommissioning of the former percolation ponds. The observed slow decline in chloride concentrations in groundwater beneath the former percolation ponds is evidence of continuing drain-out of high-chloride perched water and/or the diffusion of chloride out of low-permeability zones in the SRPA.

Sulfate concentrations in groundwater ranged from a low of 21 mg/L in well USGS-123 to a high of 48 mg/L in well ICPP-MON-A-230 located north of the tank farm. This same well contained the highest sulfate concentration during 2005 (41 mg/L). Elevated sulfate concentrations near the tank farm appear to correspond with elevated concentrations of Tc-99, which has been associated with past liquid waste releases at the tank farm.

Sodium concentrations in groundwater ranged from a low of 8 mg/L at upgradient well USGS-121 to a maximum of 48 mg/L at well ICPP-MON-A-230 located north of the tank farm. Similar to chloride, elevated sodium concentrations near and downgradient from the former percolation ponds reflect the relatively high salinity of the service waste previously discharged to the ponds. However, a separate zone of elevated sodium concentrations in groundwater appears near the tank farm and appears attributable to past releases of high-sodium liquid waste at the tank farm.

2.1.13 Performance Evaluation Sample Results

For SRPA groundwater samples, all laboratory analyses were performed by General Engineering Laboratories, LLC, (GEL) in Charleston, South Carolina. Level A data validation was performed on all laboratory results. To assess analytical performance for key radionuclides, double-blind aqueous performance evaluation (PE) samples prepared by the Radiological and Environmental Sciences Laboratory (RESL) were submitted to the off-Site laboratory (GEL) with the February–March 2006 SRPA groundwater water samples. The PE samples contained known concentrations (activities) of selected radionuclides, including tritium, Am-241, Cs-137, I-129, Pu-238, Pu-239, Sr-90, Tc-99, U-234, and U-238, among others.

RESL and the Sample and Analysis Management program assessed the results reported by the off-Site laboratory. Based on the laboratory results for the PE sample, RESL concluded that

- U-234 results were judged as not acceptable due to high bias (151% recovery).
- U-238 results were judged as not acceptable due to high bias (134% recovery).
- Pu-238 results were judged as not acceptable due to low bias (62% recovery).

With the exceptions listed above, the PE sample results for all other analytes met the acceptance criteria, indicating that the laboratory results were in agreement with the known concentrations. The contract laboratory has been notified of these results so that appropriate corrective actions may be performed. The PE sample results do not imply that the groundwater results for U-234, U-238, and Pu-238 are unusable, but that the results for the two uranium isotopes may be biased high, and the Pu-238 results biased low. The SRPA groundwater results for U-234 and U-238 show that the concentrations of these constituents did not approach or exceed the MCL of 15 pCi/L (Table B-4). Therefore, the possible high bias of the uranium results is not considered cause for concern. Similarly, Pu-238 was only detected in one of the 21 SRPA groundwater samples, and the concentration in that one sample was far below the MCL of 15 pCi/L; therefore, the possible low bias of the Pu-238 results does not constitute a significant data quality issue.

2.2 Perched Water Sampling Laboratory Results

Perched water samples were collected from 21 perched wells and 19 suction lysimeters (Table B-1). Water samples were not obtained from some wells, either because the well was dry or the water level did not recover sufficiently (by the next business day) following purging or because the well was inaccessible due to construction or site remediation activities. In cases where lack of water precluded collection of the entire sample volume, only a partial suite of laboratory analyses was performed. Table B-1 summarizes which wells were sampled and for which laboratory analytes.

At those wells where sufficient water was available, perched water samples were analyzed for tritium, Sr-90, I-129, Tc-99, uranium isotopes, plutonium isotopes, Am-241, Np-237, gamma-emitting radionuclides (including Cs-137), metals (filtered and unfiltered), and selected anions. Field parameters measured immediately prior to sample collection are summarized in Table B-2, including pH, water temperature, EC, and dissolved oxygen. Radionuclide results for perched water samples are summarized in Tables B-3 and B-4. Table B-5 summarizes the results for nonradioactive inorganic constituents.

Complete laboratory results are included on a data CD at the back of this document. For simplicity, radionuclide concentrations (activities) are shown without the associated analytical uncertainties throughout the text of this report. However, consideration of analytical uncertainties is important when evaluating radionuclide results, and the reader is referred to the tabulated data for the uncertainties associated with each sample (see tables in Appendix B and attached data CD).

Perched water results in this report are compared to drinking water MCLs. Such comparison is for reference only and does not imply that the perched water zones constitute aquifers capable of sustained long-term yield or consumption. Moreover, although the OU 3-13 ROD (DOE-ID 1999) does not require that perched water comply with MCLs, it does require that contaminant fluxes from the vadose zone be reduced so that the SRPA outside the INTEC perimeter fence meets MCLs after 2095.

2.2.1 Northern and Southern Perched Water Zones

Perched water exists in two distinct geographic areas: northern and southern INTEC. The northern perched water system consists of the shallow and deep perched water zones. The lateral extent of the northern shallow perched water system is shown in Figure A-5 and has been further divided into the upper shallow and lower shallow perched zones, which generally correspond with the 110- and 140-ft sedimentary interbeds that underlie the site. The deep perched zone coincides with the 380-ft interbed. The southern perched water system includes three main perching zones at depths of approximately 110, 250, and 380 ft bgs when the former percolation ponds were in service.

Based on the distribution and geochemistry of the perched water, the northern and southern shallow perched water systems appear to be discontinuous, with separate recharge sources. Several shallow perched monitoring wells in the central portion of INTEC are dry or only intermittently have water, indicating that the northern and southern zones are not contiguous. These observations also suggest that recharge sources are located in both the northern and southern portions of INTEC.

The perched water contaminant of greatest environmental concern at INTEC is Sr-90. The reasons for this include (1) Sr-90 is abundant in spent nuclear fuel (6% fission yield); (2) Sr-90 can remain somewhat mobile under certain subsurface conditions (unlike many other fission products); (3) Sr-90 has a long enough half-life (29 yr) that it persists for hundreds of years, yet short enough that it has a high specific activity; and (4) the drinking water standard for Sr-90 is relatively low (MCL = 8 pCi/L). As a result of these factors, Sr-90 is the constituent whose concentrations most greatly exceed its MCL in perched water at INTEC and, therefore, presents the greatest threat to groundwater quality in the underlying SRPA. Other radionuclides present in perched water include Tc-99, I-129, tritium, and Cs-137. However, because the concentrations of these other constituents are close to, or below, their respective MCLs, they are of considerably less environmental concern, compared to Sr-90. The field and laboratory results for perched water during 2006 are discussed below.

During 2006, only three of the deep perched wells contained sufficient water for sampling: BLR-DP, MW-1-4, and USGS-50. Monthly water level measurements show that deep perched wells CS-DP, PP-DP, STL-DP, TF-DP, ICPP-2020-DP, and ICPP-2021-DP were dry or essentially dry during each of the previous 12 months (<1 ft of water). Well MW-1-4 is screened at a somewhat shallower depth (326–336 ft bgs) than other deep perched wells but is grouped with these for this discussion. The deep perched water zone lies at depths of approximately 380 to 400 ft. Elevated concentrations of tritium, Sr-90, and I-129 (and possibly Tc-99) in the deep perched zone are at least partially attributable to the former INTEC injection well (Site CPP-23), which routinely received in excess of 1 mgd of low-level radioactive service waste from 1952–1984.

2.2.2 Field Parameters for Perched Water

Table B-2 summarizes field measurements of perched water temperature, pH, EC, and dissolved oxygen, measured at the wellhead with a Hydrolab Quanta instrument during well purging. Perched water temperature ranged from 11.4 to 22.4°C. It should be noted that the temperatures were not measured downhole, but, rather, at the wellhead, and a slight warming or cooling of the water could have occurred during flow through the pump discharge line. The warmest temperature (22.4°C) was observed at monitoring well MW-2, located near the former WCF. This well has consistently shown elevated water temperatures over the past few years. The warm temperature at well MW-2 is confirmed by the temperatures recorded by the downhole Solinst Levelogger (see Appendix D). It has been speculated that the warmer temperature at this location could be the result of decay heat given off by the calcine solids in the binsets.

Perched water pH values ranged from 7.2 to 8.8. The observed pH values are similar to those observed previously in perched water and in SRPA groundwater. The pH values are consistent with the presence of calcite (CaCO_3) within the aquifer matrix, which tends to buffer the pH in the observed range.

EC values for perched water ranged from a minimum of 0.35 mS/cm (BLR-CH) to a maximum of 6.54 mS/cm (well 33-3). EC values for the majority of shallow perched wells were in the range of 0.3 to 1.0 mS/cm. However, as in previous years, well 33-3 (located near the northwest corner of the tank farm) had a much higher EC than the other wells. The elevated EC in well 33-3 corresponds with unusually high sodium and chloride concentrations that are believed to be associated with leakage of

brine from the nearby brine pit (CPP-736) and/or associated piping (EDF-5758). The brine pit is scheduled to be taken out of service in 2007.

2.2.3 Strontium-90 in Perched Water

Sr-90 concentrations in perched water during 2006 are shown in Figure A-22. Sr-90 was detected at 20 of the 21 wells sampled (Table B-3), and 13 of the wells exceeded the Sr-90 MCL (8 pCi/L). As in the past, very high Sr-90 levels (>10,000 pCi/L) were observed in the northern shallow perched water across INTEC. The highest Sr-90 concentrations were observed in wells southeast of the tank farm. Similar to 2005, the maximum Sr-90 concentrations detected were 197,000 pCi/L (33-1); 192,000 pCi/L (MW-2); 105,000 (MW-5-2); 101,000 (ICPP-2018); 23,400 (ICPP-2019); and 19,300 pCi/L (55-06). MW-10-2, completed in the lower shallow perched zone, also contained elevated Sr-90 (12,800 pCi/L).

Figure A-27 shows the Sr-90 trend over time in selected wells that have historically contained the highest concentrations (MW-2, MW-5-2, and 55-06). Sr-90 concentrations observed in 2006 are approximately half those reported in these same wells during the mid-1990s. Given its 29-year half-life, only a portion of the observed decline of Sr-90 concentrations can be attributed to radioactive decay; the remainder must be the result of other attenuation processes, such as adsorption, advection, and dilution/dispersion.

Figure A-28 shows perched water Sr-90 trends between 2004 and 2006. Sr-90 concentrations in most of the northern shallow perched wells during 2006 were similar to those observed in 2005 (DOE-ID 2006a). One exception was well MW-5-2, which has shown a significant increase in Sr-90 levels over the past 3 years. Well MW-5-2 is located at the southern edge of the WCF cap. The 2006 Sr-90 concentration in this well (105,000 pCi/L) was nearly twice that reported in 2005 (61,200 pCi/L), and over five-fold higher than in 2004 (16,100 pCi/L) and 2003 (19,000 pCi/L). The trend of increasing Sr-90 concentrations at this location (Figure A-28) is confirmed by the increasing gross beta results (Table B-3) and corresponds with a 13-ft decline in water level over the period 2004-2006. Because the Sr-90 samples are not filtered, it is possible that Sr-90 adsorbed to suspended sediment contributed to the observed increase in concentration. The EC of the perched water in well MW-5-2 has also increased significantly over this period from 0.50 mS/cm (2004) to 0.87 mS/cm (2005) to 1.12 mS/cm (2006), indicating an increase in the salinity of the perched water at this location. A downhole EC and temperature sensor installed in MW-5-2 shows that the perched water at this location had a dramatic increase in salinity, as well as a significant temperature increase, during the last half of 2004 (Appendix E). This anomaly follows a 10-ft increase in perched water levels that peaked in March 2004, followed by a 13-ft decline in water level during 2004-2006 (Appendix D). The cause(s) of the large fluctuations in water level and perched water quality at MW-5-2 has not been determined. But it appears that a recharge water source near MW-5-2 that existed during 2003 has subsequently been reduced or eliminated. A likely candidate is an underground steam line leak near CPP-1608 that was isolated (shut off) in late 2004 (DOE-ID 2006a). Whatever the cause, as of October 2006, well MW-5-2 had become essentially dry. Monitoring at this well will continue if and when the well contains sufficient water for sampling.

2.2.4 Technetium-99 in Perched Water

Technetium-99 was detected in eight of the 21 shallow perched wells during 2006 (Figure A-23). As with Sr-90, the highest levels of Tc-99 were observed in shallow perched monitoring wells located southeast of the tank farm, including wells MW-10-2 (461 pCi/L), 33-1 (118 pCi/L), MW-5-2 (39 pCi/L), and ICPP-2018 (45 pCi/L). None of the perched water samples exceeded the MCL for Tc-99 (900 pCi/L), and none have approached the concentrations of 2,000 to 3,000 pCi/L Tc-99 that have been observed at aquifer monitor well ICPP-MON-A-230 located north of the tank farm (Figure A-2).

Tc-99 trends in several perched water wells are shown in Figure A-29. The declining trends in these wells must be due to dilution/dispersion and transport to the deeper vadose zone, as the half-life of Tc-99 is long (213,000 years), and radioactive decay is insignificant over periods of a few years. Figure A-30 shows perched water Tc-99 trends between 2004 and 2006. In the majority of perched water wells, Tc-99 concentrations in 2006 were similar to or slightly lower than those observed in 2005.

2.2.5 Tritium in Perched Water

Tritium was detected in 13 of the 21 wells sampled during 2006 (Figure A-24). Tritium activities in nearly all of the monitoring wells were less than the MCL (20,000 pCi/L). Exceptions were well MW-7-2 (36,400 pCi/L) and USGS-50 (20,200 pCi/L). Figure A-31 shows long-term tritium trends in several perched water monitor wells.

Figure A-32 shows perched water tritium trends between 2004 and 2006. In the majority of perched water wells, tritium concentrations in 2006 were similar to or slightly lower than those observed in 2005. The only perched wells that showed an increase in tritium over the previous year were wells 33-2, MW-5-2, and MW-7-2. The most significant increase was at well MW-5-2, where the tritium activity has more than doubled between 2005 and 2006. The increase at MW-5-2 appears to correspond with a similar increase in Sr-90 and a large decline in water level. At well MW-7-2, tritium levels have increased from 27,300 pCi/L (2004) to 30,800 pCi/L (2005) to 36,400 pCi/L (2006). This well is located in the southern part of INTEC near CPP-603. The reason for the increase in tritium is unknown.

2.2.6 Iodine-129 in Perched Water

During 2006, I-129 was detected in only one of the 16 wells sampled for this constituent (Figure A-25; Table B-3). The I-129 concentration reported in well ICPP-2018 (5.22 pCi/L) located south of the tank farm was much higher than that reported in this same well in 2005 and was the highest concentration reported in any well in recent years. In 2005, this same well had the highest I-129 concentration (1.33 pCi/L). For the past 2 years, this was the only well that exceeded the I-129 MCL (1 pCi/L).

2.2.7 Cesium-137 in Perched Water

During 2006, Cs-137 was detected in perched water only at well 33-1 (119 pCi/L). The MCL for Cs-137 is 200 pCi/L. Cs-137 was detected in this same well during 2005 at 617 pCi/L. The presence of Cs-137 in this well is consistent with the fact that the well contains among the highest Sr-90 levels of any of the monitoring wells and is located inside the tank farm near the most significant soil release sites. It should be noted that elevated downhole gamma activity (presumably due to Cs-137) was detected during drilling of this well in 1991.

2.2.8 Uranium Isotopes in Perched Water

Uranium-238 was detected at all perched water well locations, and concentrations ranged from 0.9 to 5.5 pCi/L, with the highest concentration observed at perched water well 33-3 located near the northwest corner of the tank farm (Table B-4). U-233/234 was also detected in all samples, with activities ranging from 2.0 to 8.6 pCi/L. As with U-238, the highest concentration was reported at perched water well 33-3. U-234 is the daughter product of alpha decay of the long-lived, naturally occurring U-238. Due to limited water volume available for lab analysis, the perched water samples collected from well 33-3 during 2006 were not analyzed for total uranium. However, this analysis was performed during 2005, and well 33-3 contained the highest total uranium concentration of any of the perched water monitoring wells (18.5 µg/L). This value exceeds the background limits for total uranium of 0 to 9 µg/L, as determined by

the USGS for the SRPA (Orr, Cecil, and Knobel 1991). Total uranium concentrations for other perched wells sampled during 2006 ranged from 2.3 to 7.7 $\mu\text{g/L}$; these values lie within the background range for the SRPA. Uranium-235 was detected in perched water from several wells, including wells 37-4, BLR-CH, ICPP-2019, TF-CH, MW-1-4, and MW-5-2, with the highest activity (0.71 pCi/L) observed at the latter well.

2.2.9 Other Actinides in Perched Water

Pu-238 was detected in a single perched water sample from well 33-1 (0.48 pCi/L). Similarly, Pu-239/240 was detected only at well 33-1 (0.11J pCi/L) (Table B-4). Well 33-1 is located in the southern part of the tank farm, and fission products have repeatedly been detected in perched water from this well. The gross alpha MCL that applies to Pu isotopes is 15 pCi/L. In addition, Pu-241 (beta emitter) was reportedly detected at a single location in the perched water sample from MW-5-2 (12.1 pCi/L). Because of its sporadic detection at various monitoring locations, the presence of Pu-241 is considered questionable. The derived MCL for Pu-241 is 300 pCi/L. Am-241 was detected in two wells at concentrations close to the minimum detectable activity: BLR-CH (0.07J pCi/L) and MW-9-2 (0.079J pCi/L). Np-237 was not detected in any of the perched water samples collected during 2006.

2.2.10 Gross Alpha/Gross Beta in Perched Water

Detectable gross alpha activity was reported at nearly all perched water sampling locations (Table B-3). The highest gross alpha activities reported in 2006 were at wells BLR-DP (99 pCi/L), CS-CH (48 pCi/L), and well 33-3 (36 pCi/L). The reason for the elevated gross alpha results is unknown because, aside from natural uranium, no other alpha-emitting actinides were detected in the perched water samples from these wells. The drinking water MCL for gross alpha radiation is 15 pCi/L.

Gross beta activity was detected at all perched water sampling locations (Table B-3). The highest gross beta levels occurred at wells 33-1 (428,000 pCi/L), MW-2 (351,000 pCi/L), ICPP-2018 (266,000 pCi/L), and MW-5-2 (229,000 pCi/L). Each of these wells is located southeast of the tank farm, and each has historically yielded perched water containing high Sr-90 levels, which accounts for the elevated gross beta results.

2.2.11 Mercury in Perched Water

Both filtered and unfiltered perched water samples were collected for analysis of metals, including mercury. Filtered samples were filtered through a 0.45- μm membrane filter, and the results for dissolved mercury are shown in Table B-5. Mercury was detected in 2006 at several perched water monitoring locations, including MW-1-4 (0.13B $\mu\text{g/L}$), MW-7-2 (0.11J $\mu\text{g/L}$), TF-CH (0.18 $\mu\text{g/L}$), and deep perched well USGS-50 (0.14B $\mu\text{g/L}$). These concentrations are close to the detection limit of approximately 0.1 $\mu\text{g/L}$. The MCL for mercury is 2 $\mu\text{g/L}$. Mercury salts were formerly used as catalysts at INTEC during the dissolution of aluminum-clad fuel elements, and mercury has periodically been detected at low concentrations in perched water samples in past years.

2.2.12 Nitrate in Perched Water

Nitrate was detected in all of the perched wells sampled during 2006 (Table B-5). Nitrate/nitrite-nitrogen concentrations in perched water are shown in Figure A-26. Although the laboratory reported concentrations for combined nitrate/nitrite-nitrogen, these values should be essentially identical to the concentrations of nitrate-nitrogen, because nitrite (NO_2) concentrations are expected to be extremely low (nondetect) under the oxidizing conditions present in the perched water. Nitrate/nitrite-nitrogen results for several of the shallow perched wells exceeded the MCL of 10 mg/L

during 2006, with the highest concentration observed at well MW-1-4 (48.9 mg/L as N). At most wells, nitrate results for the perched water samples were similar to those observed during 2005. A notable exception was well MW-5-2, where nitrate-nitrogen concentrations increased from 4.9 mg/L (2005) to 36.2 mg/L (2006). The perched water in this well has shown a significant rise in solute concentrations that correlates with a decline in water level. Potential sources of nitrate at INTEC include (a) past releases of nitric acid solutions at the tank farm and other locations and (b) nitrogen in treated wastewater effluent from the former sewage treatment lagoons (STLs). The presence of elevated nitrate-nitrogen concentrations southeast of the tank farm may be attributed primarily to impacts from tank farm vadose zone sources.

2.2.13 Major Ions in Perched Water

Concentrations of major ions in perched water are summarized in Table B-5, and complete results are included in Appendix C. Cation-anion charge balance errors calculated using the filtered (dissolved) metals results were less than 5% for nearly all samples, exceptions being MW-9-2 (10%) and MW-2 (6%). The generally good match between cations and anions indicates that there were no significant laboratory errors in the major ion analyses.

Chloride concentrations in perched water ranged from 9 mg/L at BLR-DP to 85 mg/L at MW-6. The relatively low chloride concentrations observed at wells BLR-CH and BLR-DP probably result from infiltration of low-chloride surface water in the nearby Big Lost River. Well MW-6 is located near the INTEC cafeteria, relatively close to monitoring well 33-3. During the 2006 sampling event, well 33-3 did not yield sufficient water for chloride analysis, but in past years the chloride concentration at this well has been much higher than any of the other perched wells (948 mg/L in 2005). The elevated EC (6.54 mS/cm) measured at well 33-3 during 2006 indicates that high salinity continues to persist at this location. The elevated sodium and chloride in the perched water at well 33-3 (and probably also MW-6) are attributed to an underground water softener brine pit (CPP-736) located about 100 ft north of this well (EDF-5758). The CPP-736 underground brine pit was installed in 1984 and is a 55,000-gal-capacity reinforced concrete underground tank. Brine impacts to the shallow perched water in this area were observed during 1994 at monitoring well 33-3, suggesting that leakage of sodium chloride brine from the brine pit or associating piping had occurred prior to that time. As of 2006, the CPP-736 underground brine pit is still in use, and brine impacts continue to be observed in well 33-3. However, as part of a water treatment system upgrade, a new replacement aboveground brine tank has been installed inside Building CPP-1647, and the old underground CPP-736 brine pit is scheduled to be taken out of service in 2007 and abandoned in place.

2.2.14 Organic Compounds in Perched Water

Organic compounds are not routinely monitored as part of the WAG 3, Group 4 perched water program. However, on May 17, 2006, during measurement of the water level at perched monitoring well ICPP-2018, a hydrocarbon odor was noted on the e-line when it was removed from the well, which is located south of the INTEC main stack (Figure A-2). The odor was similar to diesel fuel. Field logbook entries for prior sampling of this well were reviewed to determine if hydrocarbon odors were noted previously at this location. Excerpts from the field notes from well ICPP-2018 were as follows:

- 5/09/05: "water looks clear"
- 8/18/05: notes do not indicate anything abnormal
- 11/01/05 "water smells of sulfur," "looks clear (water), smells sulfur-ish"
- 2/01/06 "water is murky, foamy, smells bad"

4/24/06 “water dirty, yellow”

5/02/06 “water is smelly and greyish in color. Diesel.”

Well ICPP-2018 was installed during February 2005. The field notes from the initial sampling event on May 9, 2005, say “water looks clear,” and there was no indication of an odor. Likewise, the notes from the August 2005 WCF sampling event do not indicate any unusual odor or appearance. However, beginning in November 2005, a sulfur odor was noted; and, beginning in May 2006, hydrocarbon odors were noted in the well.

Because of the suspected presence of hydrocarbons in this well, a special sampling event was performed on July 12, 2006, to attempt to sample the hydrocarbon nonaqueous phase liquid (NAPL), if present. The Redi-Flo 2 pump was removed from the well, and a photoionization detector (PID) meter was used to check for volatile organic compounds in the air column within the well. The PID meter did not detect any volatile organic compounds. Next, a hydrocarbon interface probe was slowly lowered into the well to check for the possible presence of a floating hydrocarbon layer. The interface probe indicated 0.04 ft (1/2 in.) of floating NAPL, and the probe came out oily and smelled of hydrocarbons. A clear plastic bailer was then lowered slowly into the well (suspended from the e-line). When the bailer was brought back up, there was an oily rainbow sheen on the water surface, but no measurable thickness of NAPL. The bailer smelled strongly of hydrocarbons, but the water appeared clear. Samples of the water containing the oily sheen were collected and submitted to the laboratory (Southwest Research Institute [SWRI]) for hydrocarbon fingerprinting lab analysis by gas chromatography. The results of these tests indicate the presence of fuel hydrocarbons but were inconclusive regarding the type of fuel product. The gas chromatography chemist at SWRI stated the following:

Clearly this is a weathered sample in which it would be unlikely to match peaks directly with any fuel. However by observing the chromatographic retention times it is obvious that there is a preponderance of later eluting peaks. Although earlier eluting (i.e., more volatile) peaks are likely to be lower in a weathered sample the presence of later eluting ones indicates that the hydrocarbon mixture is from a heavier fuel such as something like a diesel fuel oil. Fuels such as gasoline and kerosene do not have components eluting in this chromatographic region.

There are at least two possible sources of fuel hydrocarbon near well ICPP-2018. The first possibility is the former CPP-702 kerosene tanks and piping that previously existed at the same location as well ICPP-2018. CPP-702 consisted of two aboveground tanks that contained kerosene used to fuel the WCF. Past releases of kerosene from the CPP-702 tanks or associated piping during the 1970s and 1980s near the present location of well ICPP-2018 are well documented (Golder 1991). The second potential source of fuel hydrocarbons is the CPP-701 fuel oil tanks located near the northwest corner of the tank farm. On November 14, 2005, a leak of boiler fuel oil (#2 diesel) was discovered at the base of aboveground tank CPP-701A, which was installed in 1951. This tank is approximately 1,600 ft from monitoring well ICPP-2018. The tank was subsequently emptied and cleaned, and the interior was inspected. Three areas of corrosion were observed on the tank floor, and one of these had a 1/2-in. hole penetrating the tank floor plate. A subsurface investigation was then performed, which included advancing 85 borings into the alluvium surrounding and beneath the leaky tank. Alluvium samples were collected for laboratory analysis of fuel hydrocarbons. Based on the presence of fuel hydrocarbons to depths of approximately 50 ft, it was concluded that some of the fuel oil had reached the base of the alluvium and entered the underlying basalt. McNeel (2006) estimated that approximately 940 gal of fuel oil had leaked from the tank.

In spite of considerable effort, it has not been conclusively determined whether the fuel hydrocarbon detection at well ICPP-2018 is attributable to the leak at the CPP-701 fuel oil tank or leaks at the former CPP-702 kerosene tanks. However, it is clear that the fuel product observed in shallow perched well ICPP-2018 was not fresh fuel, but rather an old, weathered hydrocarbon mixture. This observation, coupled with the proximity of the well to the former CPP-702 kerosene tanks, suggests this is the most likely source.

2.2.15 Performance Evaluation Sample Results

Radionuclide laboratory analyses of perched water samples were performed by GEL, and inorganic constituents were analyzed by Severn Trent Laboratory in St. Louis, Missouri. Level A data validation was performed on all laboratory results. To assess analytical performance for key radionuclides, double-blind aqueous PE samples prepared by RESL were submitted to the off-Site laboratory (GEL) with the April 2006 perched water samples. The PE samples contained known concentrations (activities) of selected radionuclides, including tritium, Am-241, Cs-137, I-129, Pu-238, Pu-239, Sr-90, Tc-99, U-234, and U-238, among others.

RESL and the Sample and Analysis Management program assessed the results reported by the off-Site laboratory. Based on the laboratory results for the PE sample, RESL concluded the following:

- U-234 results were judged as not acceptable due to high bias (143% recovery).
- Pu-239 results were judged as not acceptable because a statistically positive result was reported (1 ± 0.2 pCi/L) when the sample was a blank for that radionuclide.
- Sr-90 results received a warning due to low bias (74% recovery).
- Pu-238 results received a warning due to low bias (82% recovery).
- Cs-134 results received a warning due to low bias (89% recovery).

With the exceptions listed above, the PE sample results for all other analytes met the acceptance criteria, indicating that the laboratory results were in agreement with the known concentrations. The contract laboratory has been notified of these results so that appropriate corrective actions may be performed. The PE sample results do not imply that the perched water results for Sr-90, Cs-134, U-234, and Pu-238 are unusable, but rather that the results for U-234 and Pu-239 may be biased high, and the results for Sr-90, Cs-134, and Pu-238 may be biased low. The perched water results for U-234 and Pu-239 show that the concentrations of these radionuclides did not approach or exceed the MCL of 15 pCi/L (Table B-4). Therefore, the possible high bias of the U-234 and Pu-239 results is not considered cause for concern. Similarly, Cs-134 was not detected in any of the samples, and Pu-238 was only detected in one of the perched water samples at a concentration far below the MCL of 15 pCi/L. Therefore, the possible low bias of the Cs-137 and Pu-238 results does not constitute a significant data quality issue. The most significant issue associated with the PE sample submitted with the perched water samples is the low Sr-90 recovery (74%). This result suggests that the Sr-90 concentrations reported for perched water samples may be 26% too low.

2.2.16 Suction Lysimeter Sampling Results

Suction lysimeters permit sampling of water from unsaturated materials. Lysimeter data are discussed separately, in part because the results may not be directly comparable to samples from perched monitoring wells. Lysimeters sampled during 2006 are listed in Table B-1. Lysimeters from which vadose zone water samples were collected include five lysimeters inside the tank farm (A-60 series) and 14 lysimeters located elsewhere around INTEC (BLR [Big Lost River], CS [central set], PP [percolation

pond], STL [sewage treatment lagoon], and TF [tank farm] well set lysimeters). In all cases, only limited volume water samples were obtained from the lysimeters, and the list of laboratory analytes for each lysimeter is shown in Table B-1. The lysimeter locations are shown on Figure A-3. The lysimeter water quality results are included in Table B-3. Due to the small sample volumes, vadose zone water samples collected from suction lysimeters were analyzed for only a limited suite of constituents, including Sr-90, Tc-99, and tritium (Table B-1).

Samples collected from the suction lysimeters at INTEC generally contained lower radionuclide concentrations than the perched water samples collected from nearby monitoring wells (Table B-3). The water samples from CS-SP-L155 and STL-DP-L418 contained Sr-90 at 12.5 and 9.4 pCi/L, respectively. Similar Sr-90 activities were detected in lysimeter CS-SP-L155 when it was sampled during 2004 and 2005. Sr-90 concentrations at all other lysimeter locations were <8 pCi/L during 2006 (Table B-3).

Concentrations of Tc-99 and tritium did not exceed MCLs in any of the lysimeters. The highest Tc-99 activity (22.1 pCi/L) was observed at lysimeter A-62-41, which is well below the Tc-99 MCL of 900 pCi/L. The highest tritium activity (12,400 pCi/L) was observed at lysimeter PP-DP-L383. The tritium MCL is 20,000 pCi/L. The presence of tritium at this location is probably the result of past discharge of service waste at the former INTEC percolation ponds.

2.3 SRPA Groundwater Levels

Table B-6 summarizes manual water level measurements for SRPA wells measured during January–April 2006. These water elevation data were used to create a groundwater elevation contour map for an area surrounding INTEC (Figure A-33). Measured depths to water ranged from 460 to 510 ft below ground. The depth to water measurements were converted to groundwater elevations using the surveyed measuring-point elevations adjusted for borehole deviation.

As in previous years, the 2006 groundwater level contour map shows that the general direction of groundwater flow near INTEC is south to southwest (Figure A-33). Near CFA, the flow ranges from southeast to southwest. The groundwater hydraulic gradient varies considerably across the map area. The gradient is relatively flat between INTEC and the CFA landfill wells (LF-series wells), with less than 4 ft of head difference over this 2-mile distance.

The 2006 groundwater contour map is similar in shape to the maps prepared for 2003–2005, except that absolute groundwater levels vary from year to year in response to wet-dry climate cycles. Groundwater levels declined during 2000–2005 as a result of drought during this time period. Figure A-34 shows groundwater hydrographs for several aquifer wells. The hydrographs show that groundwater levels declined more than 10 ft in many aquifer wells across the southern INL Site during the most recent drought cycle (2000 through 2005). However, as a result of above-normal precipitation during 2005 and 2006, and corresponding periods of flow of the BLR during those 2 years, the hydrographs show a slight rise in groundwater levels during 2006.

2.4 Perched Water Levels

Manual water level measurements were performed monthly during 2006 using a Solinst electronic water level meter (e-line). Automatic water level measurements were recorded every half-hour in selected perched water wells using Solinst Levellogger and In-Situ miniTroll water level dataloggers. Perched water hydrographs are included in Appendix C.

Figure A-5 shows the approximate lateral extent of the northern shallow perched water during 2005–2006. Areas where shallow perched water was not observed during the reporting period include (a) the central portion of the facility roughly between the dry fuel storage area and Binsets 1-3 and (b) the extreme northeast part of INTEC. During 2005-2006, the eastern boundary of the northern shallow perched water expanded to the east, presumably as a result of above-normal precipitation and recharge. Consequently, perched water was again observed in monitoring well MW-4-2, after many years during which this well had been dry.

Perched water movement at INTEC is predominantly vertical but may also flow laterally where a horizontal hydraulic gradient exists and where low-permeability units are present that impede downward flow. Compared with groundwater flow in the underlying SRPA, flow paths in the perched water can be tortuous and difficult to predict.

Figure A-35 shows hydrographs for selected shallow perched monitoring wells. As in the past, wells 33-1, 33-2, and 33-4-1 had the highest water levels. Well 33-2 showed a 3-ft drop in water level during October–November 2005, but the water level completely recovered by January 2006. As in the past, the water level in well 33-4-1 remained nearly constant. The lowest water levels were observed at MW-5-2. Continuing a trend that began in 2004, the water level in well MW-5-2 continued to decline throughout 2006, reaching the lowest level since well installation. During the reporting period, water levels in MW-5-2 were more than 6 ft lower than those in any other shallow perched monitoring well (Figure A-35).

In contrast to MW-5-2, the water level in well MW-4-2 rose nearly 6 ft during the reporting period. Well MW-4-2 was dry during 2000-2005, but as of September 2006 the well contained approximately 8 ft of water. The hydrographs for wells MW-2, 55-06, and ICPP-2019 were nearly identical (Figure A-35), which suggests that these wells are hydraulically connected and respond to the same recharge sources. The hydraulic gradient of the upper shallow perched water beneath the northern portion of INTEC generally coincides with dip of the 110-ft sedimentary interbed, which dips southeastward under this area.

Well BLR-CH is located about 500 ft southeast from the BLR, is screened 120-130 ft bgs, and is the closest monitoring well to the river channel. As a result of releases from Mackay Reservoir, the BLR began flowing past INTEC on April 16, 2006. Four days later on April 20, 2006, the water level in well BLR-CH abruptly began to rise, rising approximately 13 ft over 2 weeks. The river continued to flow until July 3, 2006, when the flow dropped to zero. The 2006 hydrograph is included in Appendix C.

Due to instrument malfunction at well BLR-CH, automated water level data were not recorded from May 24, 2006, until September 20, 2006. However, monthly manual water level measurements performed at well BLR-CH show that the water level slowly declined during July–August. By early September 2006, the water level in this well had returned to levels similar to those prior to the onset of BLR flow. The 2006 data show that well BLR-CH responded strongly to flow in the BLR, with a 4-day lag from the onset of flow until the well responded.

In contrast to shallow perched well BLR-CH, no obvious water level change occurred in deep perched well BLR-DP during the weeks immediately following the beginning of flow in the BLR in April 2006. Rather, well BLR-DP exhibited a slow 2-ft rise in water level during the summer of 2006 (Appendix C). These results are consistent with observations during the previous year and indicate that deep perched water levels in BLR-DP respond much more slowly to flow in the river.

The lateral extent of shallow perched water beneath the northern portion of INTEC is shown on Figure A-5. As indicated on the map, the following shallow perched wells were dry during the monitoring period: MW-4-2, MW-8, MW-12-2, and MW-18-2. The upper shallow perched zone generally coincides with the 110-ft sedimentary interbed and is defined as perched because it is underlain by unsaturated materials of the deeper vadose zone.

As shown in Figure A-35, the shallow perched water level in well BLR-CH responded rapidly to the onset of BLR flow on April 16, 2006, but the other shallow perched monitoring wells located further away from the river showed no obvious response to BLR flow. The BLR undoubtedly loses much water to streambed infiltration, and this water does recharge the SRPA. However, under normal flow conditions BLR infiltration appears to have little influence on the shallow perched water at locations further away from the river, such as the tank farm area. Instead, a combination of precipitation infiltration (rainfall and snowmelt) and discharges and leaks of water from facility pipelines appears to account for continued recharge of the perched water beneath the north-central part of INTEC. As a result of wetter conditions during the past 2 years, the extent of shallow perched water beneath the northern part of INTEC expanded eastward during 2005-2006. However, this appears primarily attributable to an increase in on-Site precipitation infiltration, not BLR streambed infiltration.

Based on similarities in well depth and water level response, the following shallow perched wells were selected for analysis of perched water gradients and flow directions: 33-2, 33-4-1, 37-4, 55-06, MW-2, MW-4-2, ICPP-2018, and ICPP-2019. Monitoring well 33-1 was not used because it is screened at a shallower depth (above the upper shallow perched). Wells MW-8, MW-12-2, and MW-18-2 were not included in the analysis because they were dry on the monitoring date. Wells 33-3, MW-6, MW-10-2, and MW-20-2 were not used for the contour map because all of these are screened deeper (in the lower shallow perched water). And, lastly, MW-5-2 was not used for the contour map because, although it appears to be screened in the upper shallow perched zone, it is screened slightly deeper than the others (across the 110-ft interbed), and the water level in this well during 2006 was significantly lower than the other wells.

Figure A-36 is a water level contour map for selected upper shallow perched wells on September 19, 2005. Water level elevations are in units of feet above mean sea level (National Geodetic Vertical Datum of 1929). As in previous years, the water elevation data suggest southeasterly lateral flow in the shallow perched water beneath the northern INTEC. The inferred flow direction from the hydraulic gradient generally coincides with the southeasterly dip of the top of the 110-ft interbed beneath and south of the tank farm. Note that downward vertical flow is also expected for the shallow perched water, but such vertical flow cannot be shown on the plan view water level maps.

The perched water level data for September 19, 2006, (Figure A-36) indicate a southeasterly hydraulic gradient ranging from 0.010 to 0.023 ft/ft to the southeast. Assuming a gradient of 0.02 ft/ft, along with reasonable values of hydraulic conductivity and porosity, horizontal shallow perched water flow velocities are predicted to be approximately 0.5 m/day toward the southeast. Note that this calculation assumes an isotropic, porous medium, and this assumption is not valid for the fractured basalt. Actual flow velocities through joints in the basalt could be considerably faster than the calculated 0.5 m/day.

2.5 Perched Water Temperatures

Appendix D contains graphs of water temperatures recorded by the Solinst Levellogger downhole instruments. During 2006, wells MW-2, ICPP-2018, MW-5-2, and 33-3 had the highest perched water temperatures of approximately 21.5, 20.5, 19.5, and 19°C, respectively. These same wells showed the

highest temperatures during 2004–2005. As in previous years, the highest temperatures occurred in the area southeast of the tank farm.

The remaining perched wells had temperatures of 11 to 18°C, with the coldest temperatures recorded at wells MW-4-2 and BLR-CH. Most of the perched wells displayed relatively constant temperatures over time, as measured with Solinst Leveloggers. Exceptions were wells 33-1, MW-5-2, and MW-15, which displayed temperature fluctuations greater than 0.5°C. In particular, MW-15 in the southern part of INTEC showed rather large swings in temperature and perched water level during the first half of 2006. Rapid temperature changes at a particular well most likely indicate a nearby recharge source.

2.6 Perched Water Electrical Conductivity

Appendix D includes graphs of EC recorded by the Solinst Levelogger downhole instruments. EC is an indicator of water salinity, with higher EC indicating higher salinity. Most of the perched wells displayed relatively constant downhole EC values over time, as measured with Solinst Leveloggers. EC values for most wells were in the range of 0.4 to 0.7 mS/cm. These values are slightly higher than is typically measured in the underlying SRPA groundwater, which is consistent with the elevated salinity of the perched water. Anomalously high EC values were recorded at wells 33-3 and MW-5-2. The elevated salinity at well 33-3 is believed attributable to leaks from the nearby underground brine pit discussed previously. The reason for the elevated EC in well MW-5-2 is less clear, but the salinity of the perched water at this location has risen significantly during the same period that the water level has declined. As with temperature fluctuations, large changes in downhole EC are believed attributable to specific recharge events that impact nearby wells.

2.7 Tensiometer Moisture Monitoring Data

According to the MSIP (DOE-ID 2005b), collection of soil moisture data is required to determine whether moisture contents in the vadose zone decreased after relocation of the percolation ponds. As part of the Phase I monitoring discussed in the MSIP, tensiometers were installed in the alluvium, shallow perched water zone, and deep perched zone at each of the five new well sets (BLR, STL, TF, CS, and PP) to determine spatially distributed vadose zone water potentials for comparison with future data sets. Pressure transducers and data loggers were used to measure and record soil-water tension or pressure at each of the installed tensiometers. The tensiometer plots (Appendix E) show soil-water potentials recorded from July 2001 through November 2006.

In 2006, advanced tensiometers were rigorously field-checked to determine which tensiometers were working, fix those that were not working, if possible, and determine which tensiometers were yielding representative data. Thus, the tensiometer data plots shown in this report may differ from previously published tensiometer data.

At the BLR wellset, all tensiometers except the alluvium tensiometer (33-ft depth) showed a response to flow in the BLR in 2006. The tensiometer BLR-SP1 at 132 ft showed the largest changes in water potential, beginning with a steep rise on March 14, 2006. This was about 1 month before the BLR began to flow and is likely the result of surface recharge from spring snowmelt and precipitation. An inflection point on the graph at April 21, 2006, probably signals the arrival of the wetting front from the first flow in the river, which began to flow on April 16, 2006. Water potential values at this location continued to increase, reaching a peak of nearly +500 cm of perched water on June 21, 2006. The river ceased flowing on July 3, 2006. After the July peak, water potentials at BLR-SP1 declined sharply until October when the water potential decline became gradual. Tensiometers at the 167-, 352-, and 395-ft

depths in the BLR wellset displayed similar responses to the 2006 BLR flow event, but the responses were delayed and more subdued than the +500 cm of water increase observed at the 132-ft depth.

At the Central Set tensiometer nest, recharge was recorded at the 42-, 122-, and 287-ft depths in 2006. The tensiometer at 122 ft continued to show the largest fluctuations (Appendix E). The fluctuations in spring 2005 and 2006 most likely represent recharge and drainage in response to surface water infiltration. Surface water infiltration was recorded in spring 2005 and 2006 in the alluvium by the 42-ft tensiometer in CS-AL (Figure E-6). However, the observed overall increase in perched water levels since fall 2003 at the 122-ft depth, coupled with the sharply increasing and large (~230 cm of water) change in water potentials at the 287-ft depth since at least August 2006, suggest another source of recharge was also present. Possible candidates include several fire water leaks that occurred several hundred feet southwest of this well set during 2004-2006.

The tensiometers of the Percolation Pond wellset continue to show the drain out of perched water following the cessation of service wastewater flow at the former percolation ponds in August 2002 (Appendix E). Since that time, the tensiometers at this location generally indicate unsaturated conditions (negative water potentials), with the exception of the 169-ft tensiometer in May 2006. Saturated pressures of approximately +250 cm of water were observed at the 169-ft depth; however, these pressures quickly declined to less than saturation within days. The occurrence of saturated pressures at 169 ft may be a response to recharge at the surface. However, soil-water potentials in the surface alluvium at PP-AL, located approximately 150 ft east of the 169-ft tensiometer, did not record a surface recharge event. Over the 2006 spring recharge timeframe, a lack of water potential data at the 109- and 132-ft depths, as well as a lack of data leading up to the saturated pressures observed at the 169-ft depth, prevents a conclusive interpretation. Soil-water potentials at the 28- and 264-ft depths have remained relatively constant over the past year.

Soil-water pressure readings at the Sewage Treatment Lagoon wellset indicate recharge occurred at this location in 2006 (Appendix E). At the 27-ft depth in the alluvium, a sharp rise in water potential occurred in July 2005 and again in May 2006. The rise in July 2005 may be attributable to a 0.66-in. rainstorm on June 22, 2005, that caused large volumes of water to flow in the nearby unlined drainage ditch. At STL-SP1, installed at the 104-ft depth, several wetting-drying cycles are apparent between 2001 and 2006. In 2006, this tensiometer recorded water potentials approaching saturation. The peak of this event occurred during January 2006, so BLR river recharge cannot be responsible. Additionally, in the interbed at the 154-ft depth, water potential data indicate a gradual wetting since 2005 with a small +15 cm of water rise over this period. The source(s) of the recharge at the Sewage Treatment Lagoon set remains uncertain, but a likely candidate is infiltration of storm runoff and cooling water into the unlined ditch that flows nearby within 50 ft of this wellset.

At the Tank Farm well set, water potentials remained nearly constant during 2006. Saturated conditions (positive soil-water pressures) have consistently been observed at the 157- and 173-ft depths. The presence of saturated conditions at these depths is supported by the presence of perched water in nearby monitoring well TF-CH, which is screened at 145-150 ft bgs, and manual water level measurements in the 173-ft tensiometer at the Tank Farm set. Minor water potential changes were observed at some of the tank farm tensiometer locations. A slow rise in water potentials at the 173-ft depth began in mid-2005 and indicates a gradual increase in perched water levels at that depth. Tensiometer TF-DP2 showed a wetting and drying cycle at the 388-ft depth between December 2005 and October 2006, but soil-water potentials remained close to zero, and large fluctuations in moisture were not observed. Water potentials at the 118-ft depth indicate the slow wetting from 2001 through 2004 appears to have stabilized.

3. SUMMARY

For each of the primary constituents of concern, Table B-7 summarizes the maximum COC concentration observed during 2006 in the shallow perched water, the deep perched water, and SRPA groundwater at INTEC, along with the number of MCL exceedances reported for each of these three media. Highlights of the 2006 monitoring results are presented below.

Sr-90, Tc-99, and nitrate exceeded their respective drinking water MCLs in one or more of the aquifer monitoring wells at or near INTEC, with Sr-90 exceeding its MCL by the greatest margin. Sr-90 concentrations remain above the MCL (8 pCi/L) at nine of the 22 monitoring wells sampled in 2006, and Sr-90 concentrations remained nearly constant (within ± 2 sigma) in nine out of 14 monitoring wells that were sampled in both 2004 and 2005. Six of 22 wells showed Sr-90 declines during this period, and only one well located southeast of INTEC showed a slight increase (USGS-67).

Tc-99 was detected above the MCL (900 pCi/L) in two wells within INTEC, but concentrations were below the MCL at all other locations. As in the past, the highest Tc-99 level was at the ICPP-MON-A-230 monitoring well (2,150 pCi/L) located north of the INTEC tank farm. Tc-99 concentrations declined between 2005 and 2006 at seven of the wells, and Tc-99 levels at nine of the 16 aquifer wells sampled overlapped the results from the previous year. USGS-67 was the only well that showed an increase in Tc-99 from 2005 to 2006.

I-129 concentrations at all aquifer well locations were less than the MCL, with the highest concentration reported at well USGS-67 (0.65 pCi/L). This is the same well that has shown rising concentrations of Tc-99 over the past several years. The I-129 results for 15 out of 16 aquifer wells were similar to the results from the previous year. One well showed a decline in I-129 during this interval (USGS-47), and none of the aquifer wells showed increases in I-129.

Tritium concentrations have been below the MCL in all aquifer wells sampled during 2003–2006. The highest tritium concentration in groundwater during 2006 was at well MW-18-4 (8,930 pCi/L) located near the former WCF. The tritium results for 12 of the 16 wells were similar between 2005 and 2006. One well showed a tritium increase during this period (USGS-42), and three wells showed declines in tritium. Examination of longer-term trends indicates that tritium concentrations in groundwater have continued to decline during the period from 2000 through 2006.

Pu-238 was detected in a single SRPA groundwater sample from well USGS-112 (1.33 pCi/L). Similarly, Pu-239/240 was detected only at well USGS-112 (1.42 pCi/L), as was Am-241 (0.333 pCi/L). The gross alpha MCL that applies to Pu isotopes is 15 pCi/L. In addition, Pu-241 (beta emitter) was detected in the groundwater sample from MW-18-4 (5.7 pCi/L). The derived MCL for Pu-241 is 300 pCi/L. Np-237 was not detected in any of the groundwater samples collected during 2006.

U-238 was detected in SRPA groundwater at all sampling locations; however, with the exception of well USGS-112 located midway between INTEC and CFA, the reported concentrations of U-238 are generally consistent with background concentrations reported for total uranium in SRPA groundwater elsewhere (Knobel, Orr, and Cecil 1992). U-233/234 was also detected in all samples at concentrations similar to SRPA groundwater elsewhere, and U-234/U-238 ratios were similar to background U-234/U-238 ratios for the eastern SRPA. U-235 was not detected in any of the WAG 3, Group 5 aquifer monitoring wells but was reportedly detected in several ICDF aquifer monitoring wells at concentrations ranging from 0.1 to 0.168 pCi/L.

Mercury was detected at a single location in SRPA groundwater (ICPP-2020; 0.065 $\mu\text{g/L}$). This value is below the mercury MCL of 2 $\mu\text{g/L}$.

Nitrate was detected in all of the wells sampled during 2006, but the only aquifer well that exceeded the MCL for nitrate-nitrogen of 10 mg/L was well ICPP-2021 (16.4 mg/L as N) located southeast of the tank farm.

The 2006 groundwater contour map is similar in shape to the maps prepared for 2003–2005, except that groundwater levels vary from year to year in response to wet-dry climate cycles. Groundwater levels declined during 2000–2005 as a result of drought during this time period. However, as a result of above-normal precipitation during 2005 and 2006 and corresponding periods of flow of the BLR during those 2 years, the aquifer well hydrographs show a slight rise in groundwater levels during 2006.

As a result of wetter conditions during the past 2 years, the extent of shallow perched water beneath the northern part of INTEC expanded eastward during 2005–2006. The BLR began flowing past INTEC on April 16, 2006, and on May 28, 2006, the river flow peaked at 310 ft³/s. Another slightly lesser peak in flow occurred on June 13, 2006, and the river continued to flow until July 3, 2006, when the flow dropped to zero. The effect of BLR streamflow infiltration was pronounced in perched water monitoring wells at the BLR well set located about 500 ft from the river. However, there was little or no water level response observed in wells located further from the river.

As in previous years, Sr-90 was the principal radionuclide detected in the shallow perched water at concentrations exceeding the MCL. Sr-90 concentrations exceeded the MCL of 8 pCi/L in 16 of the 21 wells sampled, with shallow perched well 33-1 displaying the highest Sr-90 activity (197,000 pCi/L). Additional shallow perched wells southeast of the tank farm continued to show similarly elevated Sr-90 activities. Sr-90 activities in perched water at most well locations remained about the same as the previous year. One exception was well MW-5-2, which has shown a significant increase in Sr-90 levels over the past 3 years. Cs-137 was detected in perched water at a single location in 2006 at well 33-1 (119 pCi/L). This is somewhat lower than the Cs-137 level detected in this same well during 2005 (617 pCi/L).

Tritium concentrations exceeded the MCL of 20,000 pCi/L in two of the wells. The highest tritium concentration observed during 2006 was at shallow perched well MW-7-2 (36,400 pCi/L), followed by deep perched well USGS-50 (20,200 pCi/L). In the majority of perched water wells, tritium concentrations in 2006 were similar to or slightly lower than those observed in 2005.

I-129 was detected in only one of the 16 wells sampled for this constituent. The I-129 concentration reported in shallow perched well ICPP-2018 (5.22 pCi/L) located south of the tank farm was higher than that reported in this same well in 2005 and was the highest concentration reported in any well in recent years. In 2005, this same well had the highest I-129 concentration (1.33 pCi/L). For the past 2 years, this was the only well that exceeded the I-129 MCL (1 pCi/L). At all other monitoring locations, I-129 concentration trends were either relatively constant or slowly declining over time.

The highest levels of Tc-99 in perched water were observed in monitoring wells located southeast of the tank farm. However, as in the past, none of the perched water samples collected exceeded the MCL for Tc-99 (900 pCi/L). In the majority of perched water wells, Tc-99 concentrations in 2006 were similar to or slightly lower than those observed in 2005.

Nitrate is the predominant inorganic contaminant in the perched water. Nitrate concentrations exceeding the MCL (10 mg/L NO₃-N) were observed in several shallow and deep perched wells in the northern part of INTEC, with the highest concentration observed at deep perched well MW-1-4 (41.4 mg/L NO₃-N). Nitrate concentrations were generally consistent with historical levels.

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Appendix A

Figures

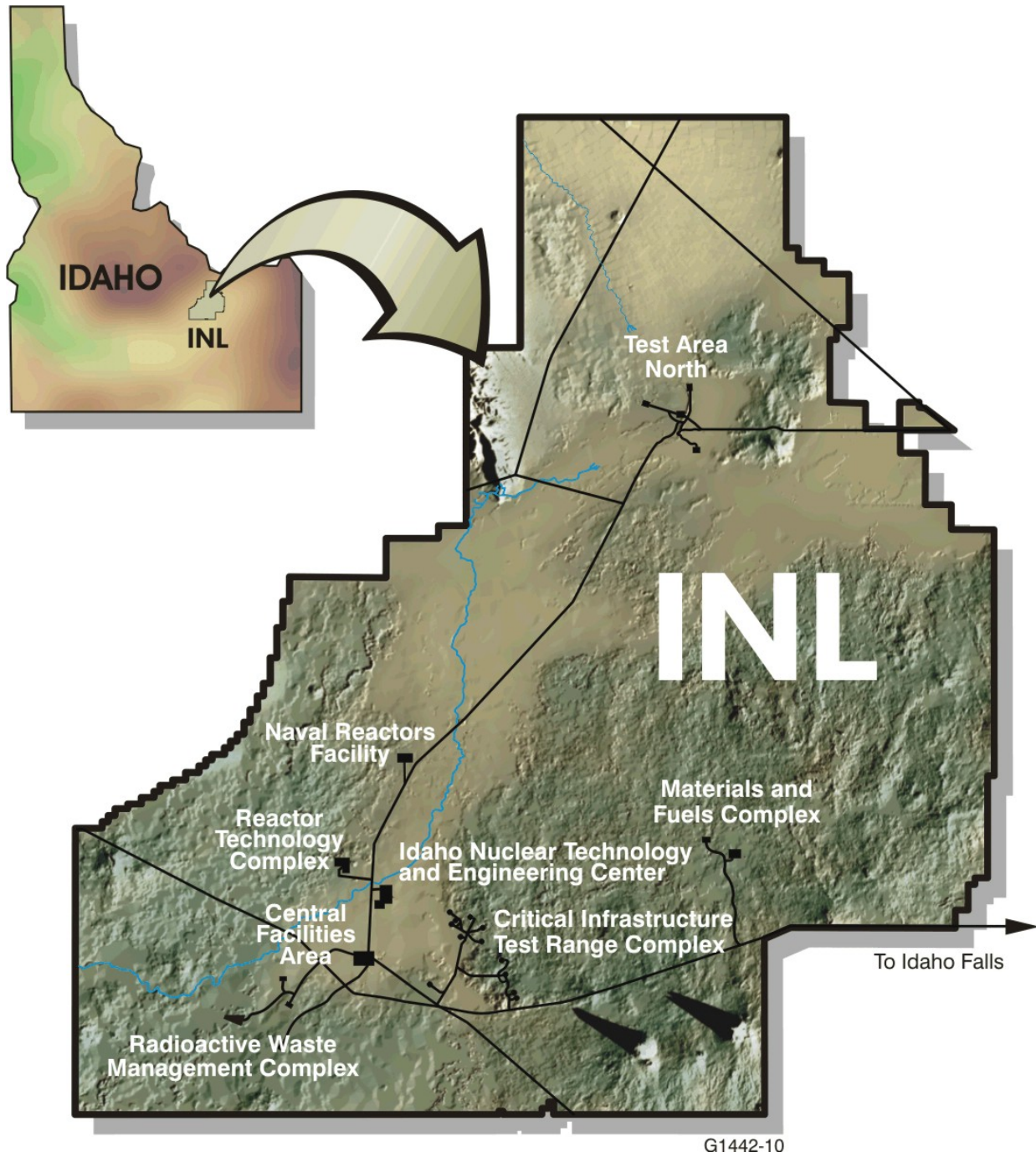


Figure A-1. Map showing the location of INTEC at the INL Site.

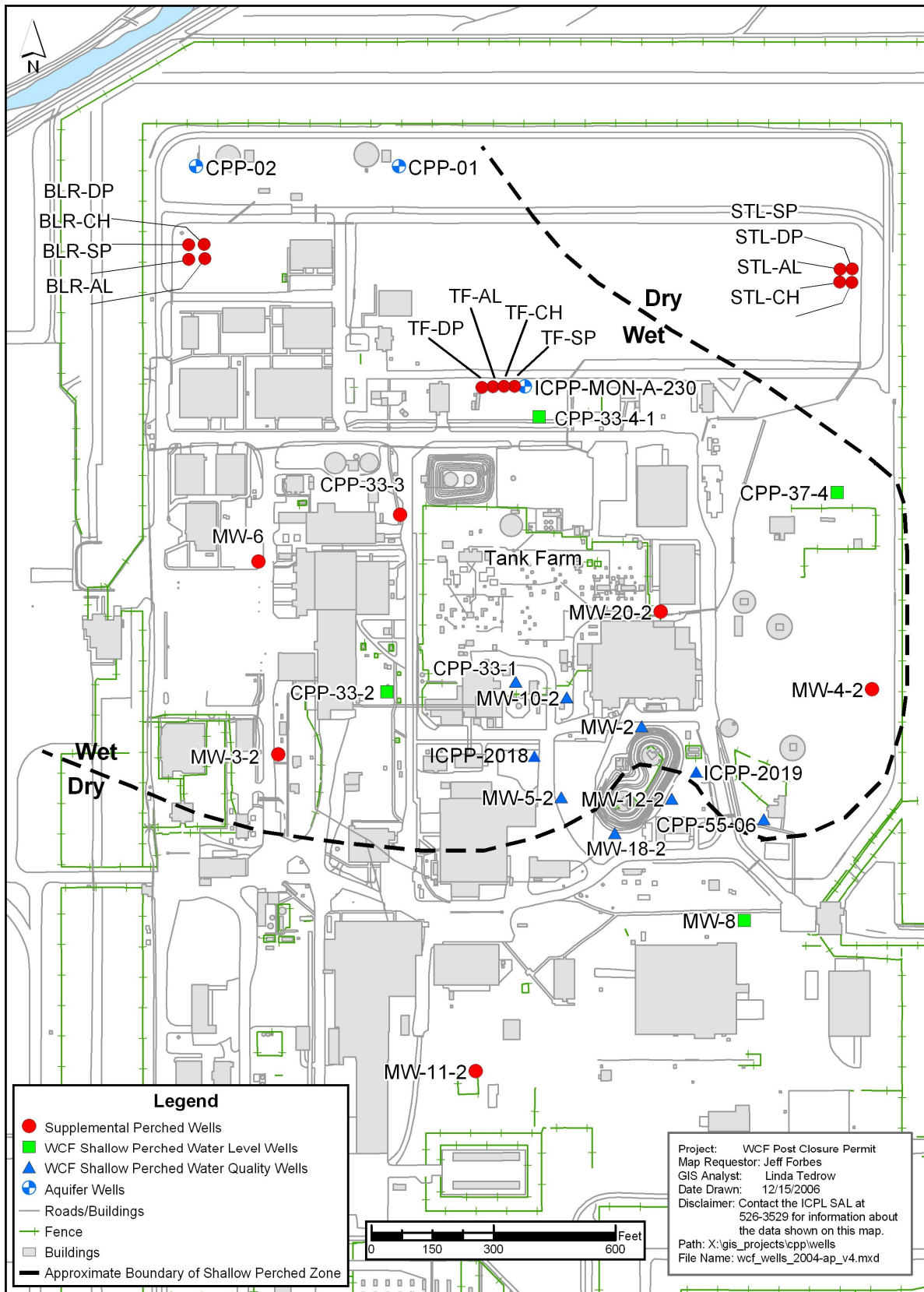


Figure A-5. Map showing lateral extent of northern shallow perched water zone during 2006.



Figure A-6. Distribution of Sr-90 in SRPA groundwater - 2006.



Figure A-7. Distribution of Tc-99 in SRPA groundwater - 2006.

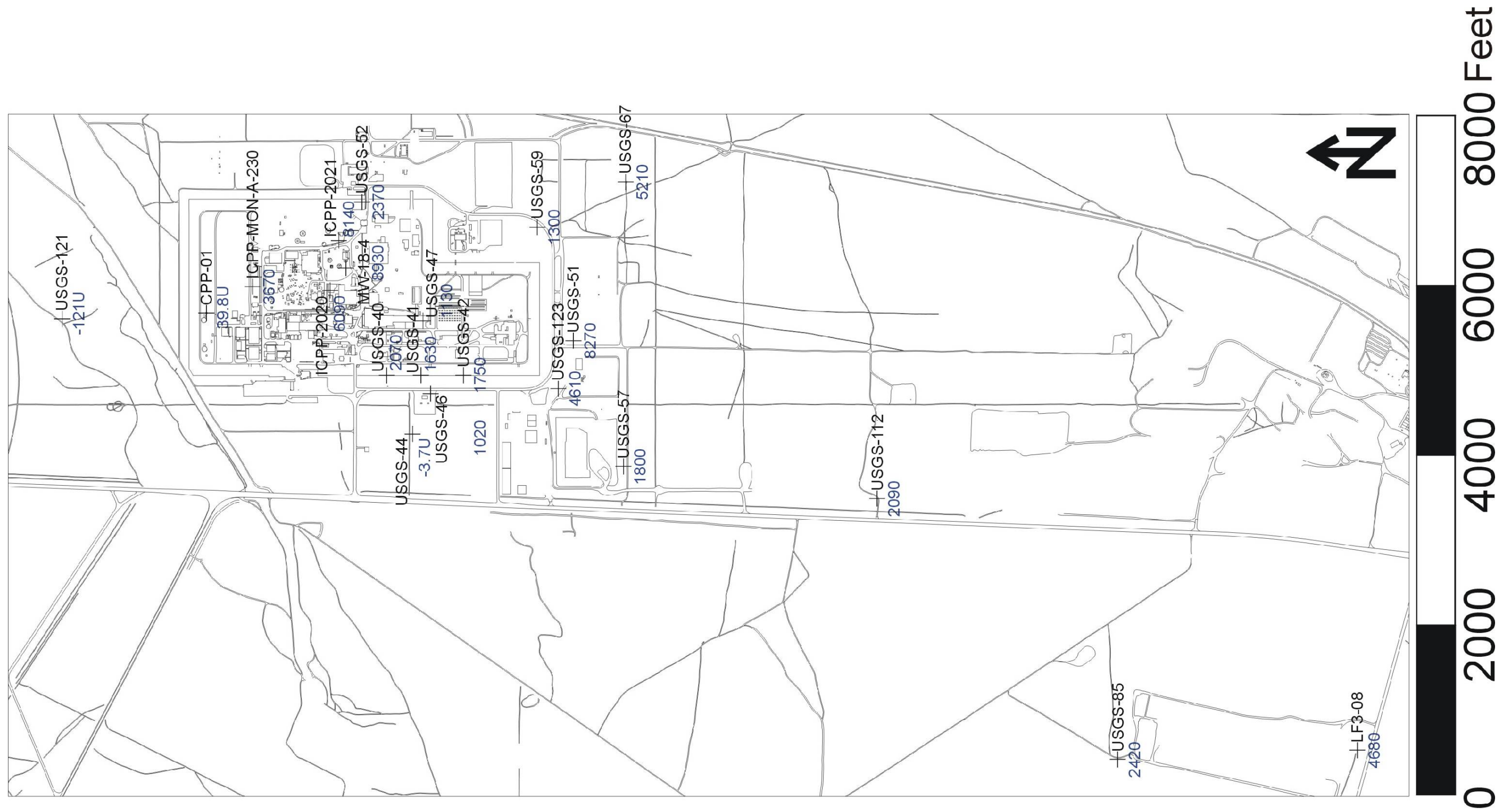


Figure A-8. Distribution of tritium in SRPA groundwater – 2006.



Figure A-9. Distribution of I-129 in SRPA groundwater - 2006.



Figure A-11. Distribution of chloride in SRPA groundwater - 2006.

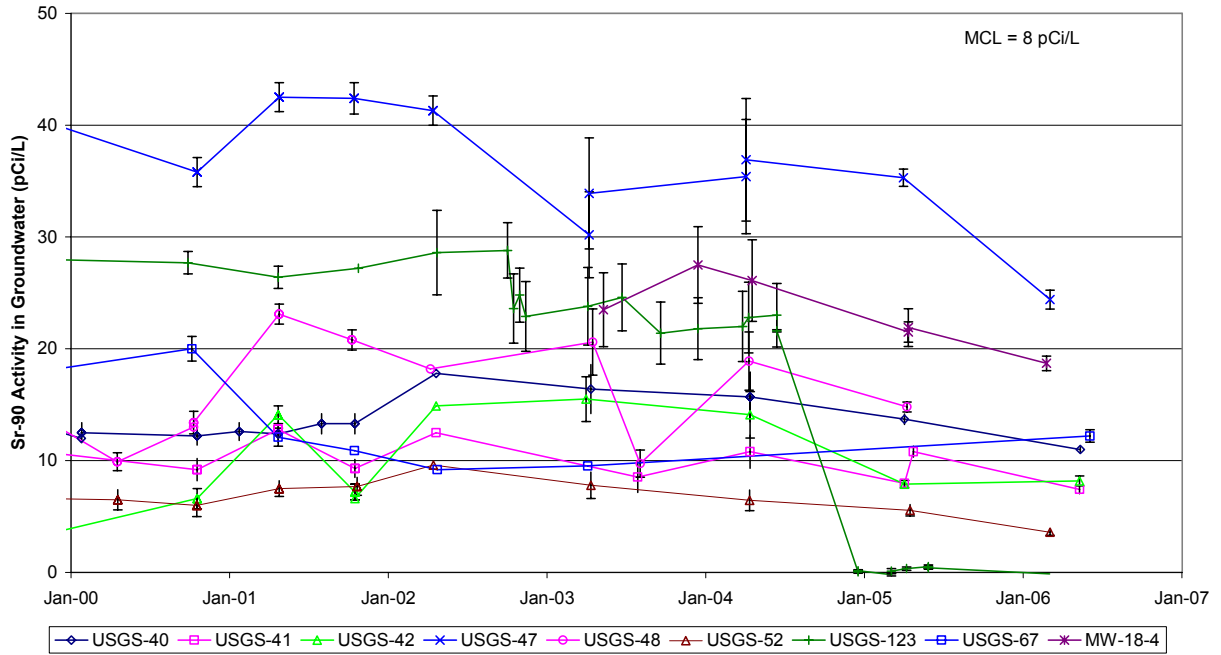


Figure A-12. Sr-90 concentration trends for selected SRPA wells.

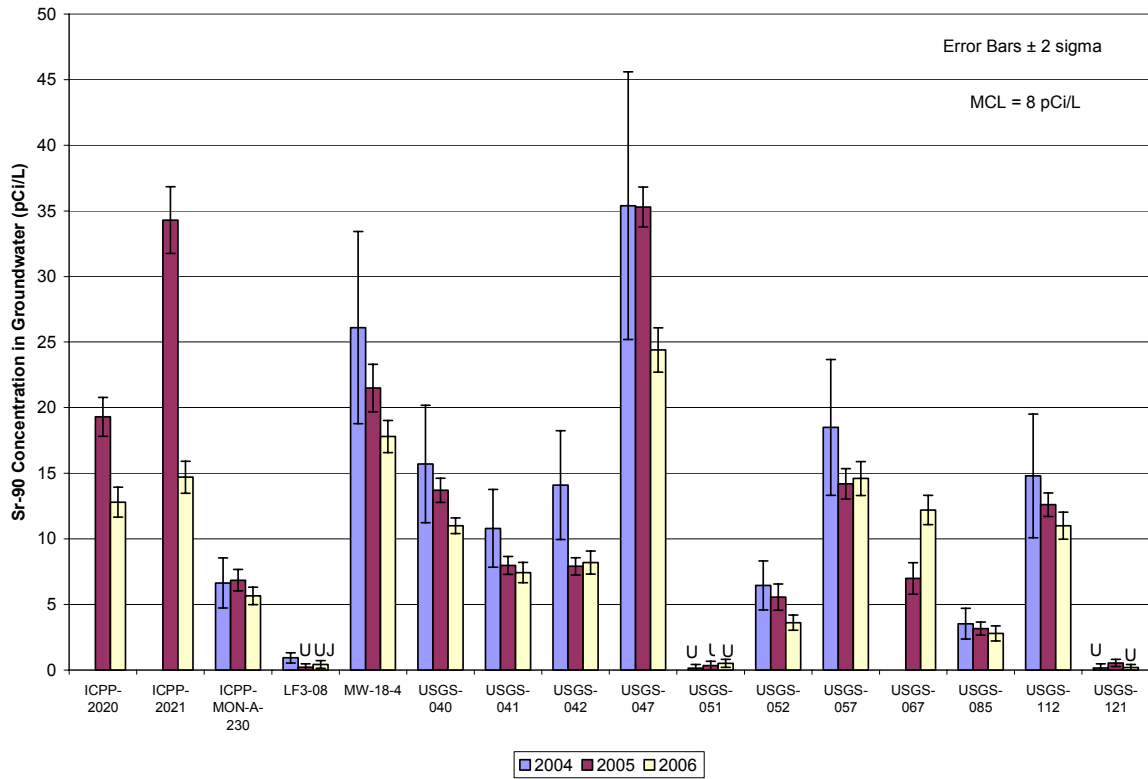


Figure A-13. SRPA Sr-90 concentration trends 2004–2006.

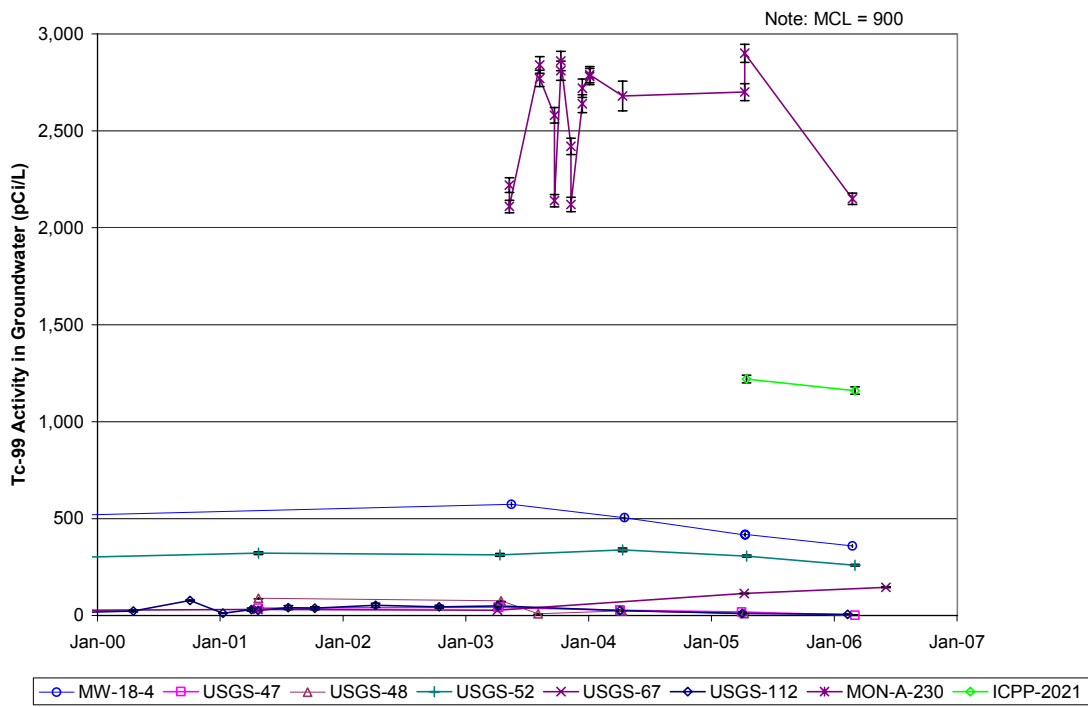


Figure A-14. Tc-99 concentration trends for selected SRPA wells.

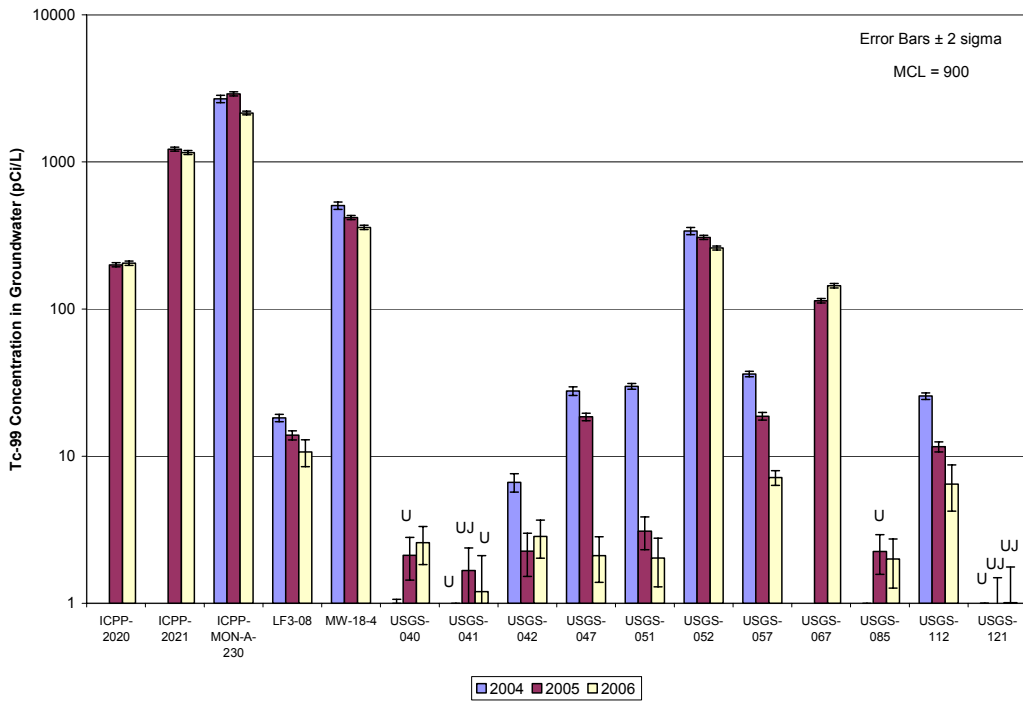


Figure A-15. SRPA Tc-99 concentration trends 2004–2006.

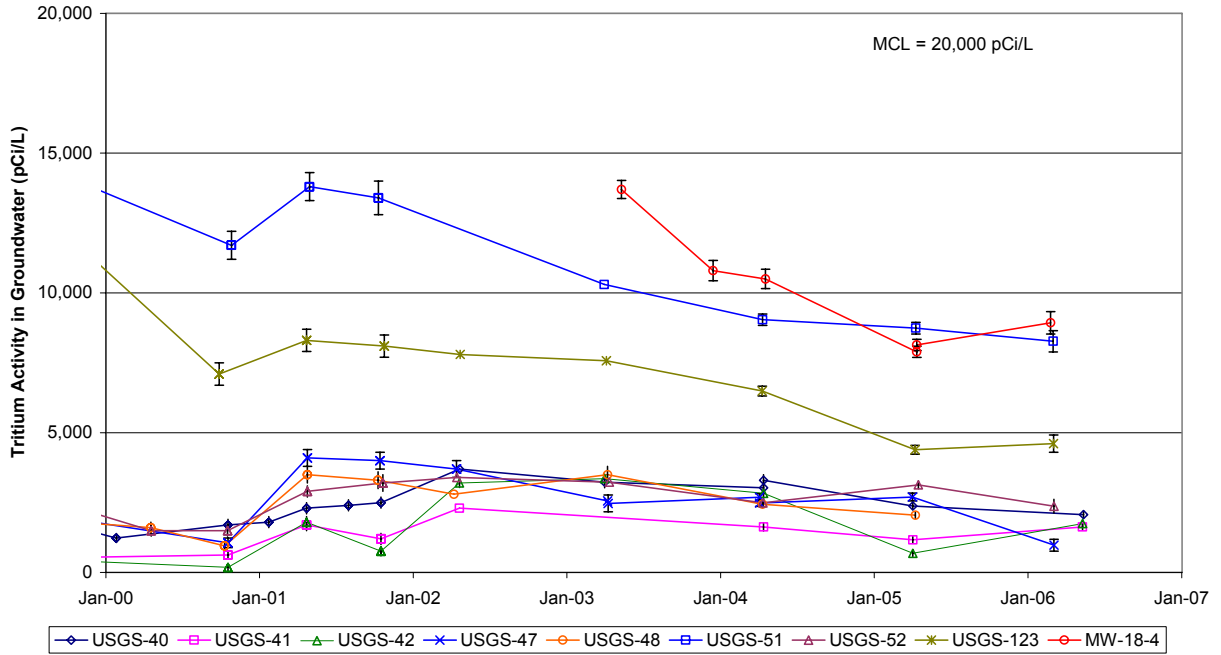


Figure A-16. Tritium concentration trends for selected SRPA wells.

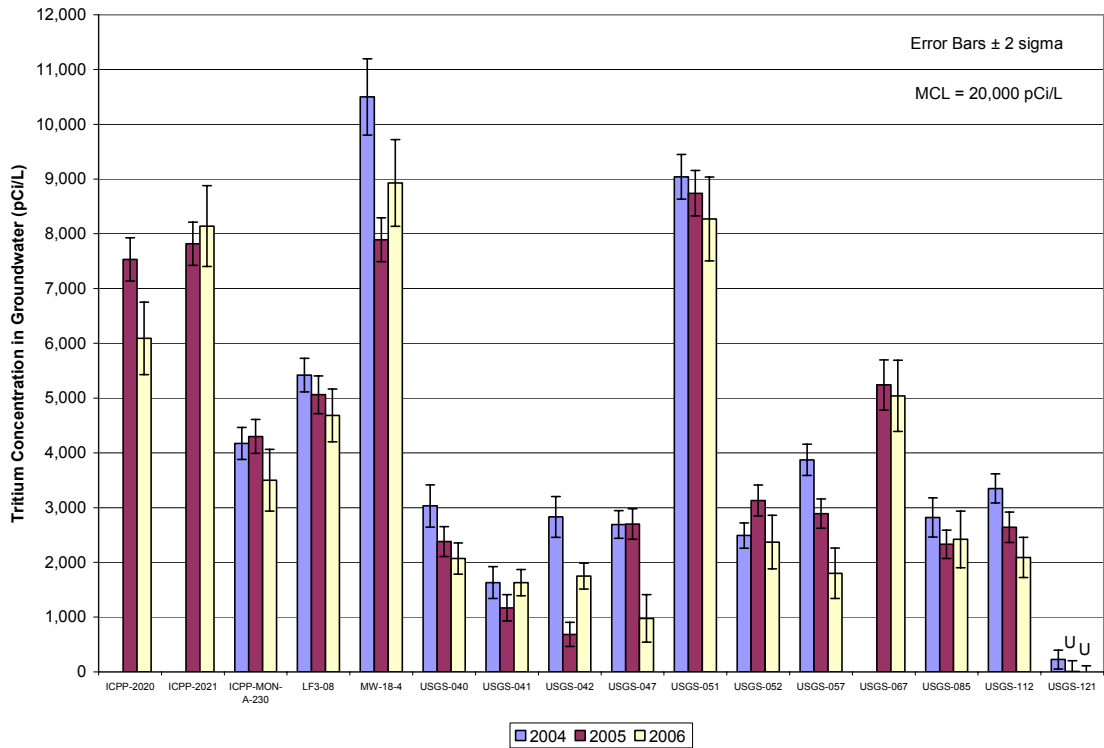


Figure A-17. SRPA tritium concentration trends 2004–2006.

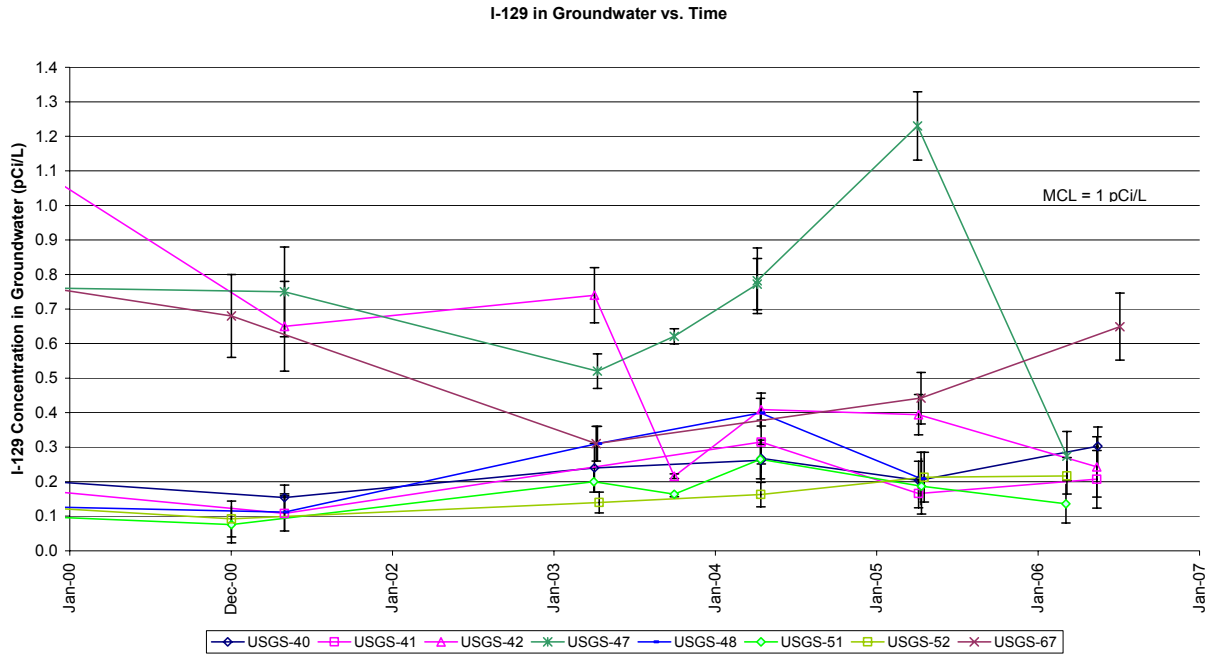


Figure A-18. I-129 concentration trends for selected SRPA wells.

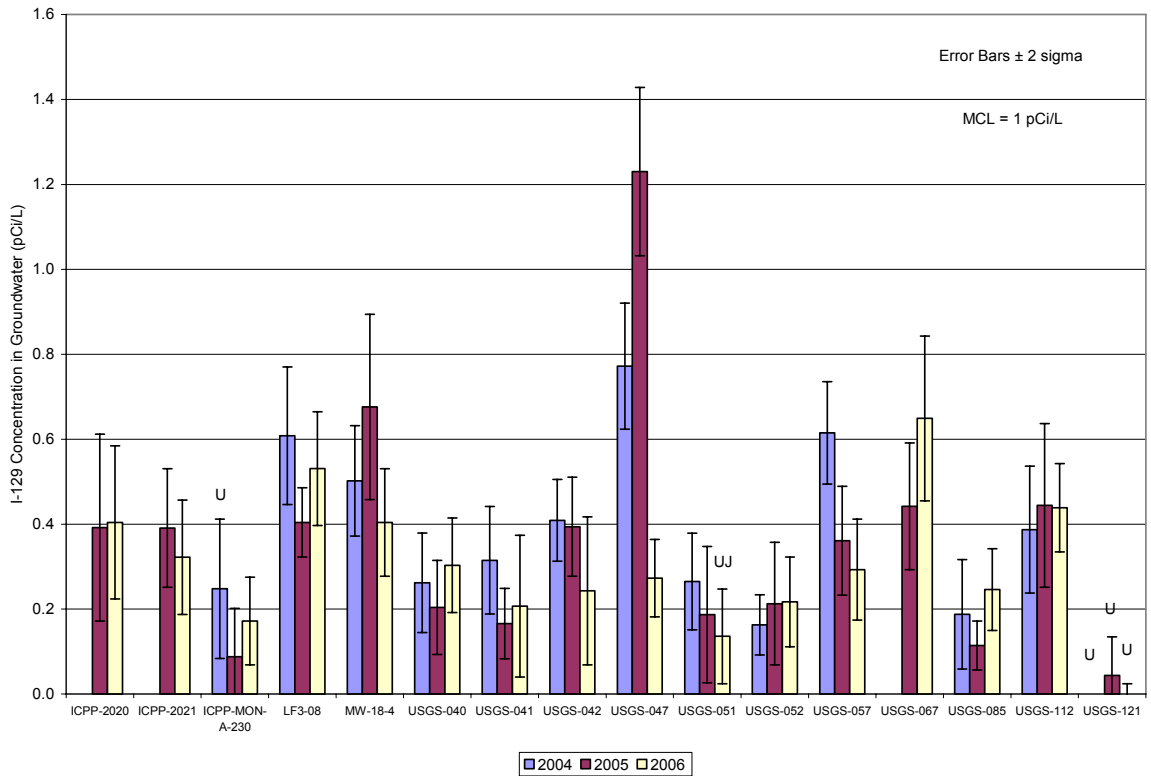


Figure A-19. SRPA I-129 concentration trends 2004–2006.

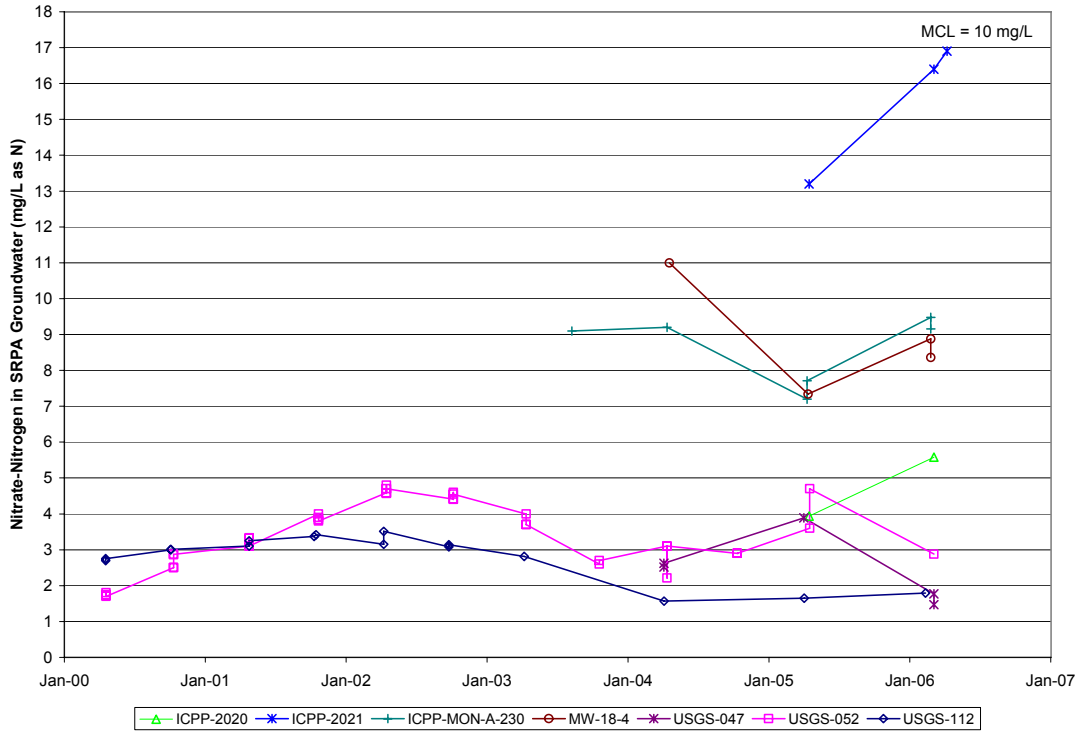


Figure A-20. Nitrate-nitrogen concentration trends for selected SRPA wells.

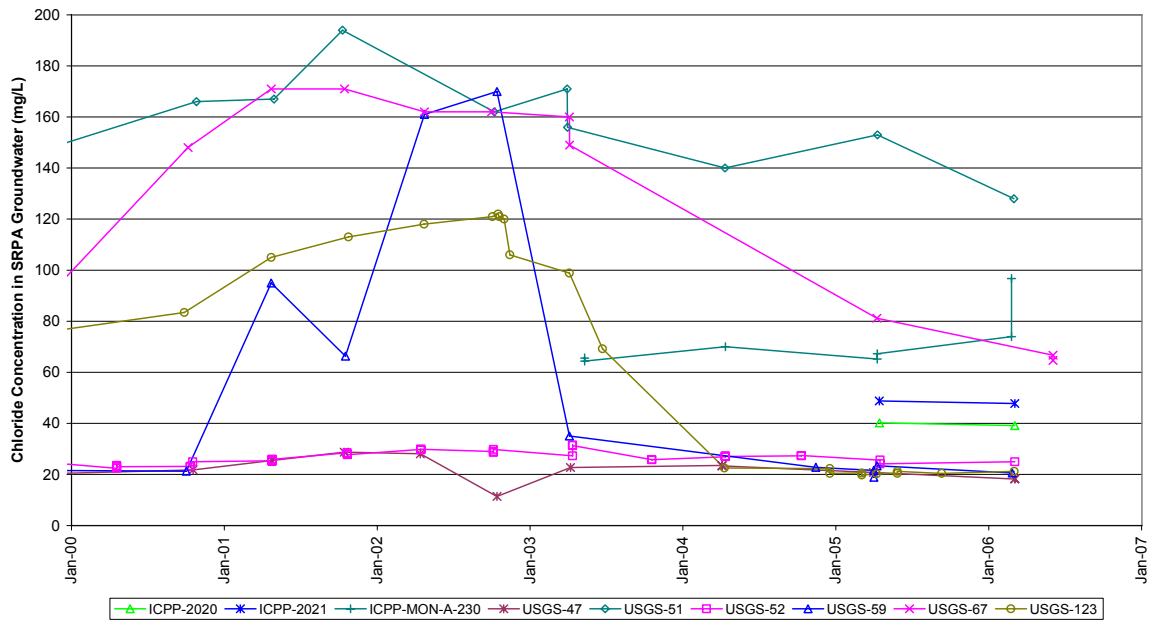


Figure A-21. Chloride concentration trends for selected SRPA wells.

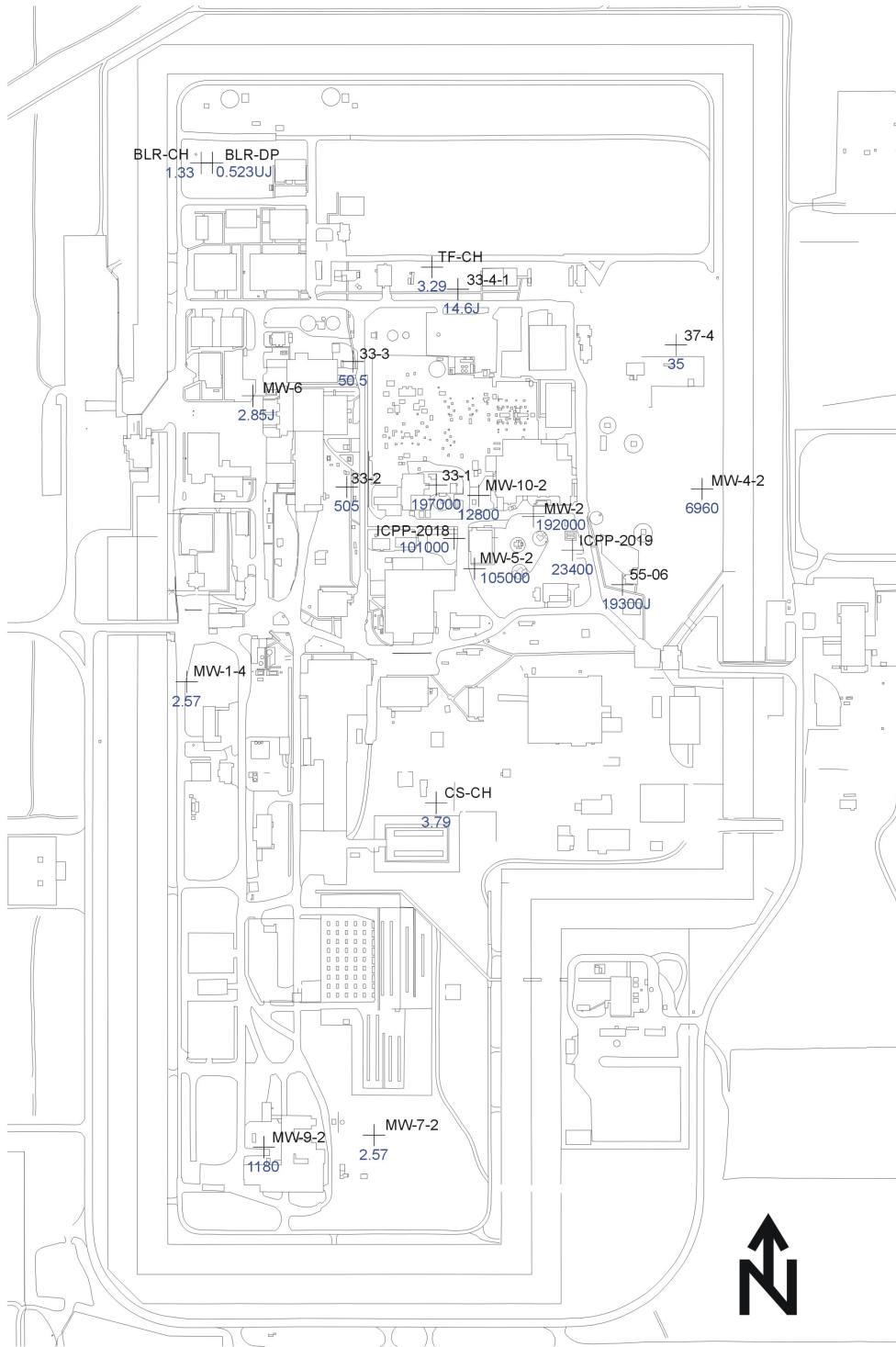


Figure A-22. Distribution of Sr-90 (pCi/L) in perched water in 2006.

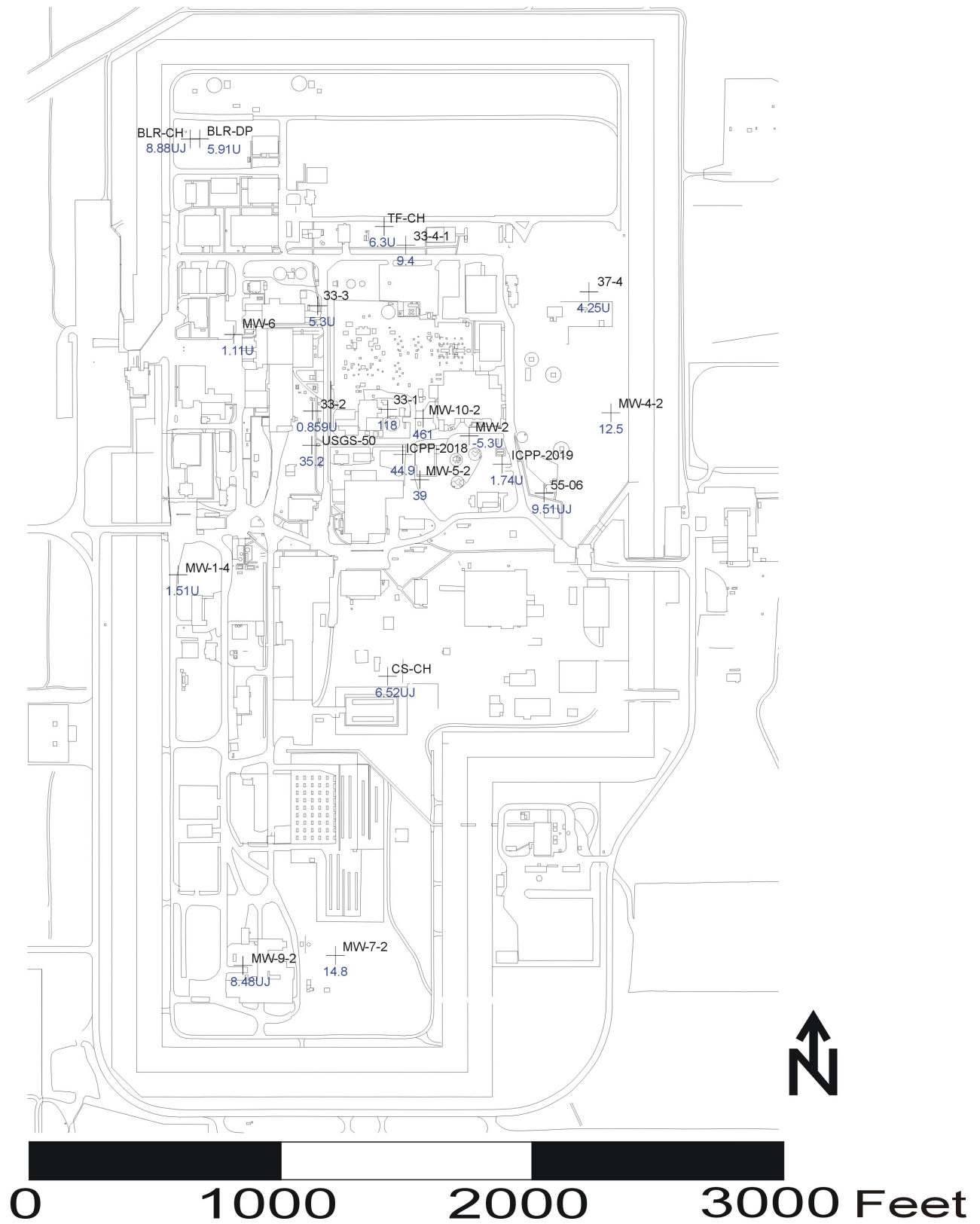


Figure A-23. Distribution of Tc-99 (pCi/L) in perched water in 2006.

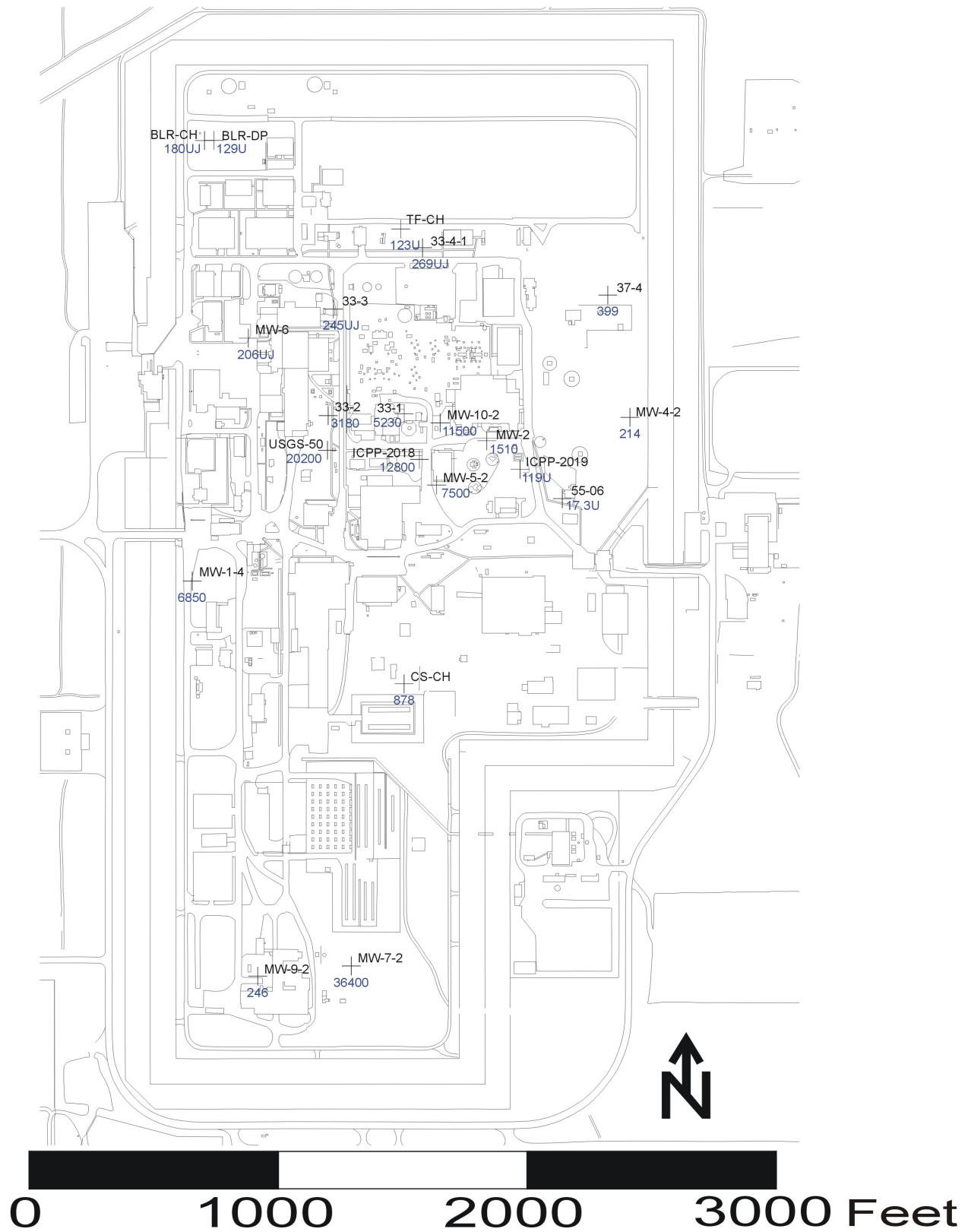


Figure A-24. Distribution of tritium (pCi/L) in perched water in 2006.

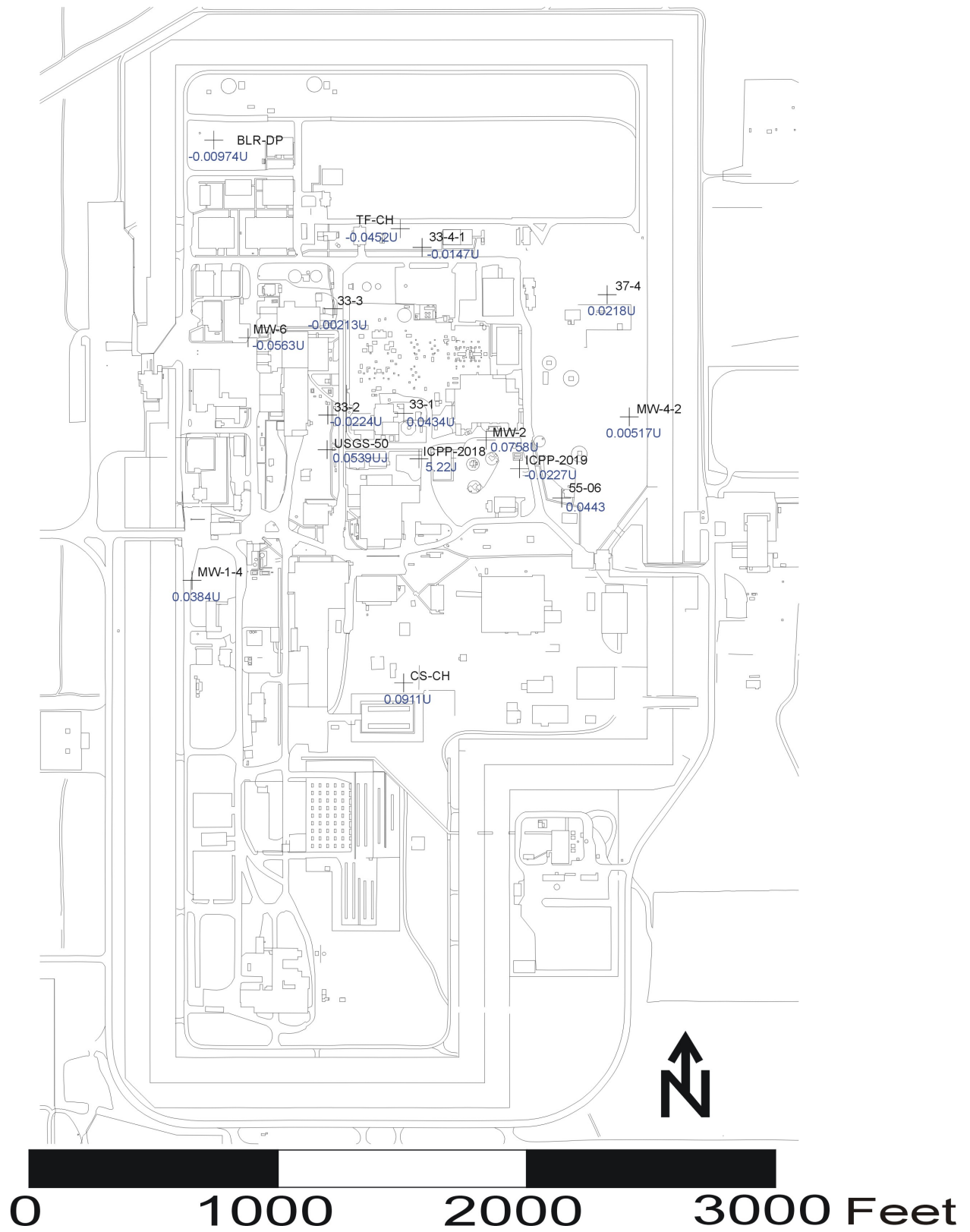


Figure A-25. Distribution of I-129 (pCi/L) in perched water in 2006.

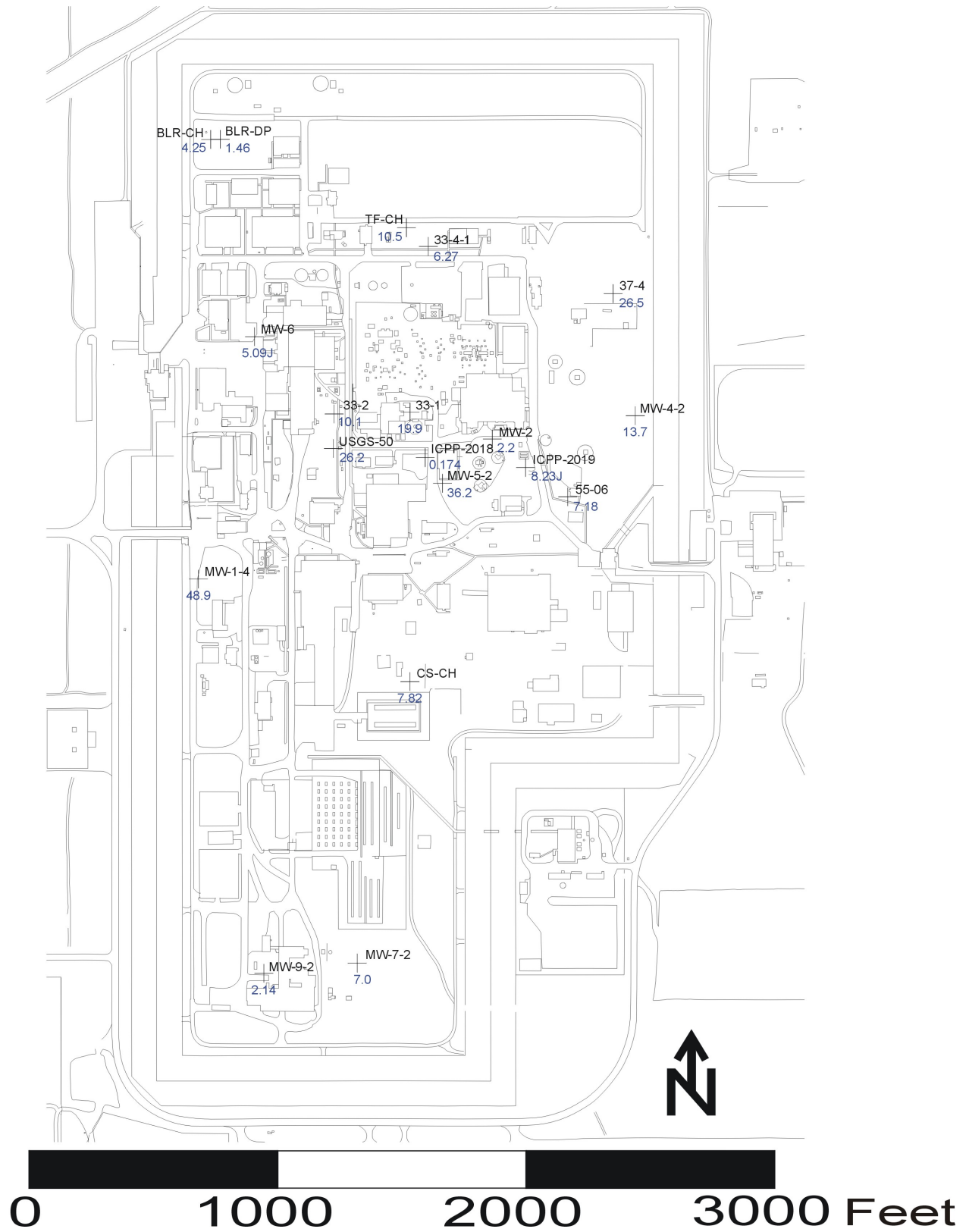


Figure A-26. Distribution of nitrate (mg/L-N) in perched water in 2006.

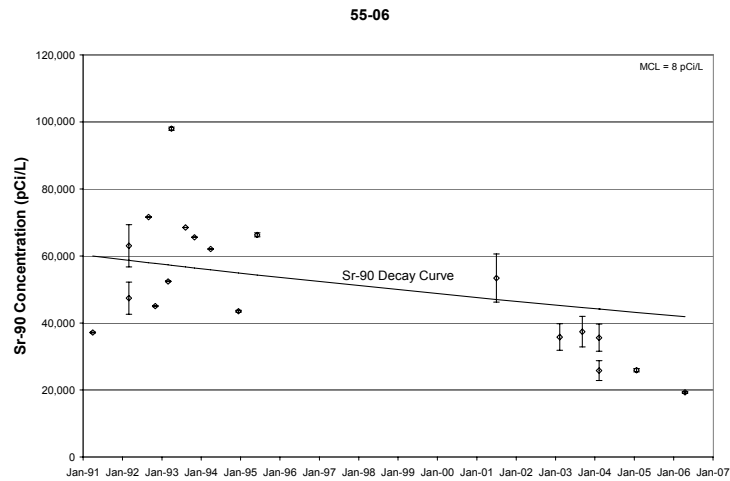
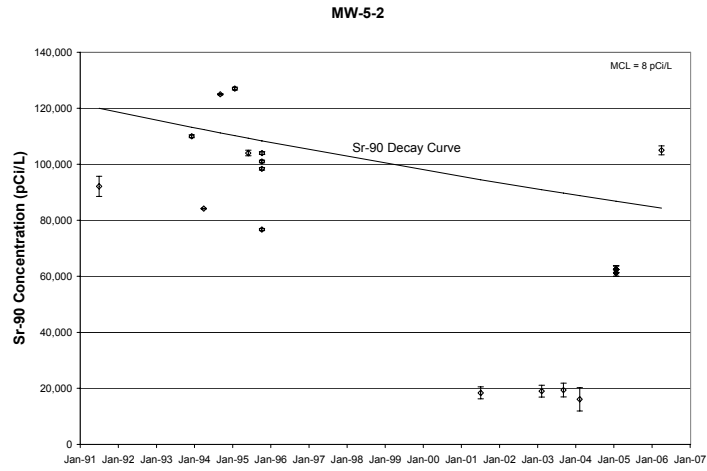
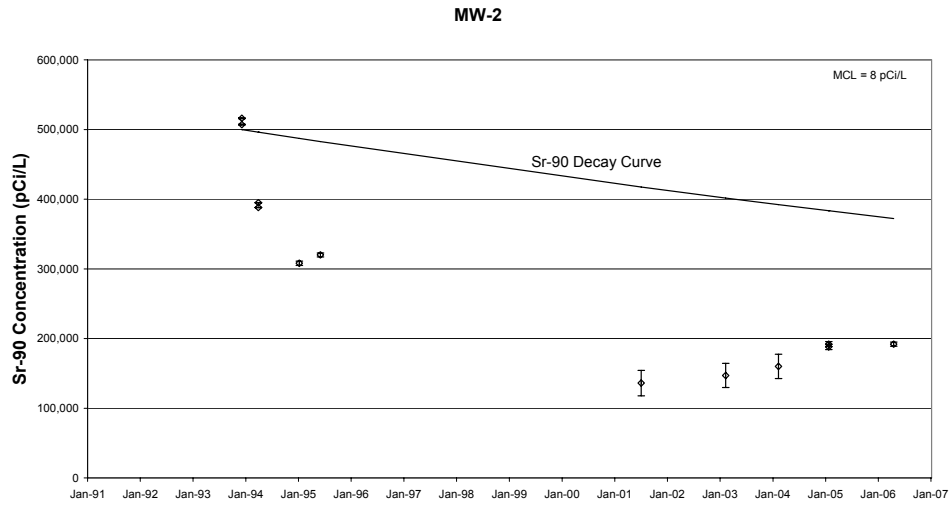


Figure A-27. Sr-90 concentration trends for selected perched water wells.

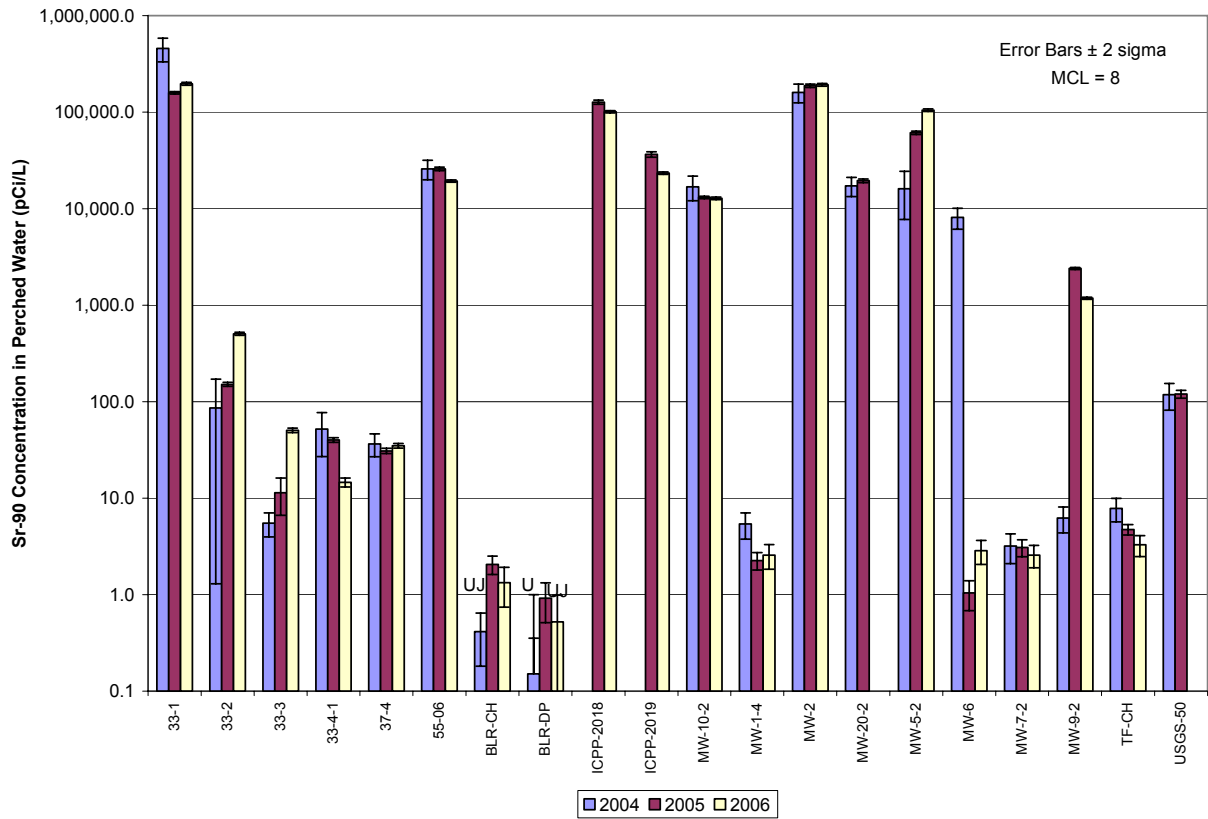


Figure A-28. Perched water Sr-90 concentration trends 2004–2006.

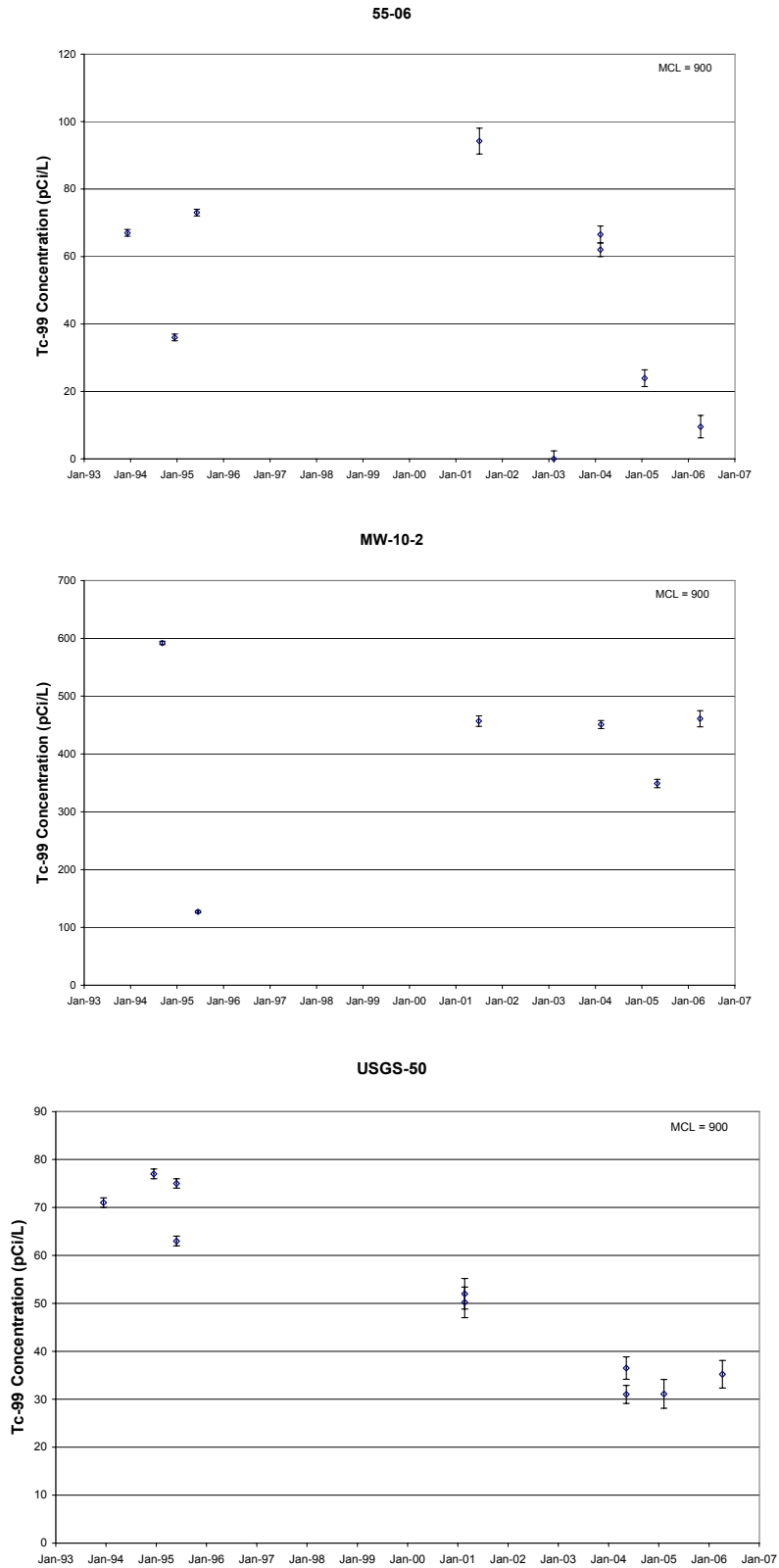


Figure A-29. Tc-99 concentration (pCi/L) trends for selected perched water wells.

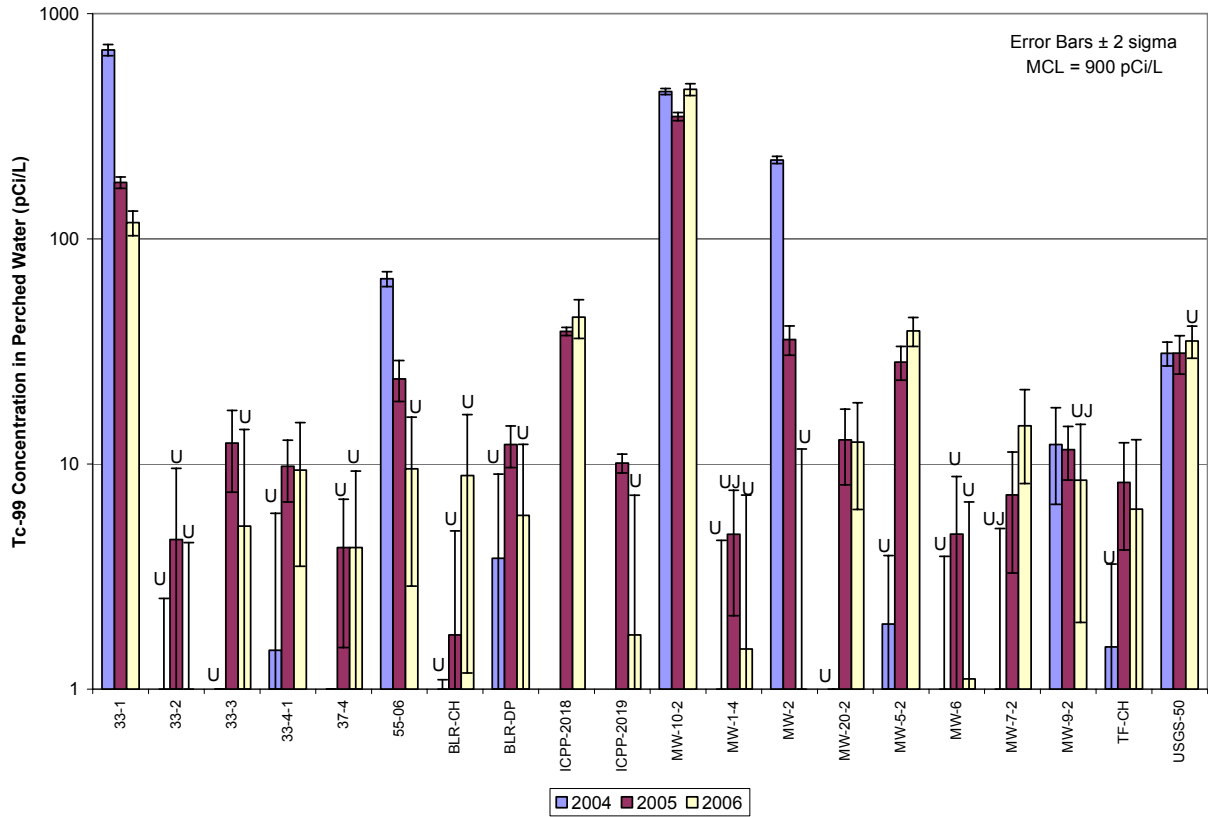


Figure A-30. Perched water Tc-99 concentration trends 2004–2006.

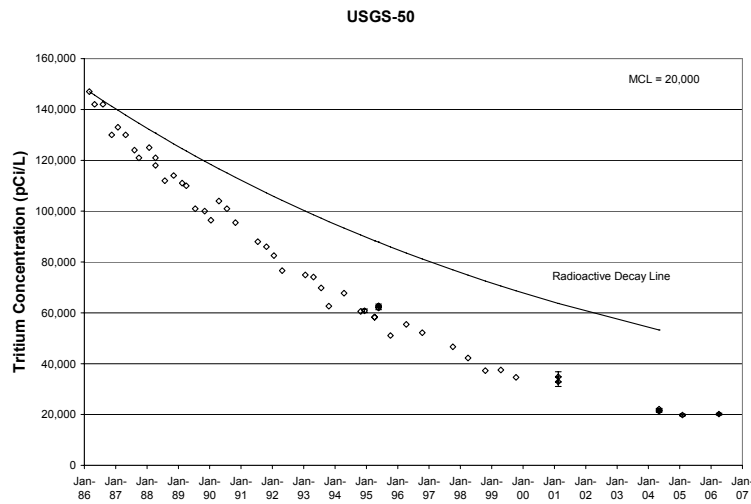
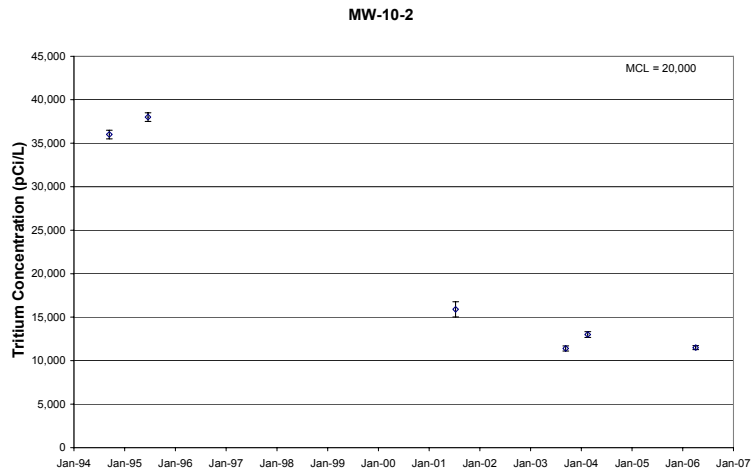
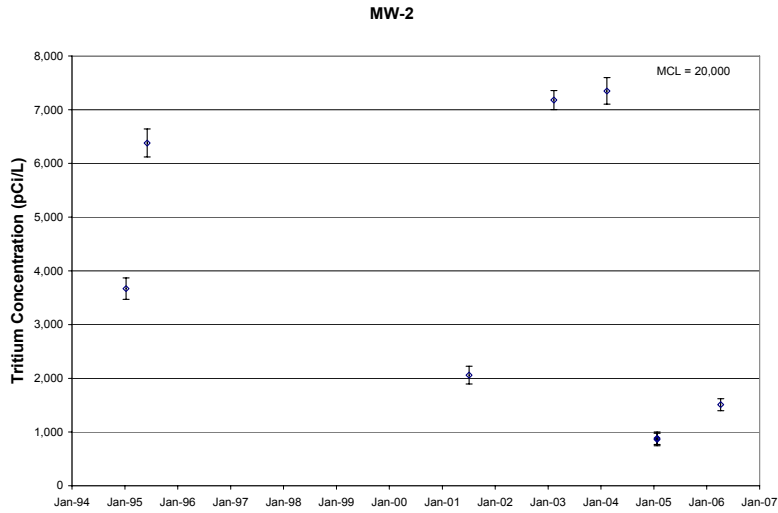


Figure A-31. Tritium concentration (pCi/L) trends for selected perched water wells.

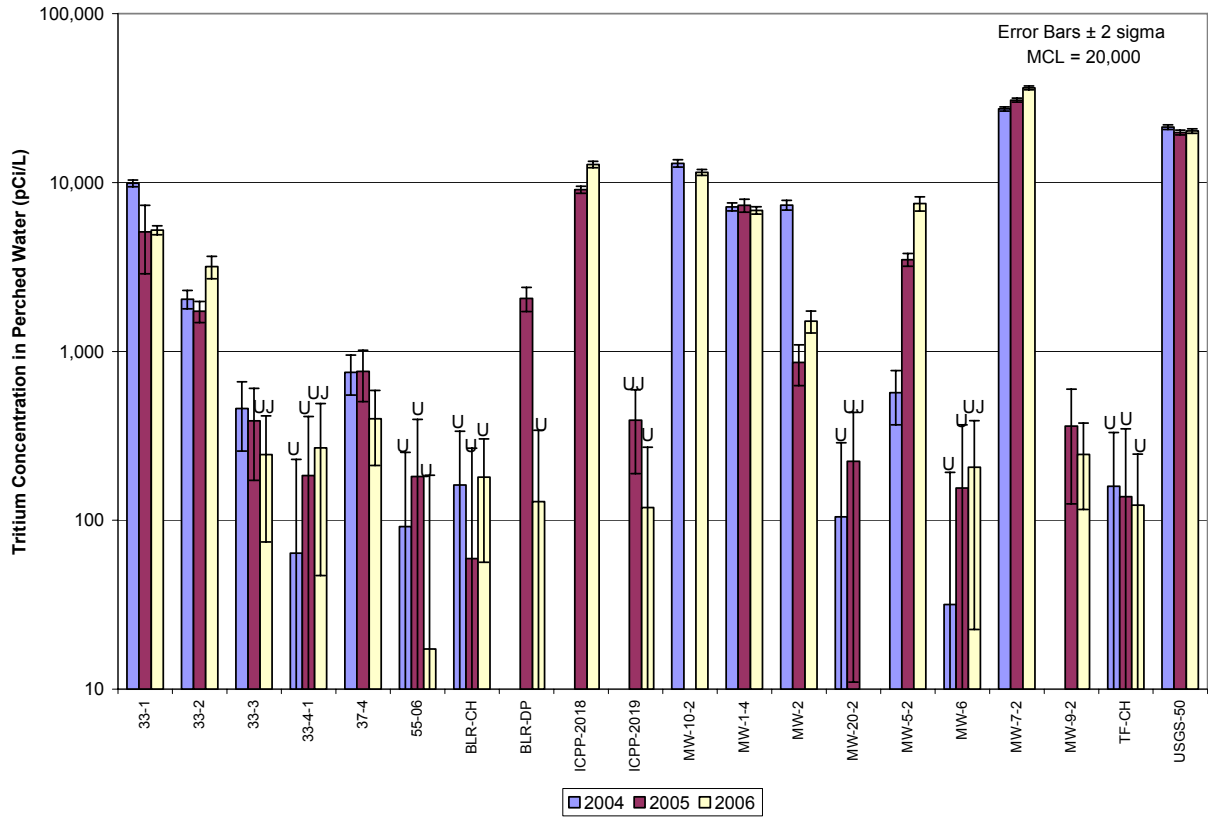


Figure A-32. Perched water tritium concentration trends 2004–2006.

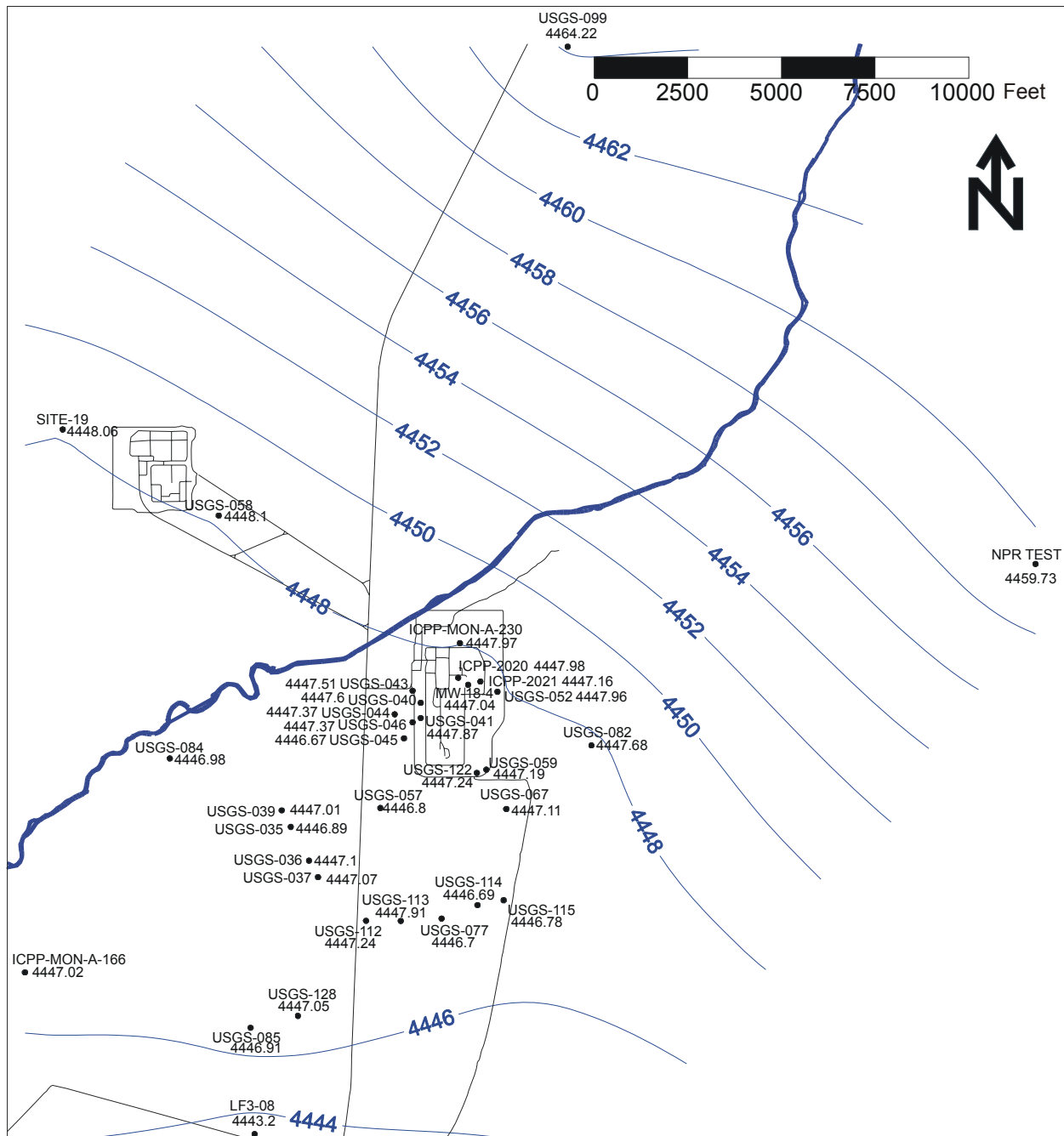


Figure A-33. SRPA groundwater elevation contour map – January–April 2006.

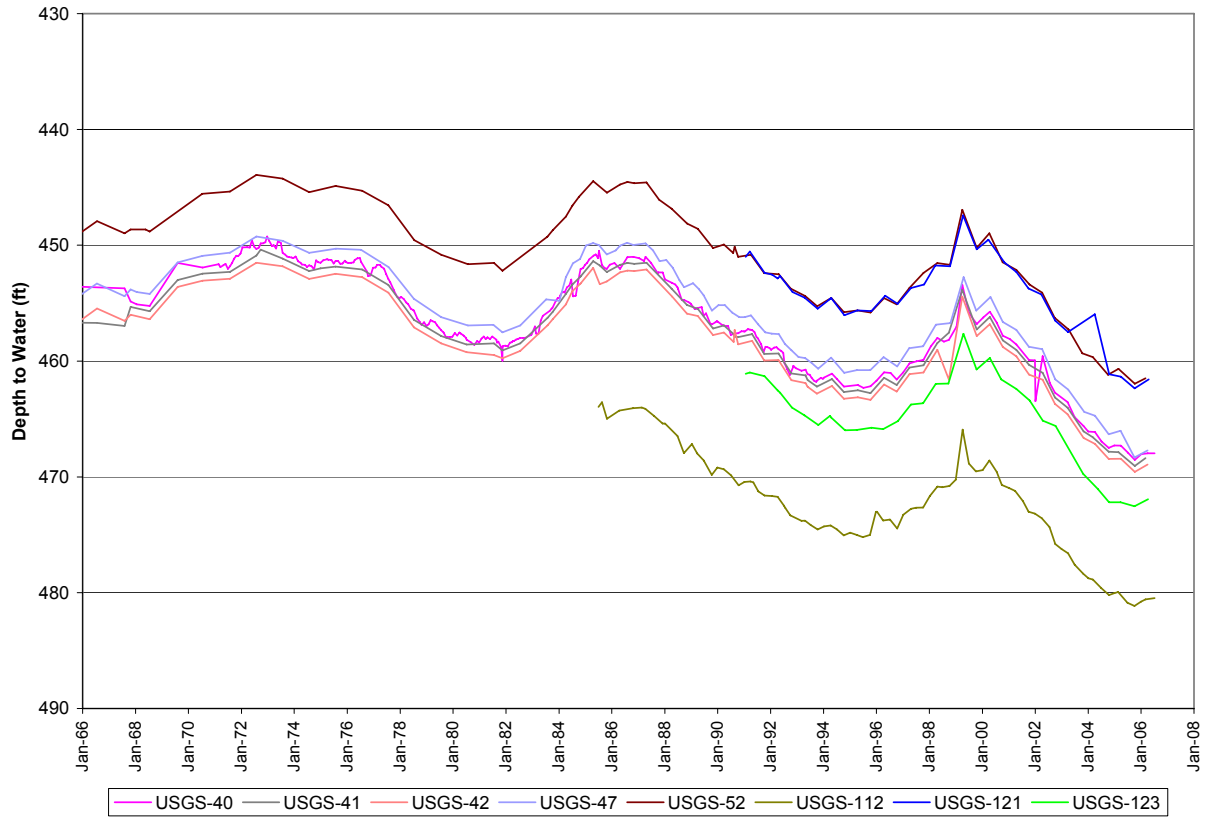


Figure A-34. Hydrographs for selected SRPA wells.

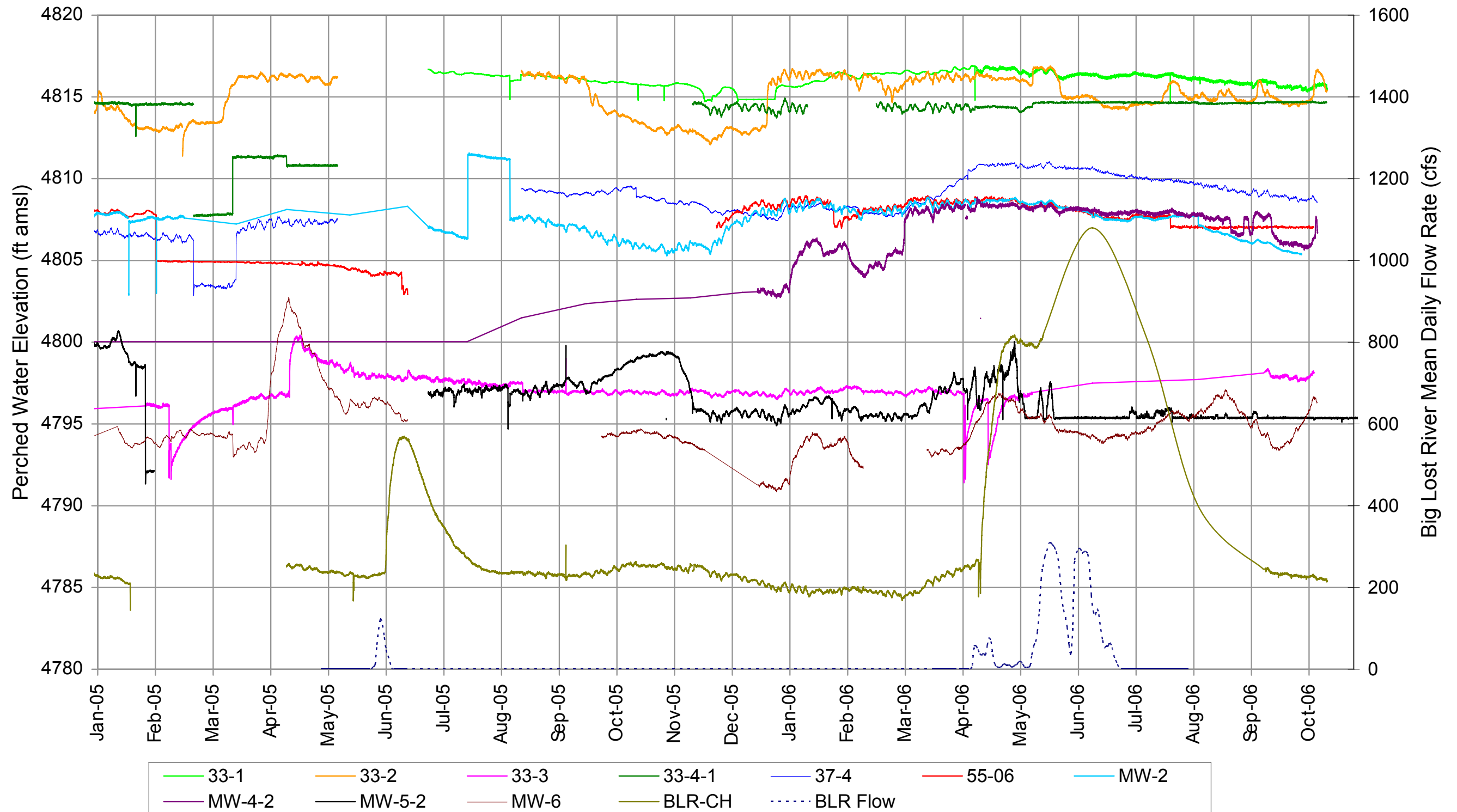


Figure A-35. Hydrographs for selected shallow perched wells.

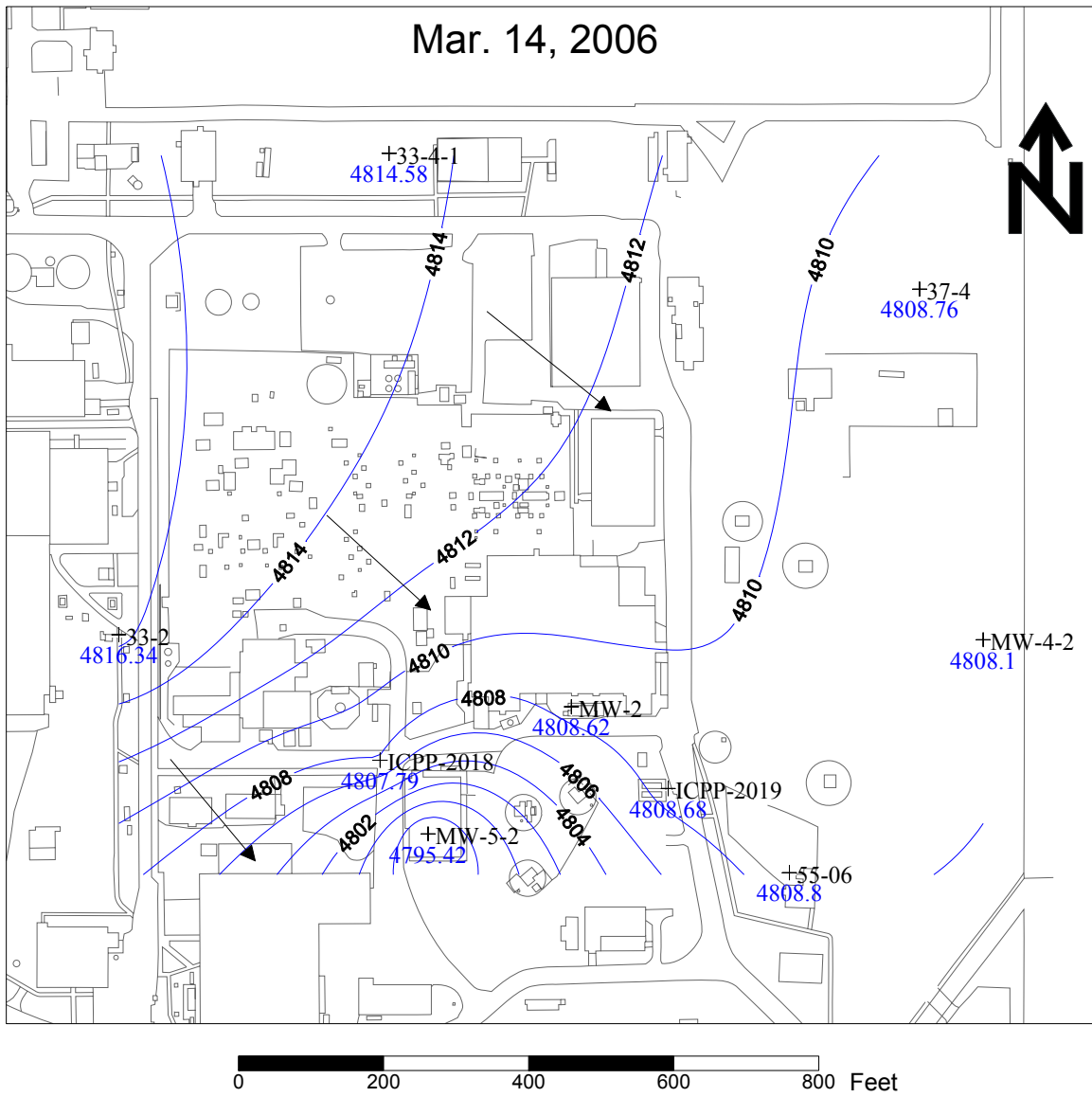


Figure A-36. Upper shallow perched water level contours for March 14, 2006.

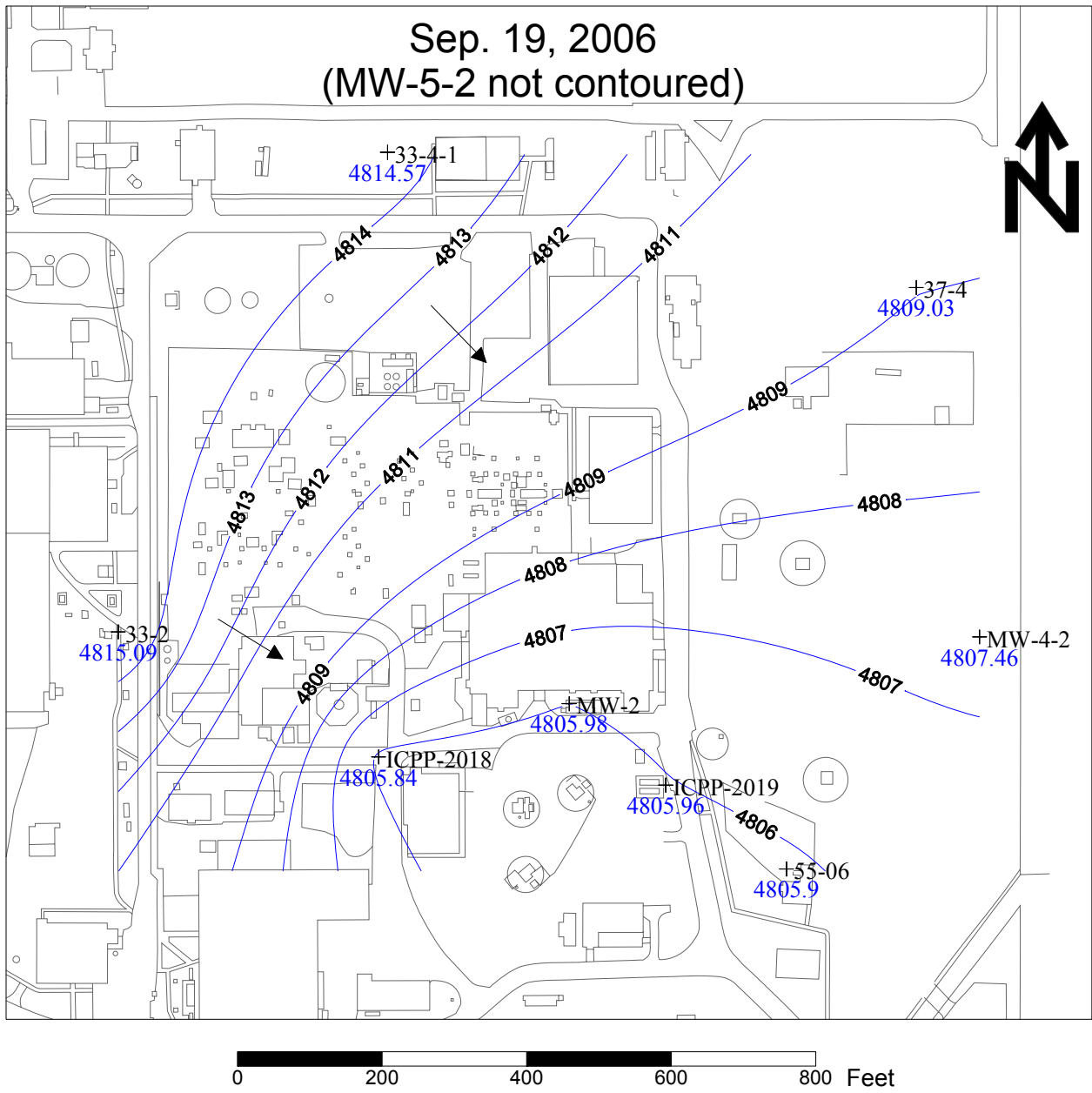


Figure A-37. Upper shallow perched water level contours for September 19, 2006.

Appendix B

Tables

Table B-1. List of wells sampled and laboratory analytes - 2006.

	Screened Interval (ft bgs)	Sample Date	Alkalinity	Actinides	Anions	Cs-137 & Gamma Emitters	Gross Alpha/Beta	Sr-90	Tc-99	I-129	Tritium	Total Dissolved Solids	Metals (filtered)	Metals (unfiltered)	Notes
Aquifer Monitoring Wells															
CPP-01	460-577	02/23/06	X	X	X	X	X	X	X	X	X	X	X	—	
ICPP-2020	455-495	03/08/06	X	X	X	X	X	X	X	X	X	X	X	—	
ICPP-2021	453-493	03/08/06	X	X	X	X	X	X	X	X	X	X	X	—	
ICPP-MON-A-230	443-483	02/28/06	X	X	X	X	X	X	X	X	X	X	X	—	
LF-2-08		—													Well dry; no sample
LF3-08	470-497	02/13/06	X	X	X	X	X	X	X	X	X	X	X	—	
MW-18-4	458-478	02/28/06	X	X	X	X	X	X	X	X	X	X	X	—	
USGS-040	452-679	05/17/06	X	X	X	X	X	X	X	X	X	X	X	—	
USGS-041	428-674 OH	05/15/06	X	X	X	X	X	X	X	X	X	X	X	—	
USGS-042	452-678 OH	05/15/06	X	X	X	X	X	X	X	X	X	X	X	—	
USGS-044	461-650 OH	03/01/06	X	X	X	X	X	X	X	X	X	X	X	—	
USGS-046	461-650 OH	03/01/06	X	X	X	X	X	X	X	X	X	X	X	—	
USGS-047	458-651 OH	03/08/06	X	X	X	X	X	X	X	X	X	X	X	—	
USGS-048		—													Pump broken; no sample
USGS-051	475-659 OH	03/06/06	X	X	X	X	X	X	X	X	X	X	X	—	
USGS-052	450-650 OH	03/08/06	X	X	X	X	X	X	X	X	X	X	X	—	
USGS-057	474-732 OH	03/07/06	X	X	X	X	X	X	X	X	X	X	X	—	
USGS-059	464-657 OH	03/02/06	X	X	X	X	X	X	X	X	X	X	X	—	
USGS-067	465-694 OH	06/08/06	X	X	X	X	X	X	X	X	X	X	X	—	I-129 samples collected on 7/6/06; all others on 6/08/06
USGS-085	522-614 OH	03/02/06	X	X	X	X	X	X	X	X	X	X	X	—	
USGS-112	430-563 OH	02/14/06	X	X	X	X	X	X	X	X	X	X	X	—	
USGS-121	449-475	02/13/06	X	X	X	X	X	X	X	X	X	X	X	—	
USGS-123	461-514	03/07/06	X	X	X	X	X	X	X	X	X	X	X	—	
ICDF Aquifer Wells															
ICPP-1782	475-515	03/30/06	—	X	—	—	—	X	X	X	—	—	—	—	
ICPP-1783	475-515	03/28/06	—	X	—	—	—	X	X	X	—	—	—	—	
ICPP-1800	475-515	03/28/06	—	X	—	—	—	X	X	X	—	—	—	—	
ICPP-1829	475-515	03/30/06	—	X	—	—	—	X	X	X	—	—	—	—	
ICPP-1831	475-515	03/30/06	—	X	—	—	—	X	X	X	—	—	—	—	
USGS-123	461-514	03/28/06	—	X	—	—	—	X	X	X	—	—	—	—	
Perched Water Monitoring Wells															
33-1	89-99	04/17/06	X	X	X	X	X	X	X	X	X	X	X	X	
33-2	86-106	04/26/06	X	X	X	X	X	X	X	X	X	X	X	X	
33-3	112-122	04/12/06	—	X	—	—	X	X	X	X	X	—	—	—	Insufficient water for all lab tests.
33-4-1	98-118	04/24/06	X	X	X	X	X	X	X	X	X	X	X	X	
37-4	100-110	04/13/06	X	X	X	X	X	X	X	X	X	X	X	X	
55-06	93-113	04/17/06	X	X	X	X	X	X	X	X	X	X	X	X	
ICPP-2018	98-118	04/24/06	X	X	X	X	X	X	X	X	X	X	X	X	
ICPP-2019	95-120	04/11/06	X	X	X	X	X	X	X	X	X	X	X	X	
MW-1-4	326-336	04/18/06	X	X	X	X	X	X	X	X	X	X	X	X	
MW-2	102-112	04/17/06	X	X	X	X	X	X	X	X	X	X	X	X	
MW-4-2	101-111	04/20/06	X	X	X	X	X	X	X	X	X	X	X	X	
MW-5-2	106-126	04/13/06	X	X	X	X	X	X	X	—	X	X	X	X	
MW-6	117-137	04/11/06	X	X	X	X	X	X	X	—	X	X	X	X	Insufficient water for all lab tests.
MW-7-2	132-142	04/20/06	X	X	X	X	X	X	X	—	X	X	X	X	Insufficient water for all lab tests.
MW-9-2	120-130	04/19/06	X	X	X	X	X	X	X	—	X	X	X	X	Insufficient water for all lab tests.
MW-10-2	141-151	04/13/06	—	—	—	X	—	X	X	—	X	—	—	—	Insufficient water for all lab tests.
BLR-CH	120-130	04/20/06	X	X	X	X	X	X	X	—	X	X	—	—	Insufficient water for all lab tests.
BLR-DP	375-385	04/25/06	X	X	X	X	X	X	X	X	X	X	X	X	
CS-CH	188-198	04/27/06	X	X	X	X	X	X	X	X	X	X	X	X	
TF-CH	145-150	04/19/06	X	X	X	X	X	X	X	X	X	X	X	X	
USGS-50	356-405	04/18/06	X	X	X	X	X	—	X	X	X	X	X	X	Sr-90 not analyzed due to labeling error.
MW-3-2	128-138	—	Well dry; no sample												

Table B-1. (continued).

	Screened Interval (ft bgs)	Sample Date	Alkalinity	Actinides	Anions	Cs-137 & Gamma Emitters	Gross Alpha/Beta	Sr-90	Tc-99	I-129	Tritium	Total Dissolved Solids	Metals (filtered)	Metals (unfiltered)	Notes
MW-8	115-125	—	Well dry; no sample.												
MW-11-2	131-136	—	Well dry; no sample.												
MW-12-2	109-119	—	Well dry; no sample.												
MW-13	100-105	—	Well dry; no sample.												
MW-14	94-104	—	Well dry; no sample.												
MW-15	111-131	—	Well inaccessible; not sampled.												
MW-16	97-107	—	Well dry; no sample.												
MW-17-2	182-192	—	Well inaccessible; not sampled.												
MW-17-4	360-381	—	Well inaccessible; not sampled.												
MW-18-2	113-123	—	Well dry; no sample.												
MW-20-2	133-148	—	Well inaccessible; not sampled.												
ICPP-2020-DP	394-414	—	Well dry; no sample.												
ICPP-2021-DP	371-391	—	Well dry; no sample.												
BLR-AL	35-36	—	Well dry; no sample.												
BLR-SP	140-145	—	Well dry; no sample.												
CS-AL	46-47	—	Well dry; no sample.												
CS-SP	159-164	—	Well dry; no sample.												
CS-DP	368-378	—	Well dry; no sample.												
PP-AL	31-32	—	Well dry; no sample.												
PP-CH-1	187-192	—	Well dry; no sample.												
PP-CH-2	235-255	—	Well casing has failed and full of sand; not sampled.												
PP-SP	180-182	—	Well dry; no sample.												
PP-DP	372-382	—	Well dry; no sample.												
STL-AL	30-31	—	Well dry; no sample.												
STL-DP	429-439	—	Well dry; no sample.												
STL-CH-2	140-145	—	Well dry; no sample.												
STL-CH-1	99-109	—	Well dry; no sample.												
TF-AL	37-38	—	Well dry; no sample.												
TF-SP	145-150	—	Well dry; no sample.												
TF-DP	375-385	—	Well dry; no sample.												
Suction Lysimeters															
A-60-39	39	04/10/06	—	—	—	—	—	X	X	—	X	—	—	—	
A-62-41	41	04/10/06	—	—	—	—	—	X	X	—	X	—	—	—	
A-63-45	45	04/10/06	—	—	—	—	—	X	X	—	X	—	—	—	
A-64-40	40	04/10/06	—	—	—	—	—	X	X	—	X	—	—	—	
A-65-36	36	04/10/06	—	—	—	—	—	X	X	—	X	—	—	—	
BLR-AL-L32	32	04/10/06	—	—	—	—	—	X	X	—	X	—	—	—	
BLR-DP-L352	352	04/10/06	—	—	—	—	—	X	X	—	X	—	—	—	
BLR-SP-L167	167	04/10/06	—	—	—	—	—	X	X	—	X	—	—	—	
CS-DP-L280	280	04/10/06	—	—	—	—	—	X	X	—	X	—	—	—	
CS-SP-L155	155	04/10/06	—	—	—	—	—	X	X	—	X	—	—	—	
PP-AL-L27	27	04/10/06	—	—	—	—	—	X	X	—	X	—	—	—	
PP-DP-L383	383	04/10/06	—	—	—	—	—	—	—	—	X	—	—	—	Insufficient water for all lab tests.
PP-SP-L108	108	04/10/06	—	—	—	—	—	—	—	—	X	—	—	—	Insufficient water for all lab tests.
PP-SP-L169	169	04/10/06	—	—	—	—	—	X	—	—	X	—	—	—	Insufficient water for all lab tests.
STL-AL-L26	26	04/10/06	—	—	—	—	—	X	X	—	X	—	—	—	
STL-DP-L418	418	04/10/06	—	—	—	—	—	X	X	—	X	—	—	—	
STL-SP-L103	103	04/10/06	—	—	—	—	—	—	—	—	X	—	—	—	Insufficient water for all lab tests.
TF-AL-L35	35	04/10/06	—	—	—	—	—	X	X	—	X	—	—	—	
TF-DP-L385	385	04/10/06	—	—	—	—	—	X	X	—	X	—	—	—	
TF-SP-L118	118	04/10/06	—	—	—	—	—	X	X	—	X	—	—	—	
Notes: Anions include Cl, F, NO ₃ , and SO ₄ . Metals include Ca, Mg, K, Na, and Hg. OH = open hole.															

Table B-2. Groundwater field parameter results - 2006.

Well ID	Sample Date	Temperature (°C)	pH	Electrical Conductivity (mS/cm)	Dissolved Oxygen (mg/L)
Aquifer Monitoring Wells					
CPP-01	02/23/06	11.92	7.83	0.391	5.83
ICPP-2020	03/08/06	13.66	7.76	0.518	5.81
ICPP-2021	03/08/06	13.06	7.9	0.624	6.91
ICPP-MON-A-230	02/28/06	NM	NM	NM	NM
LF3-08	02/13/06	11.44	7.95	0.522	7.14
MW-18-4	02/28/06	15.46	7.78	0.575	4.43
USGS-040	05/17/06	13.8	7.85	0.491	NM
USGS-041	05/15/06	14.36	7.96	0.461	NM
USGS-042	05/15/06	14.49	7.84	0.458	NM
USGS-044	03/01/06	11.39	7.84	0.387	5.74
USGS-046	03/01/06	11.79	7.85	0.402	5.44
USGS-047	03/08/06	12.68	7.89	0.416	7.57
USGS-051	03/06/06	12.51	7.75	0.755	6.41
USGS-052	03/08/06	11.07	7.91	0.429	7.35
USGS-057	03/07/06	13.39	7.79	0.421	5.33
USGS-059	03/02/06	13.19	7.99	0.420	5.04
USGS-067	06/08/06	13.51	7.73	0.633	NM
USGS-085	03/02/06	11.64	7.85	0.432	4.99
USGS-112	02/14/06	12.75	7.79	0.458	5.57
USGS-121	02/13/06	11.73	7.85	0.378	5.49
USGS-123	03/07/06	12.6	8.31	0.355	4.13
Perched Monitoring Wells					
33-1	04/17/06	NM	NM	NM	NM
33-2	04/26/06	19.6	7.66	0.556	7.38
33-3	04/11/06	20.5	7.63	6.54	NM
33-4-1	04/24/06	13.1	7.50	0.547	NM
37-4	04/13/06	14.3	7.77	0.794	NM
55-06	04/17/06	14.0	NM	0.598	NM
ICPP-2018	04/24/06	21.5	7.29	1.066	9.34
ICPP-2019	04/11/06	15.9	7.59	0.546	NM
MW-1-4	04/18/06	13.8	7.61	0.839	NM
MW-2	04/17/06	22.4	7.37	0.668	7.76
MW-4-2	04/20/06	13.6	8.80	0.692	NM
MW-5-2	04/13/06	16.6	7.34	1.127	NM
MW-6	04/11/06	20.9	7.52	0.713	8.91
MW-7-2	04/19/06	15.2	8.58	0.510	NM
MW-9-2	04/19/06	20.4	8.22	0.506	NM
MW-10-2	04/12/06	18.6	7.65	0.846	NM
BLR-CH	04/19/06	11.8	7.53	0.355	NM
BLR-DP	04/25/06	16.4	8.35	0.398	9.8
CS-CH	04/26/06	12.9	8.31	0.616	NM
TF-CH	04/19/06	11.4	7.17	0.545	NM
USGS-50	04/18/06	18.6	8.37	0.677	NM

Table B-3. Summary of radionuclide concentrations in groundwater - 2006 (all concentrations in pCi/L).

Well ID	Sample Date	Gross Alpha (MCL = 15 pCi/L)			Gross Beta (no MCL)			Cs-137 (MCL = 200 pCi/L)			Sr-90 (MCL = 8 pCi/L)			Tc-99 (MCL = 900 pCi/L)			I-129 (MCL = 1 pCi/L)			Tritium (MCL = 20,000 pCi/L)			Sum of Ratios to MCL ^a
		Result	+/-	Flag	Result	+/-	Flag	Result	+/-	Flag	Result	+/-	Flag	Result	+/-	Flag	Result	+/-	Flag	Result	+/-	Flag	
Aquifer Monitoring Wells																							
CPP-01	02/23/06	1.18	0.372	—	19.8	1.18	—	15.8	1.99	UJ	-0.00136	0.134	U	23.7	1.32	J	0.0452	0.0368	U	39.8	116	U	0.07
ICPP-2020	03/08/06	2.71	1.13	UJ	133	5.44	—	2.8	1.37	UJ	12.8	0.573	—	205	3.42	—	0.404	0.0901	—	6,090	332	—	2.51
ICPP-2021	03/08/06	5.28	1.08	—	547	10.9	—	1.79	1.41	U	14.7	0.608	—	1,160	18.9	—	0.322	0.0674	—	8,140	368	—	3.96
ICPP-MON-A-230	02/28/06	5.11	1.04	—	1,180	37.5	—	12.1	3.06	UJ	5.65	0.336	—	2,150	29.2	J	0.271	0.0635	J	3,670	287	—	3.5
LF3-08	02/13/06	3.03	0.818	—	11.5	1.32	—	17.4	2.12	UJ	0.424	0.147	UJ	10.7	1.11	J	0.531	0.067	—	4,680	241	—	0.8
MW-18-4	02/28/06	1.55	0.607	UJ	239	7.18	—	17.1	3.15	UJ	18.7	0.656	—	359	5.91	J	0.404	0.0633	—	8,930	396	—	3.6
USGS-040	05/17/06	3.39	1.11	UJ	36.5	2.38	—	1.45	2.52	U	11	0.299	—	2.58	0.373	—	0.303	0.0556	—	2,070	142	—	1.8
USGS-041	05/15/06	1.55	1.13	U	24.5	1.95	—	1.66	1.12	U	7.43	0.392	—	1.2	0.453	UJ	0.207	0.0834	J	1,630	119	J	1.2
USGS-042	05/15/06	1.13	0.838	U	24.2	1.86	—	0.0711	1.03	U	8.19	0.438	—	2.85	0.414	J	0.243	0.0871	J	1,750	119	J	1.4
USGS-044	03/01/06	4.42	0.744	—	6.49	1.09	—	-0.187	1.3	U	2.1	0.282	—	0.82	0.358	UJ	0.0655	0.0557	U	-3.7	107	U	0.3
USGS-046	03/01/06	4.09	0.969	—	18.6	1.86	—	-0.864	1.39	U	4.63	0.382	—	0.347	0.356	U	0.0993	0.0543	U	1,020	208	—	0.7
USGS-047	03/08/06	2.76	1.09	UJ	63	3.93	—	-2.57	1.61	U	24.1	0.849	—	1.54	0.369	—	0.274	0.0712	—	1,130	222	—	3.3
USGS-051	03/06/06	2.93	0.685	—	8.91	1.12	—	-1.04	1.44	U	0.512	0.149	UJ	2.03	0.368	—	0.136	0.0557	UJ	8,270	382	—	0.6
USGS-052	03/08/06	4.25	0.91	—	124	4.35	—	-0.736	1.4	U	3.61	0.289	—	260	4.33	—	0.217	0.0528	—	2,370	245	—	1.1
USGS-057	03/07/06	4.89	0.994	—	40.2	2.4	—	1.11	3.42	U	14.6	0.644	—	7.16	0.413	—	0.293	0.0594	—	1,800	230	—	2.2
USGS-059	03/02/06	3.37	0.911	—	34.2	2.16	—	-1.07	1.25	U	6.98	0.426	—	27.2	0.61	—	0.116	0.0469	UJ	1,300	225	—	1.1
USGS-067	06/08/06 ^b	-0.345	0.538	U	96.9	4.65	—	-0.994	1.79	U	12.2	0.557	—	146	2.46	—	0.649	0.097	J	5,040	325	—	2.6
USGS-085	03/02/06	4.17	0.948	—	20.5	1.87	—	3	4.13	U	2.8	0.285	—	2	0.367	—	0.246	0.0481	—	2,420	258	—	0.7
USGS-112	02/14/06	0.359	0.515	U	29.7	1.91	—	16.5	1.42	UJ	11	0.515	—	6.47	1.12	J	0.439	0.052	J	2,090	183	—	1.9
USGS-121	02/13/06	2.62	0.731	—	3.17	1.03	UJ	17.1	1.76	UJ	0.194	0.116	U	1.01	0.377	UJ	-0.0235	0.0239	U	-121	115	U	0.0
USGS-123	03/07/06	2.14	0.611	—	5.04	1.03	—	0.743	4.15	U	-0.124	0.116	U	0.744	0.359	UJ	0.0462	0.0356	U	4,610	306	—	0.3
ICDF Aquifer Wells																							
ICPP-1782	03/30/06	—	—	—	—	—	—	—	—	—	4.26	0.436	—	3.1	1.88	U	0.227	0.0473	UJ	—	—	—	—
ICPP-1783	03/28/06	—	—	—	—	—	—	—	—	—	15.4	0.735	—	16.7	2.1	—	0.636	0.0701	—	—	—	—	—
ICPP-1800	03/28/06	—	—	—	—	—	—	—	—	—	14.4	0.684	—	28.9	2.31	—	0.489	0.0653	—	—	—	—	—
ICPP-1829	03/30/06	—	—	—	—	—	—	—	—	—	5.57	0.458	—	29.5	2.31	—	0.337	0.0594	—	—	—	—	—
ICPP-1831	03/30/06	—	—	—	—	—	—	—	—	—	13.4	0.669	—	5.69	1.91	UJ	0.347	0.0572	UJ	—	—	—	—
USGS-123	03/28/06	—	—	—	—	—	—	—	—	—	0.263	0.18	U	-0.724	1.78	U	0.02	0.0473	U	—	—	—	—
Perched Water Monitoring Wells																							
33-1	04/17/06	6.47	0.72	—	428,000	8,010	—	119	16.8	—	197,000	3,320	—	118	7.41	—	0.0434	0.0358	U	5,230	160	—	—
33-2	04/26/06	1.41	0.686	UJ	1,170	59	—	0.122	2.81	U	505	9.24	—	0.859	1.81	U	-0.0224	0.0191	U	3,180	240	—	—
33-3	04/12/06	36.2	4.73	—	296	10.3	—	—	—	—	50.5	1.27	—	5.3	4.47	U	-0.00213	0.0747	U	245	85.3	UJ	—
33-4-1	04/24/06	4.46	1.21	—	118	3.78	—	1.09	2.04	U	14.6	0.787	J	9.4	2.94	—	-0.0147	0.0211	U	269	111	UJ	—
37-4	04/13/06	8.1	1.03	—	274	8.35	—	0.278	1.85	U	35	0.977	—	4.25	2.53	U	0.0218	0.0325	U	399	94	—	—
55-06	04/17/06	4.88	0.566	—	51,300	929	—	4.1	2.21	U	19,300	233	J	9.51	3.32	UJ	0.0443	0.0354	U	17.3	84	U	—
ICPP-2018	04/24/06	3.65	0.544	—	266,000	6,080	—	6.23	4.32	U	101,000	1,250	—	44.9	4.37	—	5.22	0.536	J	12,800	277	—	—
ICPP-2019	04/11/06	2.72	0.42	—	51,700	1,000	—	-2.27	2.8	U	23,400	343	—	1.74	2.76	U	-0.0227	0.0323	U	119	75.9	U	—
MW-1-4	04/18/06	6.96	0.744	—	138	2.43	—	-3.14	1.78	U	2.57	0.368	—	1.51	2.88	U	0.0384	0.0628	U	6,850	174	—	—
MW-2	04/17/06	-0.986	1.77	U	351,000	4,300	—	-3.2	8.02	U	192,000	2,970	—	-5.3	8.48	U	0.0758	0.049	U	1,510	112	—	—
MW-4-2	04/20/06	11.3	2	—	13,700	269	—	2.85	2.65	U	6,960	87.8	—	12.5	3.11	—	0.00517	0.0415	U	214	63.6	—	—
MW-5-2	04/13/06	2.41	0.478	—	229,000	4,830	—	2.36	3.82	U	105,000	1,620	—	39	2.89	—	—	—	—	7,500	364	—	—
MW-6	04/11/06	2.3	0.402	—	44.8	1.37	—	1.3	3	U	2.85	0.398	J	1.11	2.84	U	-0.0563	0.0457	U	206	91.7	UJ	—
MW-7-2	04/20/06	6.86	1.61	—	38	2.66	—	0.557	1.87	U	2.57	0.334	—	14.8	3.3	—	—	—	—	36,400	476	—	—
MW-9-2	04/19/06	9.93	1.27	—	1,630	32.1	—	6.01	4.03	U	1,180	14.3	—	8.48	3.25	UJ	—	—	—	246	65	—	—
MW-10-2	04/13/06	—	—	—	—	—	—	2.38	1.91	U	12,800	198	—	461	13.9	—	—	—	—	11,500	229	—	—
BLR-CH	04/20/06	6.53	1.71	—	23.8	2.12	J	4.15	1.99	UJ	1.33	0.293	—	8.88	3.85	UJ	—	—	—	180	61.8	UJ	—

Table B-3. (continued).

Well ID	Sample Date	Gross Alpha (MCL = 15 pCi/L)			Gross Beta (no MCL)			Cs-137 (MCL = 200 pCi/L)			Sr-90 (MCL = 8 pCi/L)			Tc-99 (MCL = 900 pCi/L)			I-129 (MCL = 1 pCi/L)			Tritium (MCL = 20,000 pCi/L)			Sum of Ratios to MCL ^a
		Result	+/-	Flag	Result	+/-	Flag	Result	+/-	Flag	Result	+/-	Flag	Result	+/-	Flag	Result	+/-	Flag	Result	+/-	Flag	
BLR-DP	04/25/06	98.9	12.6	—	45.7	9.89	—	-1.42	2.13	U	0.523	0.233	UJ	5.91	3.16	U	-0.00974	0.0173	U	129	106	U	—
CS-CH	04/27/06	47.6	9.34	—	64.9	8.48	—	-4.02	2.41	U	3.79	0.297	—	6.52	3.16	UJ	0.0911	0.0629	U	878	193	—	—
TF-CH	04/19/06	4.98	0.996	—	22.5	1.51	J	0.158	2.45	U	3.29	0.405	—	6.3	3.26	U	-0.0452	0.0345	U	123	61.6	U	—
USGS-50	04/18/06	2.87	0.512	—	239	5.67	—	-0.369	2.13	U	—	—	—	35.2	2.88	—	0.0539	0.0247	UJ	20,200	322	—	—
Suction Lysimeters																							
A-60-39	04/10/06	—	—	—	—	—	—	—	—	—	0.357	0.295	U	4.11	2.05	UJ	—	—	—	547	86.5	—	—
A-62-41	04/10/06	—	—	—	—	—	—	—	—	—	0.923	0.252	—	22.1	4.23	J	—	—	—	530	84.3	—	—
A-63-45	04/10/06	—	—	—	—	—	—	—	—	—	-0.214	0.263	U	—	—	—	—	—	—	307	81.9	—	—
A-64-40	04/10/06	—	—	—	—	—	—	—	—	—	0.409	0.26	U	-2.92	2.01	U	—	—	—	209	76.2	UJ	—
A-65-36	04/10/06	—	—	—	—	—	—	—	—	—	0.54	0.198	UJ	-1.06	2.02	U	—	—	—	320	81.2	—	—
BLR-AL-L32	04/10/06	—	—	—	—	—	—	—	—	—	0.417	0.287	U	3.67	2.02	U	—	—	—	181	80.2	UJ	—
BLR-DP-L352	04/10/06	—	—	—	—	—	—	—	—	—	-0.155	0.304	U	13.5	4.3	UJ	—	—	—	92.3	78.9	U	—
BLR-SP-L167	04/10/06	—	—	—	—	—	—	—	—	—	-1.04	0.402	U	2.69	2.09	U	—	—	—	141	80.8	U	—
CS-DP-L280	04/10/06	—	—	—	—	—	—	—	—	—	0.443	0.273	U	17.2	6.32	UJ	—	—	—	1,560	105	—	—
CS-SP-L155	04/10/06	—	—	—	—	—	—	—	—	—	12.5	0.539	—	5.7	2.12	UJ	—	—	—	200	81.5	UJ	—
PP-AL-L27	04/10/06	—	—	—	—	—	—	—	—	—	1.61	0.307	—	0.375	2.06	U	—	—	—	148	78.3	U	—
PP-DP-L383	04/10/06	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	12,400	230	—	—
PP-SP-L108	04/10/06	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	865	90	—	—
PP-SP-L169	04/10/06	—	—	—	—	—	—	—	—	—	0.622	0.337	U	—	—	—	—	—	—	674	89.1	—	—
STL-AL-L26	04/10/06	—	—	—	—	—	—	—	—	—	7.74	0.356	—	-0.221	1.99	U	—	—	—	251	80.3	UJ	—
STL-DP-L418	04/10/06	—	—	—	—	—	—	—	—	—	9.45	0.439	—	3.85	2.11	U	—	—	—	120	78.8	U	—
TF-AL-L35	04/10/06	—	—	—	—	—	—	—	—	—	0.541	0.314	U	4.08	2.05	U	—	—	—	229	81	UJ	—
TF-DP-L385	04/10/06	—	—	—	—	—	—	—	—	—	0.369	0.33	U	16.8	7.03	UJ	—	—	—	836	91.5	—	—
TF-SP-L118	04/10/06	—	—	—	—	—	—	—	—	—	0.104	0.279	U	11	5.77	U	—	—	—	206	83.9	UJ	—
<p>a. Sum of ratios to MCL calculated for beta-emitters by summing the ratio of the observed concentration to the MCL for Sr-90, Tc-99, I-129, and tritium. Sum of ratios values exceeding 1.0 indicates cumulative beta dose exceeds 4 mrem/yr limit established by EPA.</p> <p>b. I-129 samples collected July 6, 2006; all others on June 8, 2006.</p> <p>Data Qualifier Flags: J = estimated value. U = not detected. UJ = not detected, quantitation limit is an estimate.</p>																							

Table B-4. Summary of actinide concentrations in groundwater - 2006 (all concentrations in pCi/L).

Well ID	Sample Date	Am-241 (MCL = 15 pCi/L)			Np-237 (MCL = 15 pCi/L)			Pu-238 (MCL = 15 pCi/L)			Pu-239/240 (MCL = 15 pCi/L)			Pu-241 (MCL = 300 pCi/L)			U-233/234 (MCL = 15 pCi/L)			U-235 (MCL = 15 pCi/L)			U-238 (MCL = 15 pCi/L)		
		Result	+/-	Flag	Result	+/-	Flag	Result	+/-	Flag	Result	+/-	Flag	Result	+/-	Flag	Result	+/-	Flag	Result	+/-	Flag	Result	+/-	Flag
Aquifer Monitoring Wells																									
CPP-01	02/23/06	-0.0067	0.131	U	0.0466	0.0359	U	0.0115	0.0241	U	-0.00435	0.0115	U	4.83	2.34	UJ	1.61	0.197	J	0.0297	0.0243	U	0.841	0.127	—
ICPP-2020	03/08/06	-0.0113	0.0644	U	-0.00701	0.00497	U	0.0108	0.0108	U	0.0108	0.0108	U	2.17	2.58	U	1.62	0.182	—	0.031	0.0274	U	0.98	0.13	—
ICPP-2021	03/08/06	0.0429	0.0195	J	0.00725	0.0198	U	0	1	U	0	1	U	-5.31	2.93	U	1.7	0.188	—	0.0833	0.0378	UJ	0.938	0.127	—
ICPP-MON-A-230	02/28/06	-0.0413	0.0264	U	0.0134	0.0253	U	-0.00103	0.0286	U	-0.0185	0.0076	U	2.9	2.98	U	2.34	0.243	J	0.0453	0.0377	U	1.14	0.146	—
LF3-08	02/13/06	-0.0092	0.148	U	-0.0266	0.014	U	-0.0228	0.00815	U	-0.0138	0.0146	U	1.05	2.79	U	2.09	0.236	J	0.0236	0.0272	U	0.813	0.127	—
MW-18-4	02/28/06	0.00403	0.0117	U	-0.0171	0.00859	U	-0.00454	0.0182	U	-0.0241	0.0151	U	5.7	1.68	—	1.86	0.212	J	0.00447	0.0173	U	0.852	0.124	—
USGS-040	05/17/06	0.0572	0.0321	U	-0.0126	0.022	U	0.0063	0.0172	U	0.00854	0.0116	U	-1.6	1.72	U	1.2	0.16	J	0.0462	0.0295	U	0.741	0.117	J
USGS-041	05/15/06	0.00426	0.00427	U	-0.0171	0.0065	U	0	1	U	0.0229	0.022	—	-3.29	3.04	U	1.61	0.16	—	0.0493	0.0248	U	0.578	0.0835	J
USGS-042	05/15/06	-0.0101	0.0101	U	-0.0322	0.0225	U	0.00338	0.0131	U	0.0121	0.0121	U	-0.64	2.39	U	1.49	0.156	—	0.0649	0.0293	UJ	0.84	0.107	J
USGS-044	03/01/06	-0.0102	0.0102	U	-0.0334	0.0301	U	-0.00551	0.00553	U	-0.00551	0.00552	U	2.51	3.06	U	1.77	0.204	—	0.0432	0.0304	U	0.767	0.118	—
USGS-046	03/01/06	0.00964	0.00685	U	-0.0449	0.0122	U	-0.00446	0.00447	U	0.0186	0.0186	U	-0.175	2.25	U	1.74	0.203	—	0.00904	0.0184	U	0.792	0.122	—
USGS-047	03/08/06	0.0036	0.00361	U	-0.00534	0.0214	U	-0.0112	0.00796	U	-0.0336	0.0139	U	2.76	2.44	U	1.92	0.224	—	0.0565	0.0355	U	0.679	0.112	—
USGS-051	03/06/06	0.00288	0.00289	U	-0.0121	0.0179	U	-0.0197	0.00811	U	0.00382	0.0148	U	-4.54	2.98	U	1.45	0.182	—	-0.0215	0.0327	U	0.524	0.101	—
USGS-052	03/08/06	0.0513	0.026	U	-0.0201	0.0157	U	-0.00432	0.00433	U	-0.00432	0.00433	U	5.12	2.69	U	1.86	0.222	—	0.105	0.0475	UJ	1.12	0.156	—
USGS-057	03/07/06	0.000311	0.000312	U	-0.000983	0.0274	U	0	1	U	-0.0176	0.00889	U	0.0699	2.96	U	1.72	0.212	—	-0.00438	0.0044	U	1.06	0.151	—
USGS-059	03/02/06	0.0556	0.0302	U	0.00787	0.0215	U	-0.00365	0.00366	U	-0.0182	0.00823	U	1.82	2.32	U	1.68	0.181	—	0.0234	0.037	U	0.752	0.109	—
USGS-067	06/08/06	0.0136	0.0215	U	-0.0122	0.00705	U	0.012	0.0162	U	0.0157	0.0157	U	-10.4	3.25	U	1.73	0.233	—	0.0945	0.0511	U	0.687	0.132	—
USGS-085	03/02/06	0.00126	0.00126	U	-0.0103	0.018	U	0	1	U	-0.0046	0.00461	U	4.29	2.13	UJ	2.4	0.268	—	0.0249	0.0288	U	0.86	0.135	—
USGS-112	02/14/06	0.333	0.0561	—	-0.00825	0.0144	U	1.33	0.147	—	1.42	0.153	—	2.62	2.57	U	3.67	0.37	J	0.108	0.0468	UJ	2.8	0.298	—
USGS-121	02/13/06	-0.00766	0.00069	U	-0.0155	0.00636	U	0.0128	0.022	U	0.0179	0.0172	U	3.83	2.06	U	1.37	0.168	J	0.0912	0.0414	UJ	0.712	0.111	—
USGS-123	03/07/06	0.0046	0.00461	U	0.0201	0.0272	U	0	1	U	-0.00269	0.00269	U	2.75	1.36	UJ	1.21	0.185	—	0.0657	0.0489	U	0.722	0.133	—
ICDF Aquifer Wells																									
ICPP-1782	03/30/06	—	—	—	—	—	—	0.0134	0.0134	U	0	1	U	—	—	—	1.77	0.17	J	0.115	0.0439	J	0.973	0.121	J
ICPP-1783	03/28/06	—	—	—	—	—	—	0	1	U	0.0179	0.0179	U	—	—	—	1.69	0.166	J	0.1	0.0411	J	1.05	0.127	J
ICPP-1800	03/28/06	—	—	—	—	—	—	-0.0131	0.0131	U	0	1	U	—	—	—	2.26	0.203	J	0.157	0.0529	J	0.778	0.11	J
ICPP-1829	03/30/06	—	—	—	—	—	—	0	1	U	0.0123	0.0123	U	—	—	—	1.68	0.164	J	0.114	0.0432	J	0.958	0.119	J
ICPP-1831	03/30/06	—	—	—	—	—	—	0	1	U	0	1	U	—	—	—	1.76	0.171	J	0.168	0.0537	—	1.16	0.134	J
USGS-123	03/28/06	—	—	—	—	—	—	-0.0129	0.0129	U	-0.0259	0.0183	U	—	—	—	1.61	0.224	J	0.135	0.0679	U	0.847	0.157	J
Perched Water Monitoring Wells																									
33-1	04/17/06	0.0464	0.0233	U	0.0748	0.0433	U	0.485	0.0839	—	0.114	0.0404	J	-3.61	18.3	U	3.87	0.503	—	0.243	0.131	U	1.94	0.337	—
33-2	04/26/06	-0.0459	1,090,000 ^a	U	0.0107	0.0242	U	-0.000244	0.0245	U	-0.0124	0.0213	U	5.13	5.72	U	2.09	0.378	—	0.149	0.106	U	1.19	0.279	—
33-3	04/12/06	0.0422	0.03	U	0.0263	0.0263	U	0	1	U	0.0285	0.0285	U	3.34	2.01	U	8.58	0.918	—	0.296	0.135	UJ	5.54	0.661	—
33-4-1	04/24/06	-0.0298	0.0299	U	-0.0156	0.0111	U	0.0129	0.0262	U	0.0377	0.0361	U	2.96	1.69	U	2.08	0.303	—	0.124	0.0719	U	0.91	0.188	—
37-4	04/13/06	0.00392	0.00278	U	0.149	0.0865	U	0.0564	0.0565	U	0.113	0.0798	U	3.25	2.57	U	4.64	0.542	J	0.391	0.161	J	2.37	0.371	—
55-06	04/17/06	0.057	0.033	U	0.158	0.0917	U	0.186	0.0933	U	0.0466	0.0466	U	4.75	2.72	U	3.99	0.562	J	0.34	0.171	U	1.1	0.281	—
ICPP-2018	04/24/06	0.0545	0.0317	U	-0.0109	0.0109	U	0.0833	0.0482	U	0.0278	0.0278	U	-1.98	2.2	U	2.87	0.378	—	0.11	0.0775	U	1.81	0.285	—
ICPP-2019	04/11/06	0.0957	0.0555	U	0.106	0.075	U	0.113	0.0797	U	0.113	0.0797	U	4.84	2.73	U	2.76	0.391	J	0.483	0.172	—	2	0.327	—
MW-1-4	04/18/06	0.0784	0.0455	U	0	1	U	0.0495	0.0495	U	0.0494	0.0495	U	7.74	3.18	UJ	2.96	0.42	J	0.458	0.174	J	0.953	0.229	—
MW-2	04/17/06	0.052	0.037	U	0.0426	0.0427	U	0	1	U	0.124	0.0716	U	13.6	27.8	U	2.22	0.347	J	0.154	0.11	U	1.29	0.257	—
MW-4-2	04/20/06	0.082	0.0376	UJ	-0.000217	0.0267	U	0.0115	0.0261	U	0.0233	0.0233	U	-1.55	2.43	U	3.88	0.589	—	0.359	0.181	U	2.23	0.429	—
MW-5-2	04/13/06	0.113	0.0567	U	0.102	0.0725	U	0	1	U	0.101	0.0713	U	12.1	3.5	—	2.76	0.421	J	0.711	0.228	—	2.27	0.381	—
MW-6	04/11/06	0.00564	0.00565	U	-0.00728	0.00729	U	0.0204	0.0276	U	0.0537	0.038	U	6.85	3.1	UJ	3.01	0.398	—	0.0172	0.0947	U	0.985	0.209	—
MW-7-2	04/19/06	-0.0132	0.0133	U	0.0117	0.0264	U	-0.0177	0.0177	U	0.0525	0.0527	U	-4.25	2.38	U	2.48	0.442	—	0.32	0.172	U	1.36	0.32	—
MW-9-2	04/20/06	0.0793	0.0357	J	0.0113	0.0255	U	-0.0125	0.0125	U	0.0122	0.0277	U	-2.35	2.32	U	2.63	0.403	—	0.178	0.113	U	1.7	0.316	—
BLR-CH	04/20/06	0.07	0.0315	J	0.0487	0.0487	U	0.0117	0.0264	U	0	1	U	-3.56	2.27	U	2.06	0.343	—	0.373	0.154	J	1.41	0.278	—
BLR-DP	04/25/06	0.0319	0.0227	U	-0.0138	0.00977	U	-0.0181	0.0128	U	-0.00906	0.00907	U	-1.69	2.98	U	2.88	0.496	—	-0.0364	0.0259	U	1.89	0.386	—
CS-CH	04/27/06	0.0304	0.0216	U	-0.000231	0.0284	U	-0.025	0.0177	U	0.0864	0.0372	UJ	8.22	8.36	U	2.69	0.415	—	0.203	0.118				

Table B-5. Summary of inorganic constituent concentrations in groundwater - 2006 (all concentrations in mg/L unless otherwise noted.)

Well ID	Sample Date	Alkalinity		Calcium		Chloride		Fluoride		Magnesium		Mercury (µg/L)		Nitrate (as N)		Potassium		Sodium		Sulfate		TDS	
		Result	Flag	Result	Flag	Result	Flag	Result	Flag	Result	Flag	Result	Flag	Result	Flag	Result	Flag	Result	Flag	Result	Flag	Result	Flag
Aquifer Monitoring Wells																							
CPP-01	02/23/06	149	—	51.9	—	15.1	J	0.238	J	14.9	—	0.05	U	1.01	J	2.49	B	8.5	—	22.9	—	244	—
ICPP-2020	03/08/06	145	—	60.9	—	39.1	—	0.27	—	17.5	—	0.065	B	5.58	—	3.33	B	23.9	—	37.7	—	317	—
ICPP-2021	03/08/06	135	—	63.4	—	47.8	—	0.271	—	19.8	—	0.05	U	16.4	—	4.37	B	34.7	—	38.0	—	387	—
ICPP-MON-A-230	02/28/06	137	—	71.8	—	96.7	J	0.265	—	23.2	—	0.05	U	9.48	—	4.75	B	34.1	—	48.6	—	408	—
LF3-08	02/13/06	144	—	50.6	—	52.3	—	0.272	—	14.5	—	0.05	U	2.4	J	4.27	B	35.4	—	30.9	—	310	—
MW-18-4	02/28/06	139	—	62.3	—	45.2	J	0.283	—	18.0	—	0.05	U	8.36	—	3.59	B	28.4	—	38.4	—	322	—
USGS-040	05/17/06	145	—	54.8	—	19.5	J	0.261	—	14.7	—	0.06	U	4.37	—	2.26	B	12.8	—	23.3	—	269	—
USGS-041	05/15/06	149	—	54.1	—	19.7	J	0.23	—	14.5	—	0.06	U	3.16	—	2.13	B	11.0	—	24.2	—	256	—
USGS-042	05/15/06	148	—	52.8	—	17.9	J	0.236	—	14.2	—	0.06	U	2.98	—	2.14	B	11.0	—	24.3	—	247	—
USGS-044	03/01/06	153	—	54.5	—	13.0	J	0.247	—	14.4	—	0.05	U	0.796	—	2.23	B	8.4	—	22.5	—	177	—
USGS-046	03/01/06	153	—	55.6	—	16.1	J	0.258	—	15.0	—	0.05	U	1.55	—	2.27	B	9.6	—	23.3	—	224	—
USGS-047	03/08/06	157	—	56.3	—	18.2	—	0.281	—	15.5	—	0.05	U	1.47	—	2.11	B	10.9	—	24.5	—	254	—
USGS-051	03/06/06	106	—	72.2	—	128.0	—	0.23	—	25.3	—	0.05	U	2.68	—	5.36	—	32.8	—	29.3	—	464	—
USGS-052	03/08/06	145	—	53.4	—	25.0	—	0.263	—	15.6	—	0.05	U	2.88	—	3.04	B	15.9	—	26.2	—	264	—
USGS-057	03/07/06	148	—	55.5	—	22.8	—	0.289	—	14.7	—	0.05	U	2.03	—	2.64	B	15.9	—	23.8	—	249	—
USGS-059	03/02/06	159	—	54.6	—	20.6	—	0.263	—	15.0	—	0.05	U	1.35	—	2.65	B	12.2	—	25.3	—	219	—
USGS-067	06/08/06	128	—	56.0	—	66.7	J	0.26	—	15.3	—	60	U	4.71	—	3.92	B	33.0	—	28.2	—	339	—
USGS-085	03/02/06	155	—	59.3	—	17.0	—	0.243	—	15.4	—	0.05	U	1.22	—	2.83	B	14.1	—	39.1	—	205	—
USGS-112	02/14/06	152	—	52.2	—	36.4	—	0.278	—	13.8	—	0.05	U	1.79	J	3.17	B	25.0	—	29.1	—	263	—
USGS-121	02/13/06	150	—	50.6	—	13.1	—	0.24	—	14.5	—	0.05	U	0.822	J	2.55	B	7.8	—	22.6	—	228	—
USGS-123	03/07/06	124	—	41.4	—	20.4	—	0.248	—	15.6	—	0.05	U	1.05	—	2.99	B	11.3	—	21.1	—	216	—
ICDF Aquifer Wells																							
ICPP-1782	03/30/06	—	—	53.4	—	19.1	—	—	—	14.2	—	0.19	U, B	1.44	—	3.04	B	14.6	—	21.9	J	—	—
ICPP-1783	03/28/06	—	—	58.3	—	44.4	—	—	—	15.7	—	0.093	U	3.97	—	1.50	U	23.4	—	24.7	—	—	—
ICPP-1800	03/28/06	—	—	60.8	—	66.1	—	—	—	16.5	—	0.17	U, B	3.98	—	1.60	B	29.9	—	25.4	—	—	—
ICPP-1829	03/30/06	—	—	62.3	—	129.0	—	—	—	17.8	—	0.11	U, B	3.05	—	5.11	—	57.5	—	27.0	J	—	—
ICPP-1831	03/30/06	—	—	50.9	—	26.8	—	—	—	13.5	—	0.093	U	1.52	—	1.50	U	17.3	—	23.2	J	—	—
USGS-123	03/28/06	—	—	—	—	21.2	—	—	—	—	—	—	—	1.08	—	—	—	—	—	20.0	—	—	—
Perched Water Monitoring Wells																							
33-1	04/17/06	210	J	62.9	—	17.5	J	0.28	—	17.6	J	0.13	U	19.9	—	4.1	J	61.8	J	59.8	—	458	—
33-2	04/26/06	140	—	53.3	—	49.5	J	0.27	—	13.2	—	0.093	UJ	10.1	—	2.8	—	30.8	—	19.7	—	317	—
33-4-1	04/24/06	166	—	62.8	—	31.5	J	0.16	J	16.6	J	0.093	UJ	6.27	—	2.9	J	13.7	J	29.7	—	281	—
37-4	04/13/06	226	—	88.4	—	27.8	—	0.2	—	26.7	J	0.093	U	26.5	—	4.1	J	39.4	J	64.4	—	502	—
55-06	04/17/06	186	J	65.9	—	55.4	J	0.19	—	18.4	J	0.093	U	7.18	—	3.6	J	29.7	J	24.2	J	349	—
ICPP-2018	04/24/06	480	—	86.8	—	50.7	J	0.47	J	61.2	J	0.15	J, B	0.174	—	5.1	J	46.8	J	43.4	—	617	—
ICPP-2019	04/11/06	190	—	58.1	—	23.0	—	0.29	—	14.3	J	0.093	U	8.23	J	3.0	—	34.1	J	25.5	—	327	J
MW-1-4	04/18/06	144	J	88.6	—	52.7	J	0.18	—	24.8	J	0.14	B	48.9	—	4.8	J	28.7	J	26.1	—	575	—
MW-2	04/17/06	180	J	63.6	—	62.4	J	0.26	—	17.5	J	0.093	U	2.2	—	5.0	J	47.9	J	25.7	J	386	—
MW-4-2	04/20/06	242	—	71.1	J	31.7	J	0.22	—	19.6	J	0.093	UJ	13.7	—	4.6	J	39.5	J	38.0	—	432	—
MW-5-2	04/13/06	352	J	119.0	—	51.8	J	0.32	—	50.6	J	0.093	U	36.2	—	5.8	J	54.0	J	26.4	J	700	—
MW-6	04/11/06	166	—	73.1	—	85.1	—	0.33	—	18.9	J	0.093	U	5.09	J	3.8	J	33.4	J	34.1	—	403	J
MW-7-2	04/20/06	156	—	35.6	J	27.3	J	0.32	J	7.9	J	0.11	J	7	—	8.5	J	70.9	J	36.6	—	335	—
MW-9-2	04/20/06	142	—	40.5	J	17.7	J	0.31	—	11.1	J	0.093	UJ	2.14	—	3.9	J	48.4	J	32.3	—	295	—
BLR-CH	04/20/06	122	—	—	—	18.0	J	0.22	—	—	—	—	—	4.25	—	—	—	—	—	26.6	—	199	—
BLR-DP	04/25/06	140	—	46.1	—	9.5	J	0.23	—	12.2	R	0.093	U	1.46	—	2.2	J	7.2	R	21.5	—	306	—
CS-CH	04/27/06	110	—	59.4	—	81.1	J	0.22	—	18.7	—	0.093	UJ	7.82	—	4.1	—	29.6	—	46.8	—	336	—
TF-CH	04/19/06	194	—	76.7	—	30.7	J	0.16	J	17.5	J	0.18	B	10.5	—	2.5	J	11.9	J	42.2	—	314	—
USGS-50	04/18/06	130	J	57.5	—	50.5	J	0.31	—	14.7	J	0.14	B	26.2	—	4.8	J	60.6	J	37.0	—	425	—
Data Qualifier Flags: J = estimated value. B = instrument detection limit (IDL) ≤ value < contract required detection limit (CRDL). R = rejected value. U = not detected. UJ = not detected, quantitation limit is an estimate.																							

Table B-6. 2006 groundwater levels.

Well ID	Date Measured	Data Source	Water Level Elevation	Water Depth Below Measuring Point (ft)	Water Depth Below Land Surface (ft)	Measuring Point Elevation (ft asl)	USGS Land Surface Elevation (ft asl)
ICPP-2020	03/08/06	WAG 3	4447.98	469.27	—	4917.25	—
ICPP-2021	03/08/06	WAG 3	4447.16	467.52	—	4914.68	—
ICPP-MON-A-166	01/10/06	USGS	4447.02	—	509.1	—	4956.12
ICPP-MON-A-230	04/17/06	WAG 3	4447.97	466.85	—	4914.82	—
LF3-08	02/13/06	WAG 3	4443.2	498.57	—	4941.77	—
MW-18-4	02/28/06	WAG 3	4447.04	469.45	—	4916.49	—
NPR TEST	01/10/06	USGS	4459.73	—	473.4	—	4933.13
SITE-19	03/14/06	USGS	4448.06	—	477.89	—	4925.95
USGS-035	03/08/06	USGS	4446.89	—	482.08	—	4928.97
USGS-036	01/10/06	USGS	4447.1	—	481.73	—	4928.83
USGS-037	03/08/06	USGS	4447.07	—	481.47	—	4928.54
USGS-039	03/08/06	USGS	4447.01	—	483.54	—	4930.55
USGS-040	01/17/06	USGS	4447.6	—	468.05	—	4915.65
USGS-041	03/15/06	USGS	4447.87	—	468.39	—	4916.26
USGS-043	03/14/06	USGS	4447.51	—	467.97	—	4915.48
USGS-044	03/01/06	WAG 3	4447.37	472.11	—	4919.48	—
USGS-045	03/14/06	USGS	4446.67	—	471.02	—	4917.69
USGS-046	03/01/06	WAG 3	4447.37	474.55	—	4921.92	—
USGS-052	03/15/06	USGS	4447.96	—	461.48	—	4909.44
USGS-057	03/15/06	USGS	4446.8	—	475.43	—	4922.23
USGS-058	01/11/06	USGS	4448.1	—	470.01	—	4918.11
USGS-059	03/02/06	WAG 3	4447.19	467.74	—	4914.93	—
USGS-065	01/10/06	USGS	4451.53	—	473.22	—	4924.75
USGS-067	03/14/06	USGS	4447.11	—	466.23	—	4913.34
USGS-077	03/14/06	USGS	4446.7	—	474.73	—	4921.43
USGS-082	01/10/06	USGS	4447.68	—	459.15	—	4906.83
USGS-083	01/09/06	USGS	4435.26	—	505.85	—	4941.11
USGS-084	01/10/06	USGS	4446.98	—	490.65	—	4937.63
USGS-085	01/10/06	USGS	4446.91	—	492.08	—	4938.99
USGS-099	01/23/06	USGS	4464.22	—	407.33	—	4871.55
USGS-112	03/14/06	USGS	4447.24	—	480.58	—	4927.82
USGS-113	01/10/06	USGS	4447.91	—	477.41	—	4925.32
USGS-114	03/14/06	USGS	4446.69	—	473.35	—	4920.04
USGS-115	03/14/06	USGS	4446.78	—	472.08	—	4918.86
USGS-121	02/13/06	WAG 3	4445.68	465.85	—	4911.53	—
USGS-122	03/14/06	USGS	4447.24	—	466.55	—	4913.79
USGS-123	03/07/06	WAG 3	4445.65	476.2	—	4921.85	—
USGS-128	01/10/06	USGS	4447.05	—	487.87	—	4934.92

Note: Shaded values not used for water-level map.

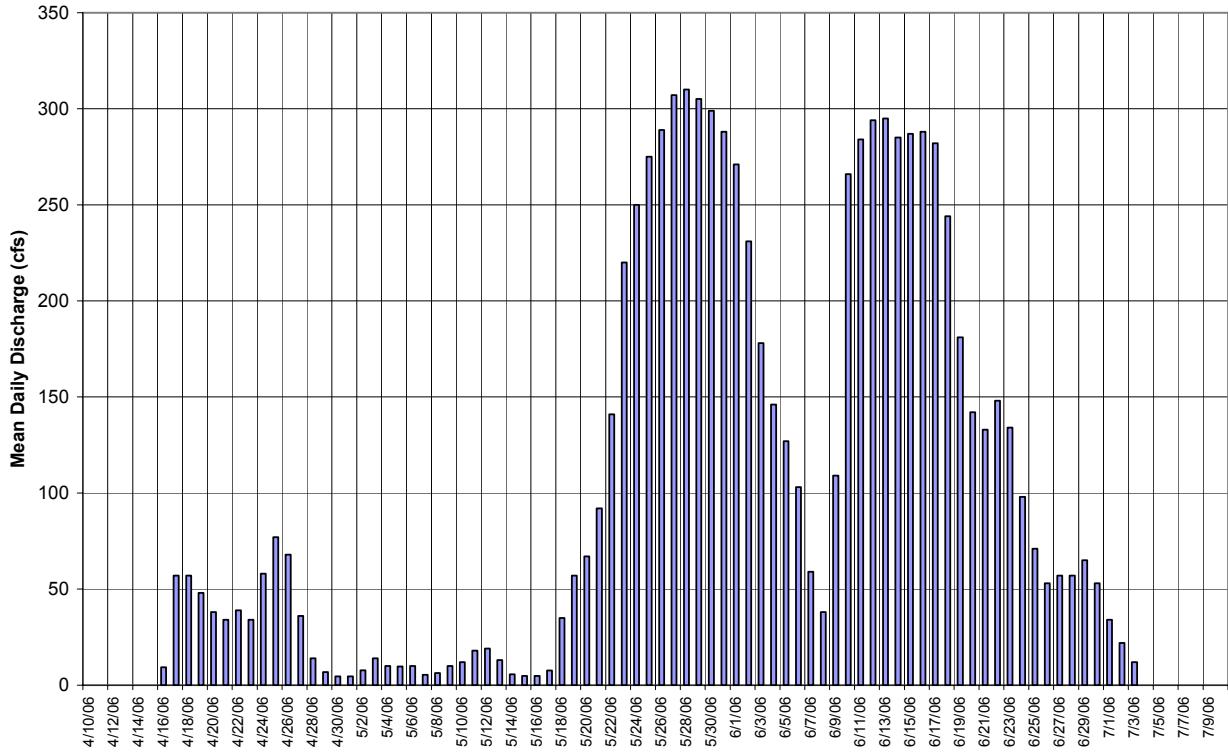
Table B-7. Summary of constituents detected in 2006 groundwater and perched water samples.

Constituent	MCL	Units	SRPA Groundwater			Shallow Perched Water			Deep Perched Water		
			Maximum Value	# Results	# Results >MCL	Maximum Value	# Results	# Results >MCL	Maximum Value	# Results	# Results >MCL
Gross Alpha	15	pCi/L	5.28	21	0	47.6	17	2	98.9	3	1
Gross Beta	NA	pCi/L	1,180	21	NA	428,000	17	NA	239	3	NA
Cs-137	200	pCi/L	17.4 UJ	21	0	119	17	0	-0.369 U	3	0
Sr-90	8	pCi/L	24.1	27	12	197,000	18	13	2.57	2	0
Tc-99	900	pCi/L	2,150 J	27	2	461	18	0	35.2	3	0
I-129	1	pCi/L	0.649 J	27	0	5.22 J	13	1	0.0539 UJ	3	0
Tritium	20,000	pCi/L	8,930	21	0	36,400	18	1	20,200	3	1
Am-241	15	pCi/L	0.333	21	0	0.113 U	17	0	0.0784 U	3	0
Np-237	15	pCi/L	0.0466 U	21	0	0.158 U	17	0	0.0195 U	3	0
Pu-238	15	pCi/L	1.33	27	0	0.485	17	0	0.0495 U	3	0
Pu-239/240	15	pCi/L	1.42	27	0	0.124 U	17	0	0.0587 U	3	0
Pu-241	300	pCi/L	5.7	21	0	13.6 U	17	0	7.74 UJ	3	0
U-233/234	15	pCi/L	3.67 J	27	0	8.58	17	0	3.5	3	0
U-235	15	pCi/L	0.168	27	0	0.711	17	0	0.458 J	3	0
U-238	15	pCi/L	2.8	27	0	5.54	17	0	2.64	3	0
Alkalinity	NA	mg/L	159	21	NA	480	16	NA	144 J	3	NA
Calcium	NA	mg/L	72.2	26	NA	119	15	NA	88.6	3	NA
Chloride	250	mg/L	129	27	0	85.1	16	0	52.7 J	3	0
Fluoride	4	mg/L	0.289	21	0	0.47 J	16	0	0.31	3	0
Magnesium	NA	mg/L	25.3	26	NA	61.2 J	15	NA	24.8 J	3	NA
Mercury	2	µg/L	60 U	26	1	0.18 B	15	0	0.14 B	3	0
Nitrate (as N)	10	mg/L	16.4	27	1	36.2	16	1	48.9	3	2
Potassium	NA	mg/L	5.36	26	NA	8.48 J	15	NA	4.83 J	3	NA
Sodium	NA	mg/L	57.5	26	NA	70.9 J	15	NA	60.6 J	3	NA
Sulfate	250	mg/L	48.6	27	0	64.4	16	0	37	3	0
TDS	500	mg/L	464	21	0	700	16	3	575	3	1

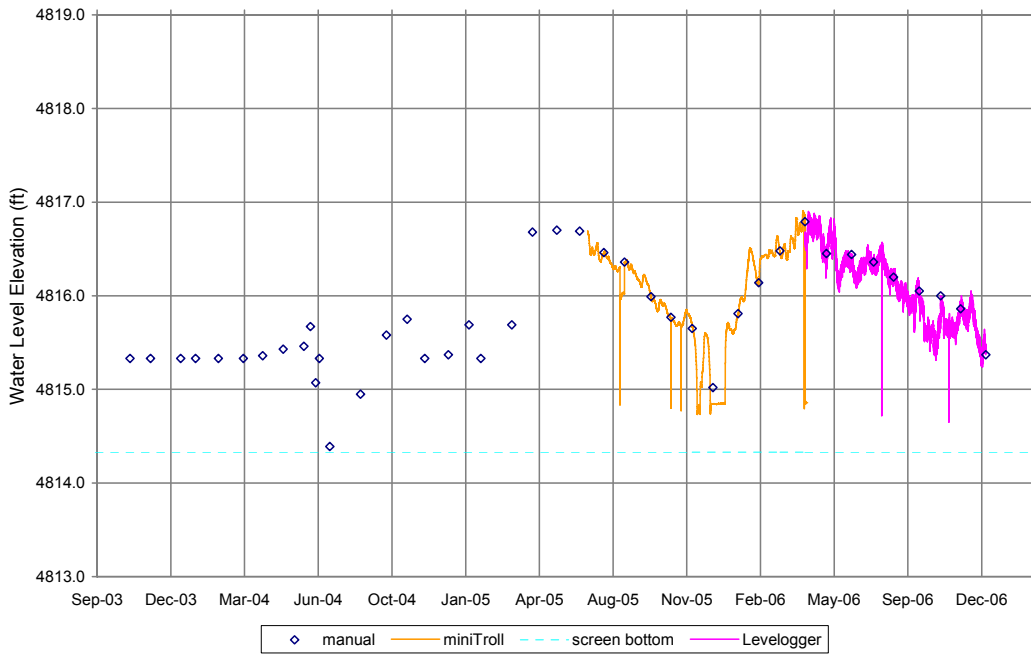
NA = not applicable

Appendix C
Perched Water Hydrographs

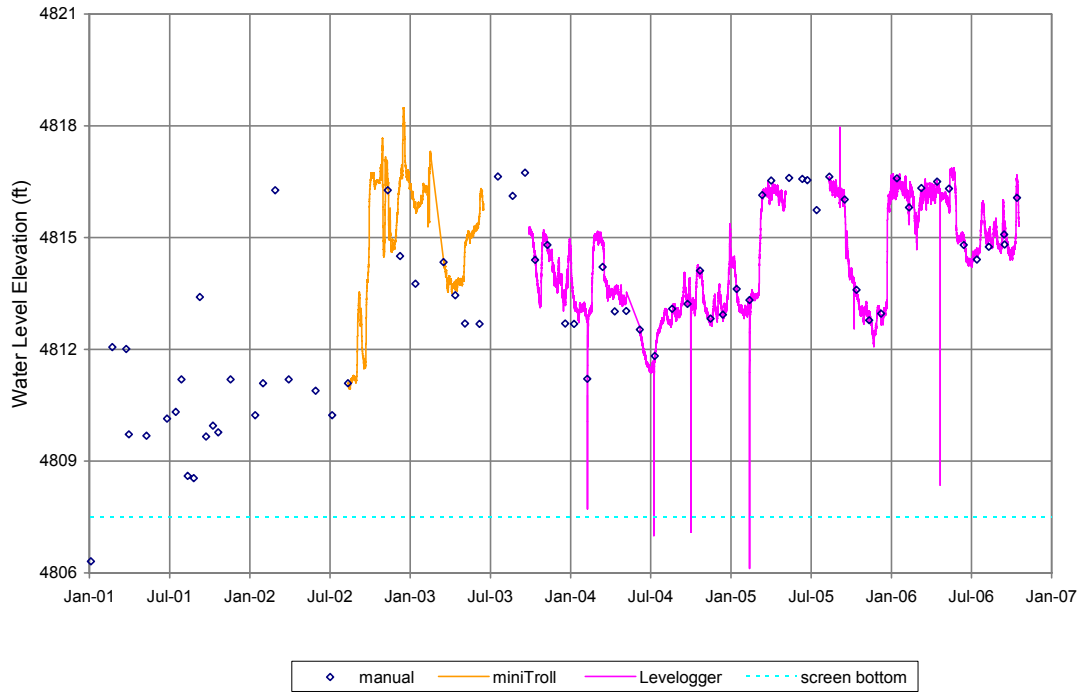
Big Lost River Flow at Lincoln Blvd



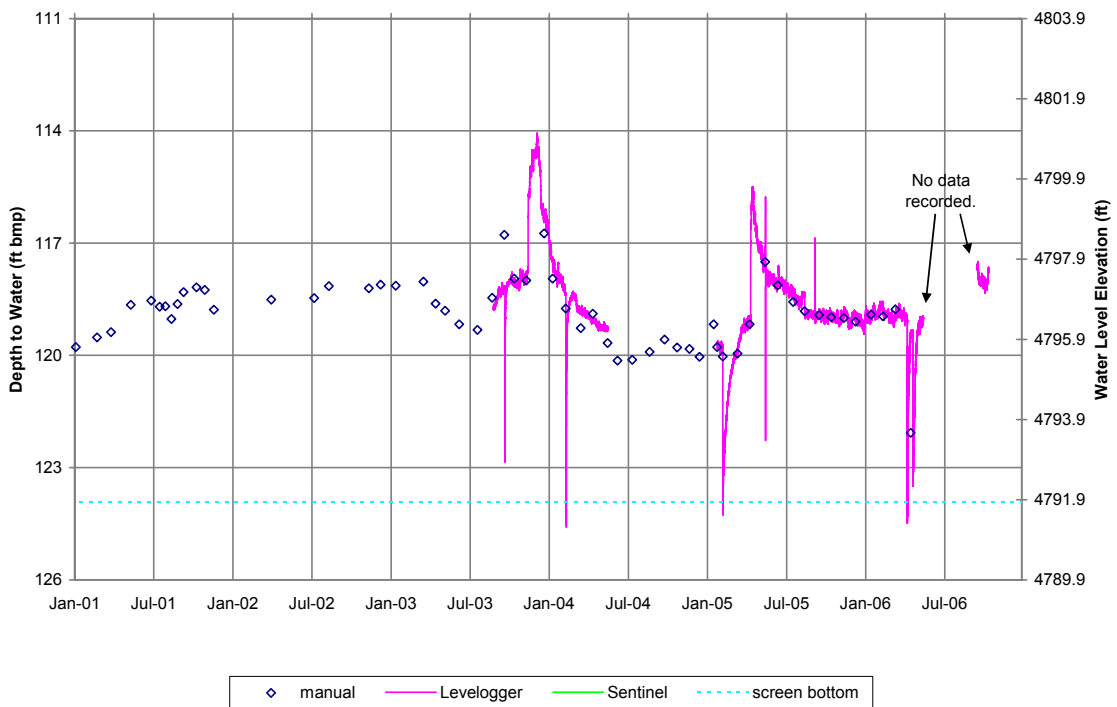
33-1



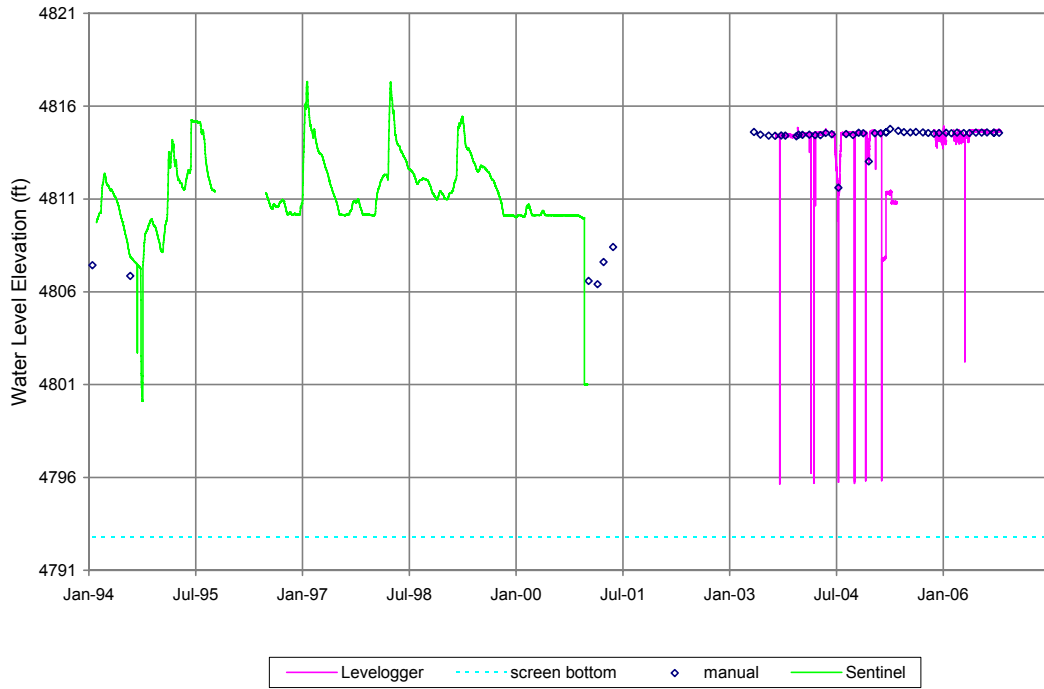
33-2



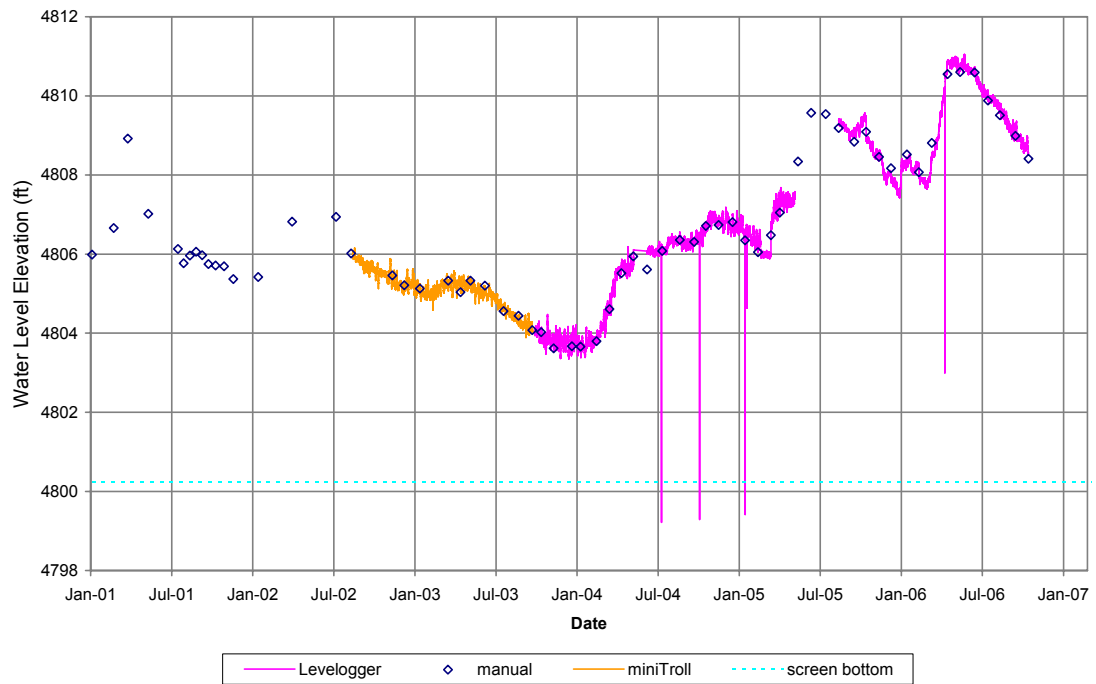
33-3



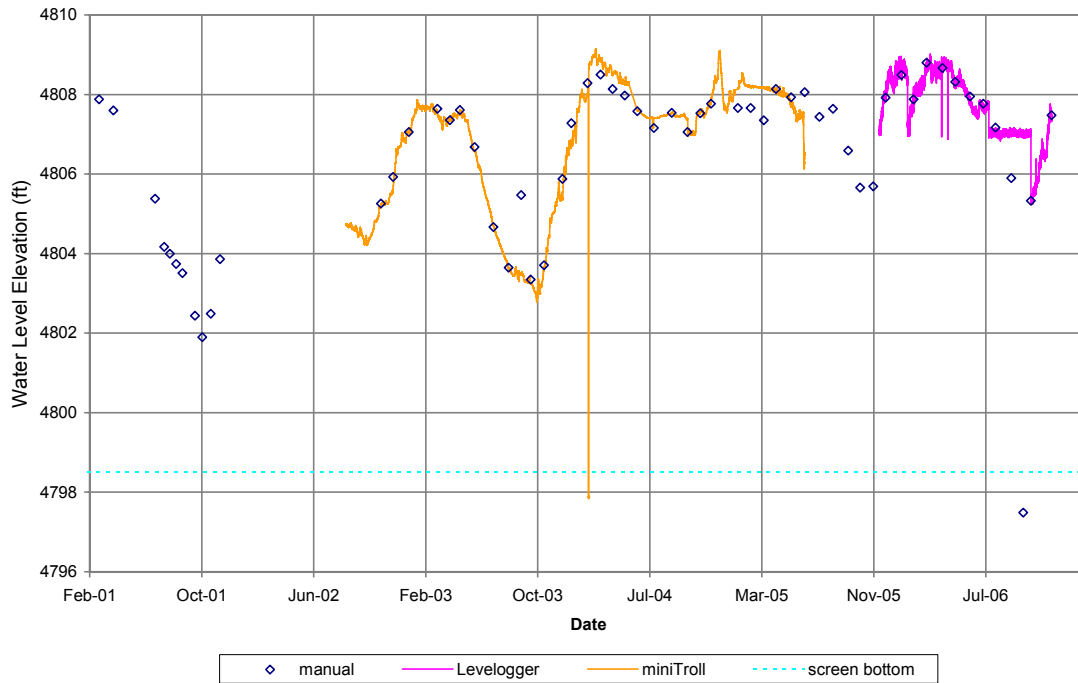
33-4-1



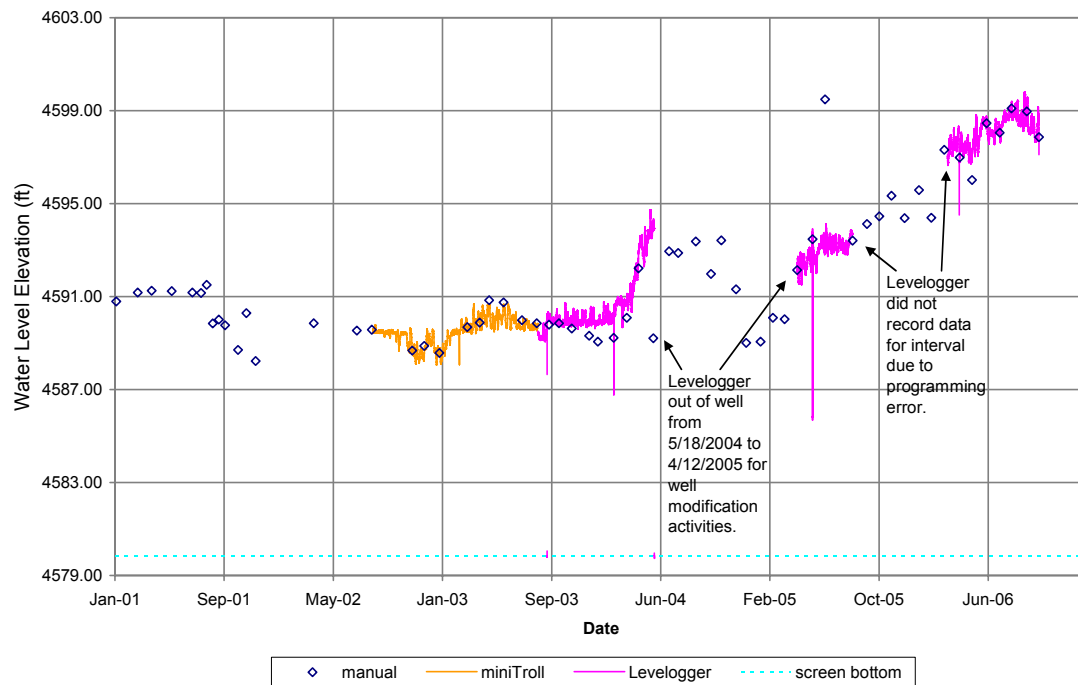
37-4



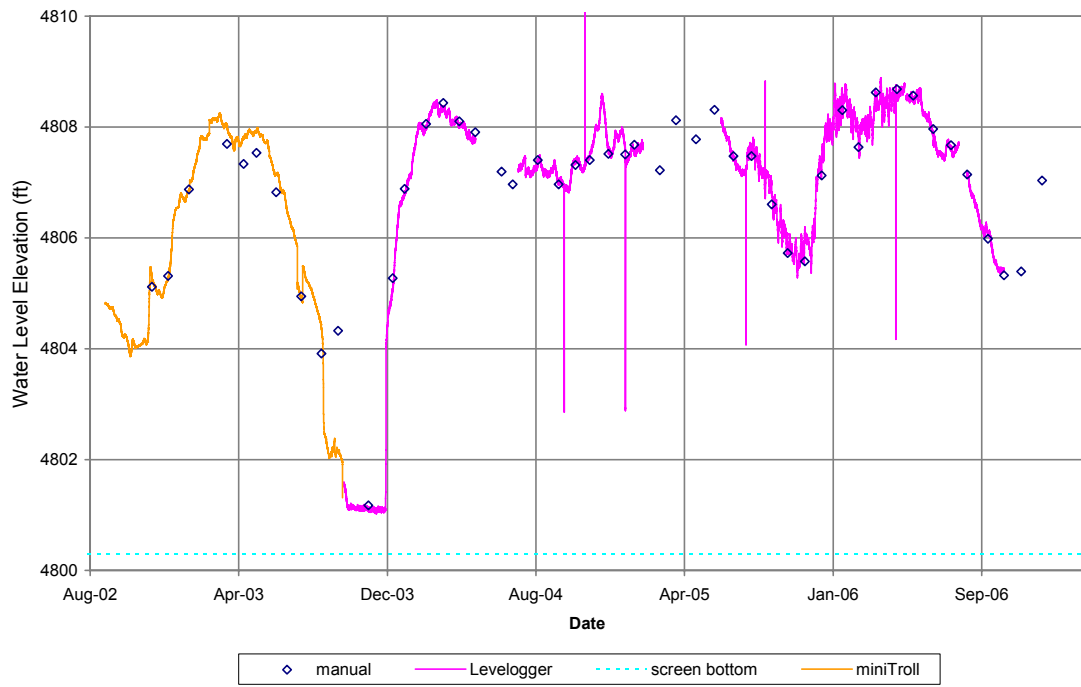
55-06



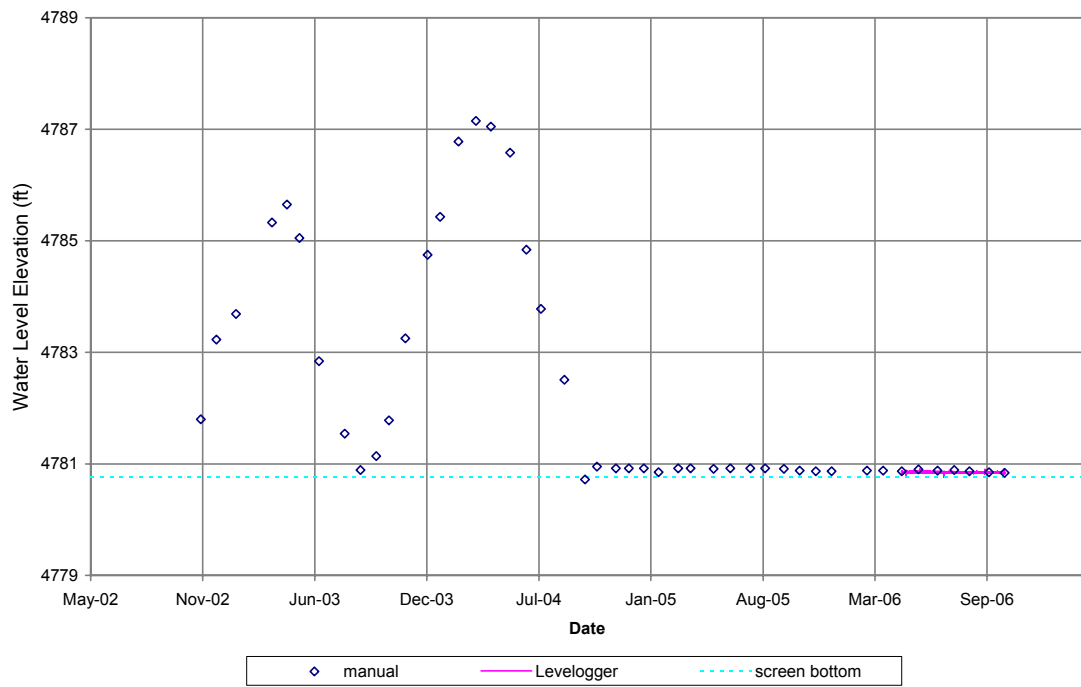
MW-1-4



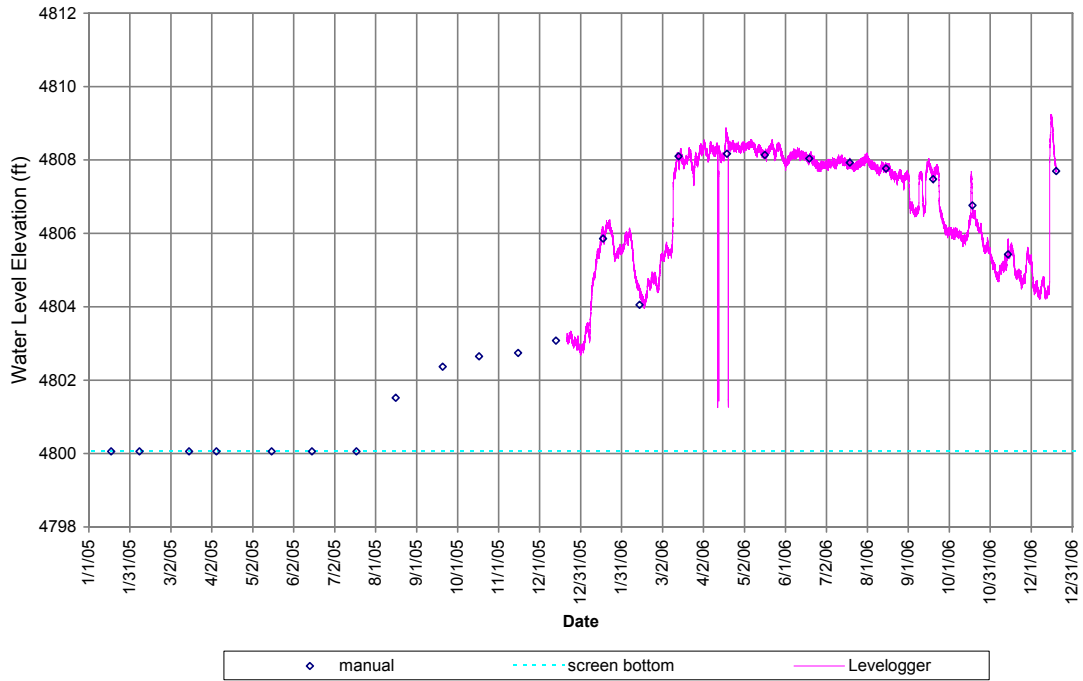
MW-2



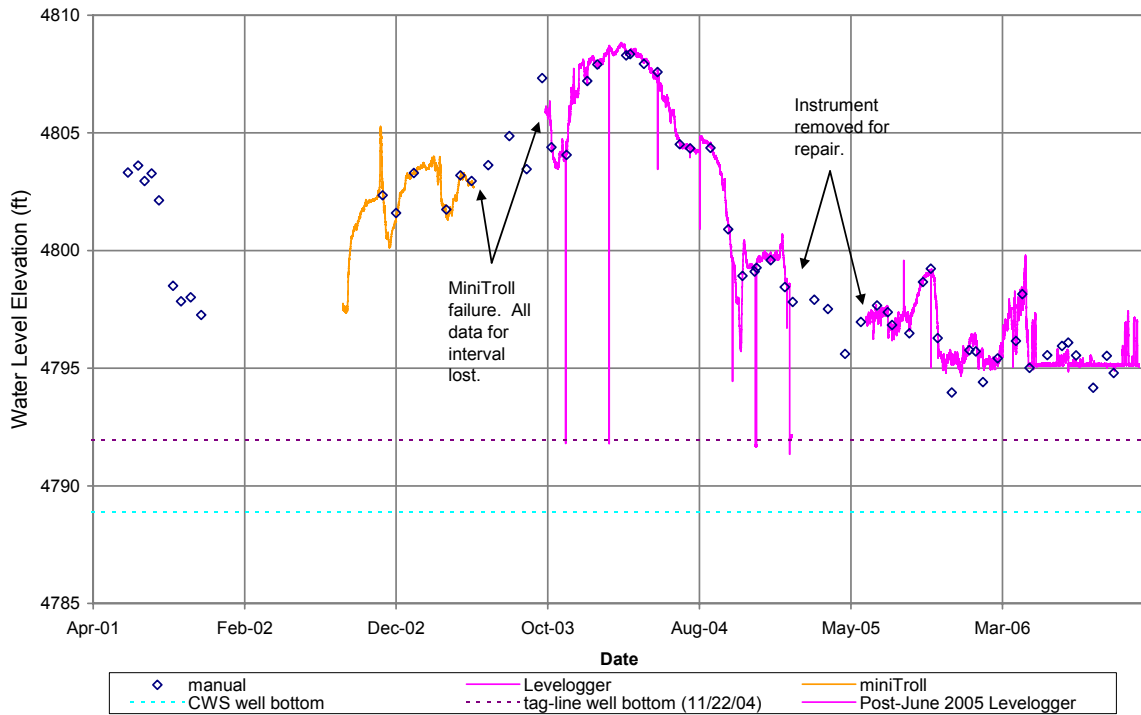
MW-3-2



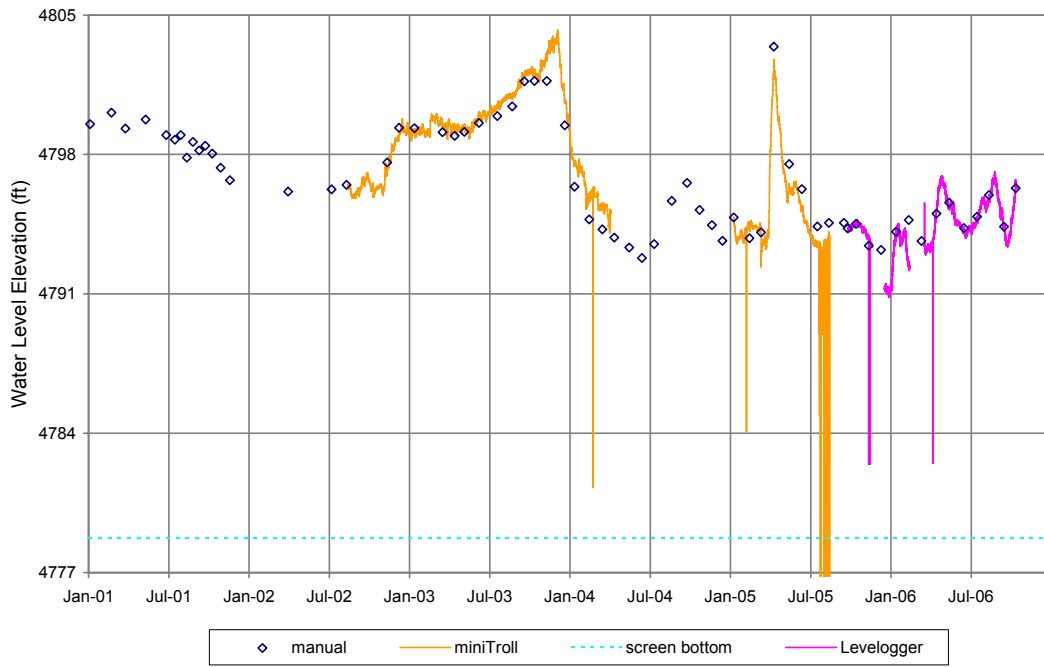
MW-4-2



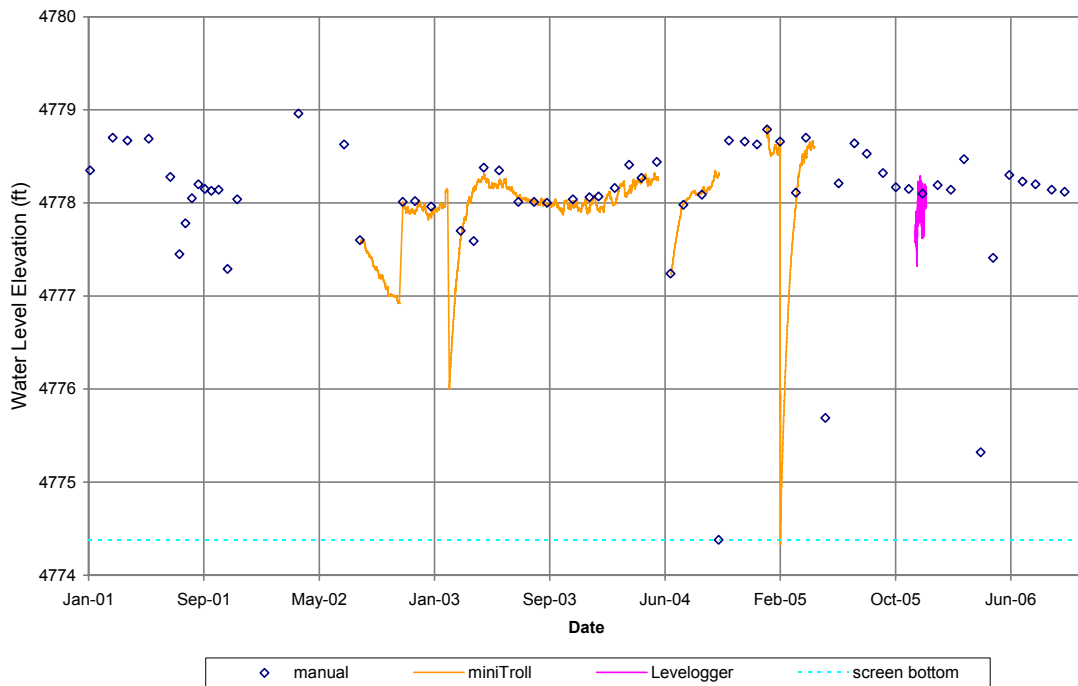
MW-5-2



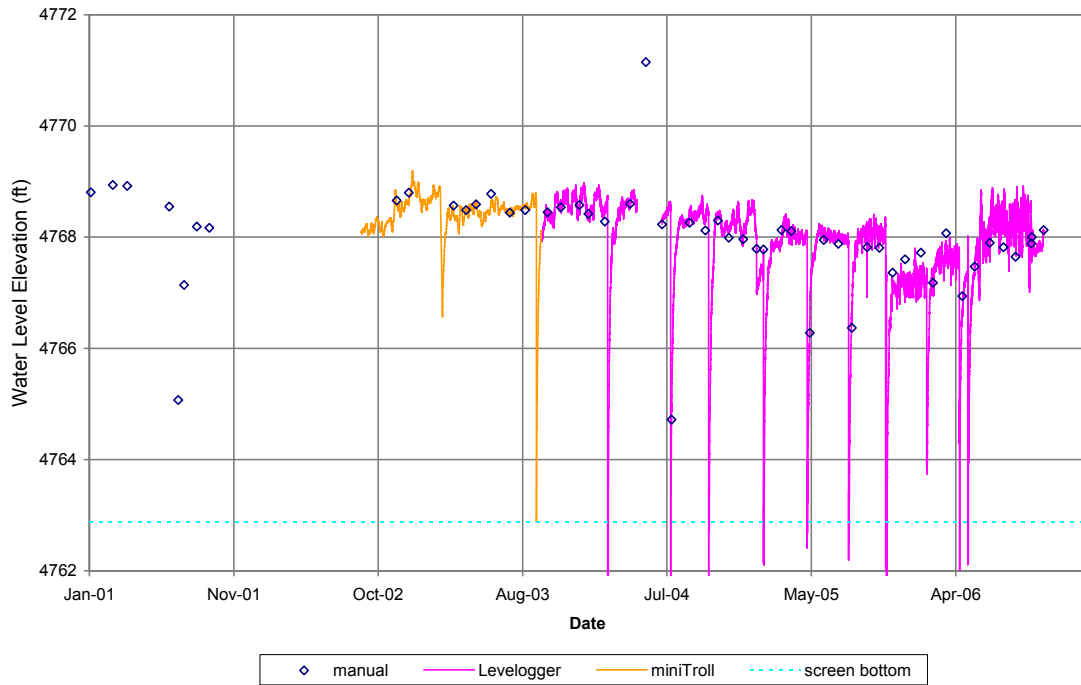
MW-6



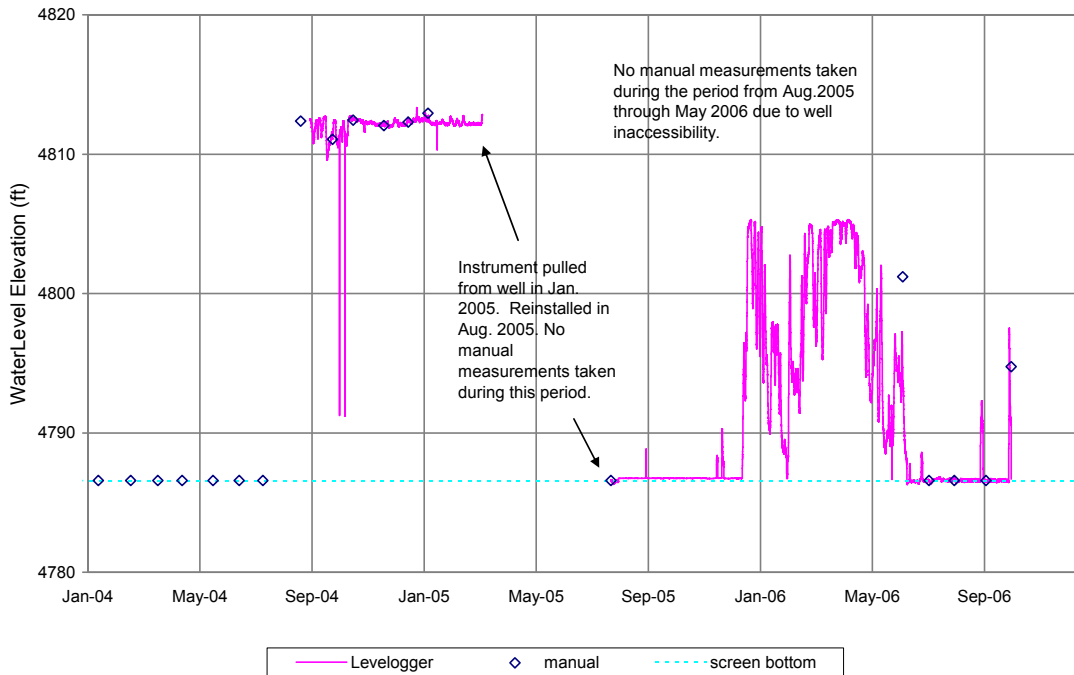
MW-7-2



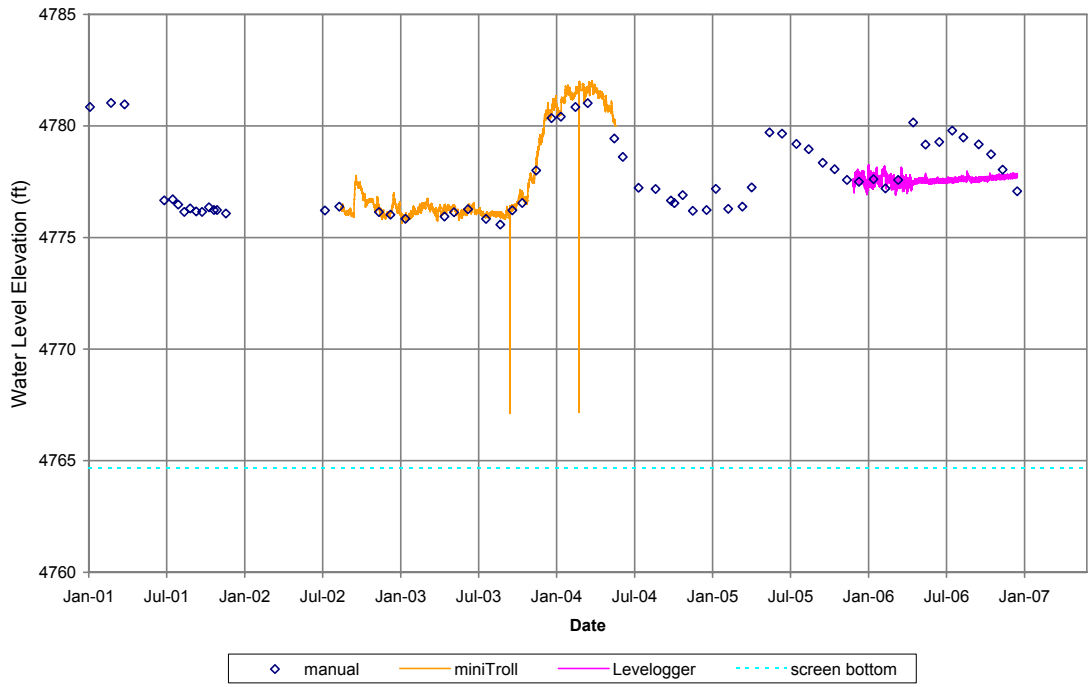
MW-10-2



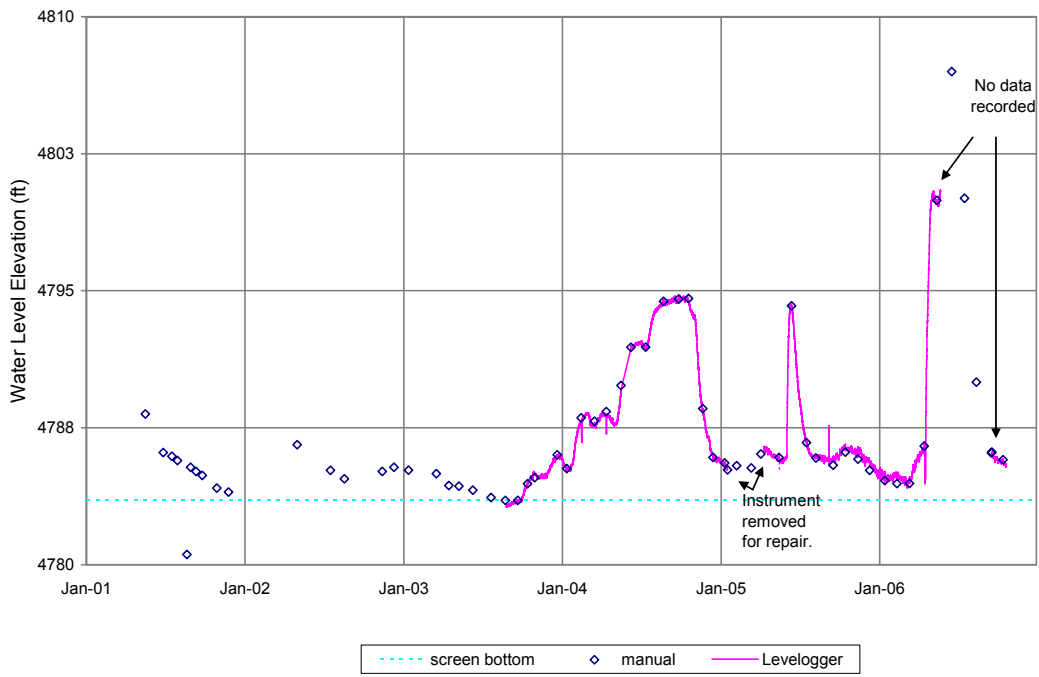
MW-15



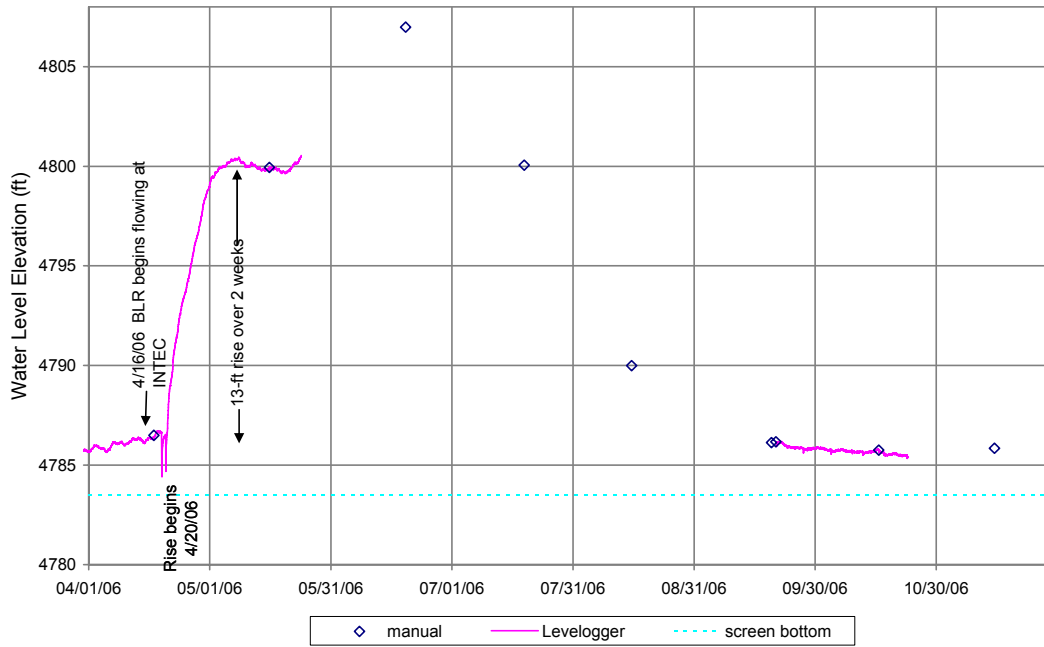
MW-20-2



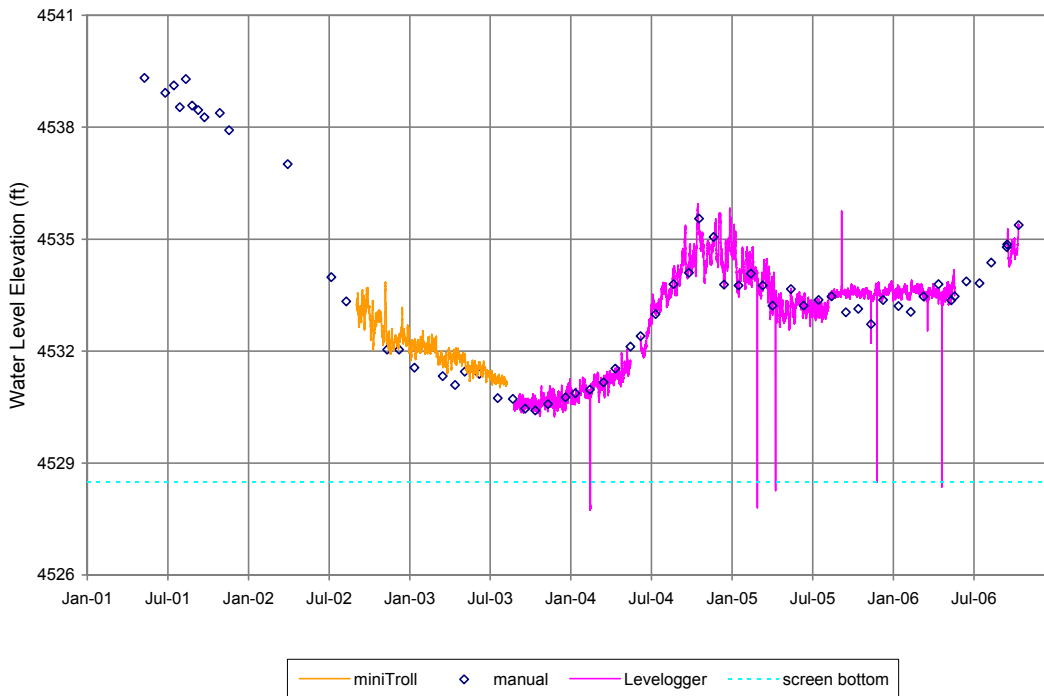
BLR-CH



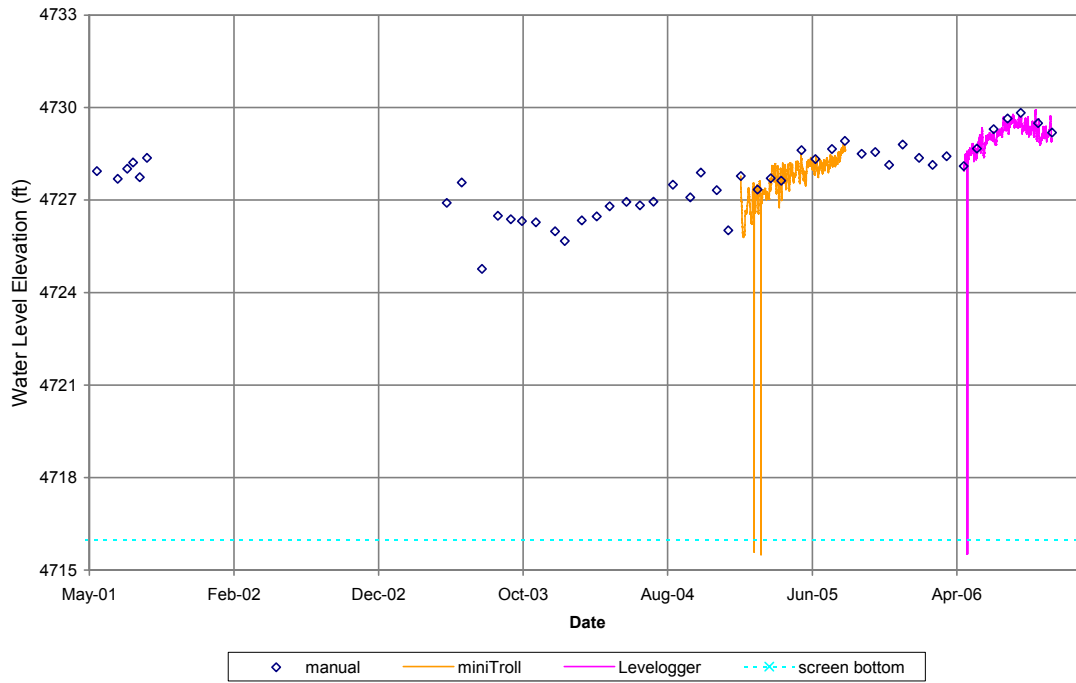
BLR-CH
 (well located 500 ft from Big Lost River; screened 120-130 ft bgs)



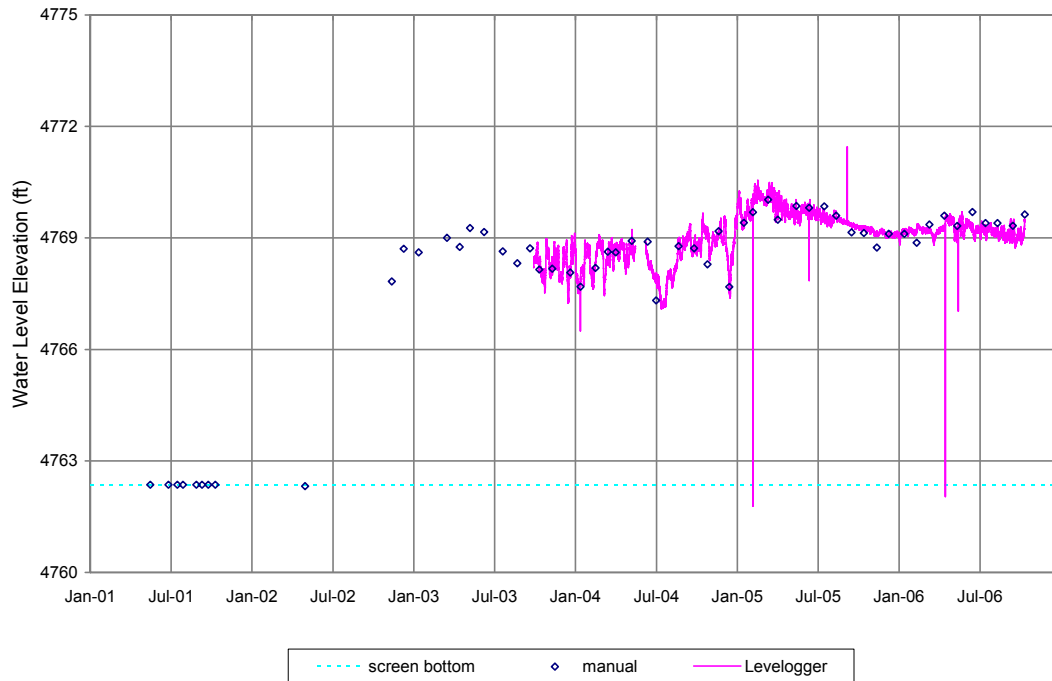
BLR-DP



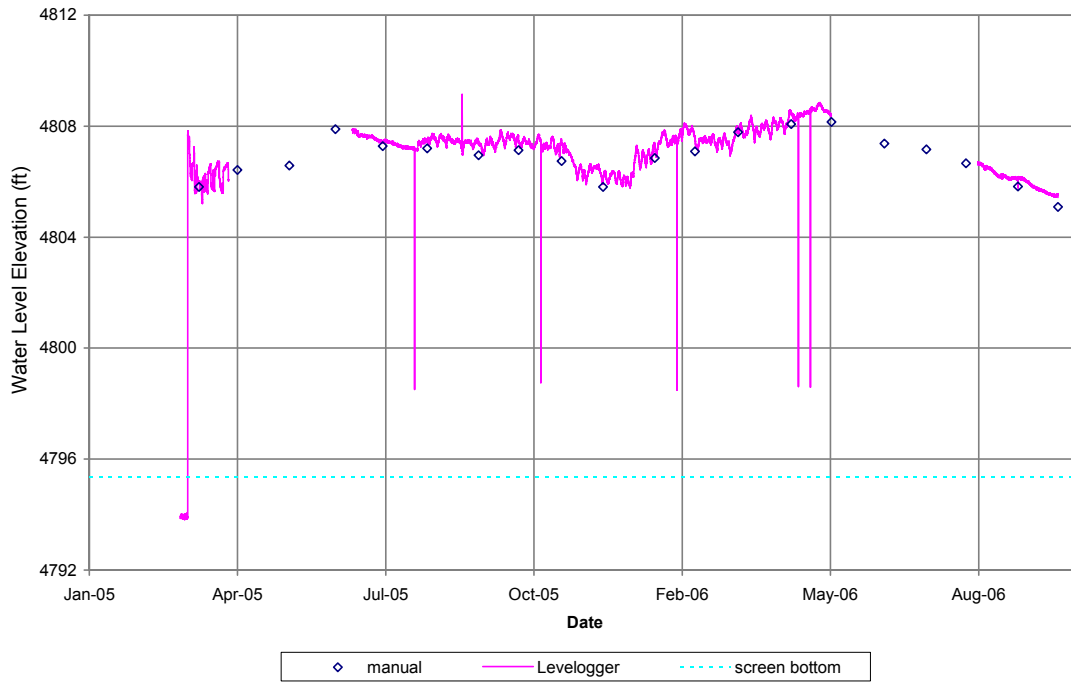
CS-CH



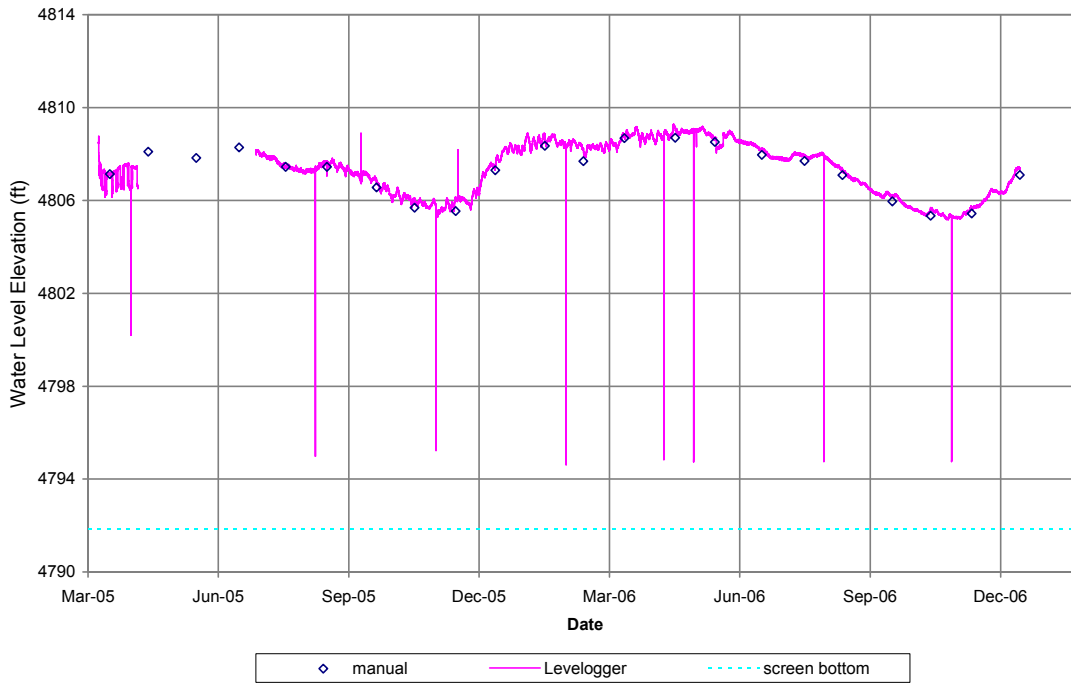
TF-CH



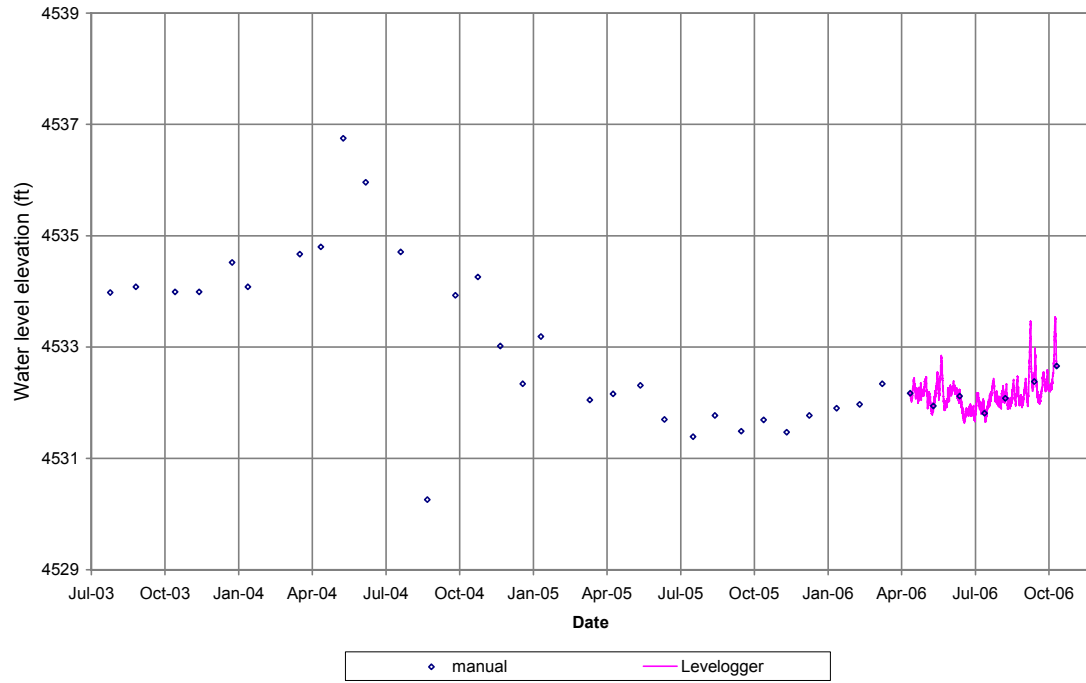
ICPP-2018



ICPP-2019

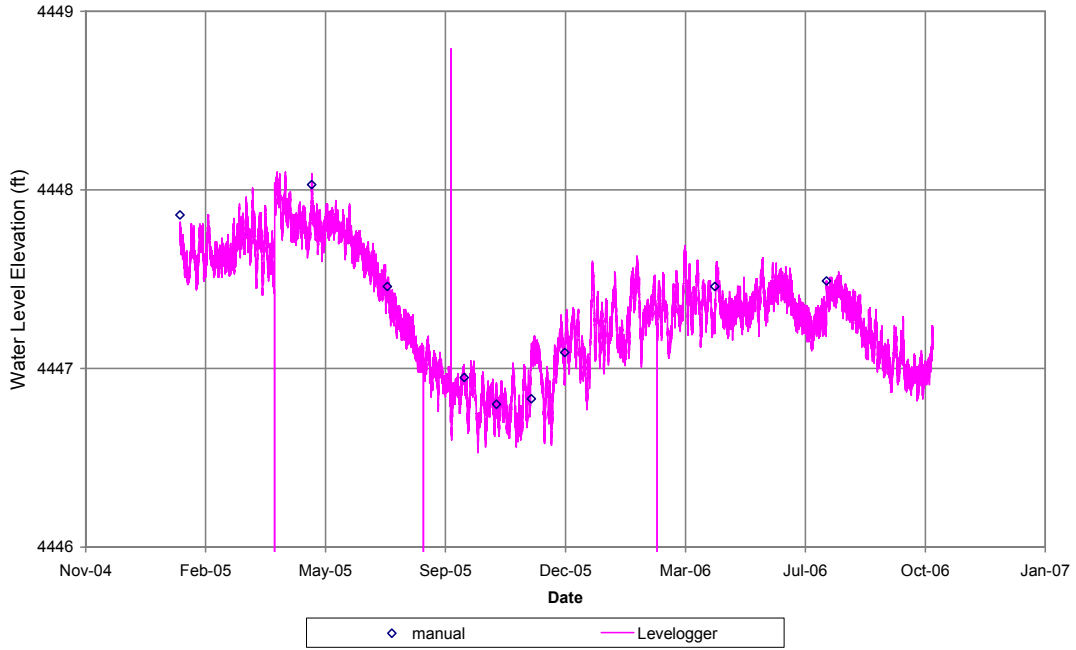


USGS-50

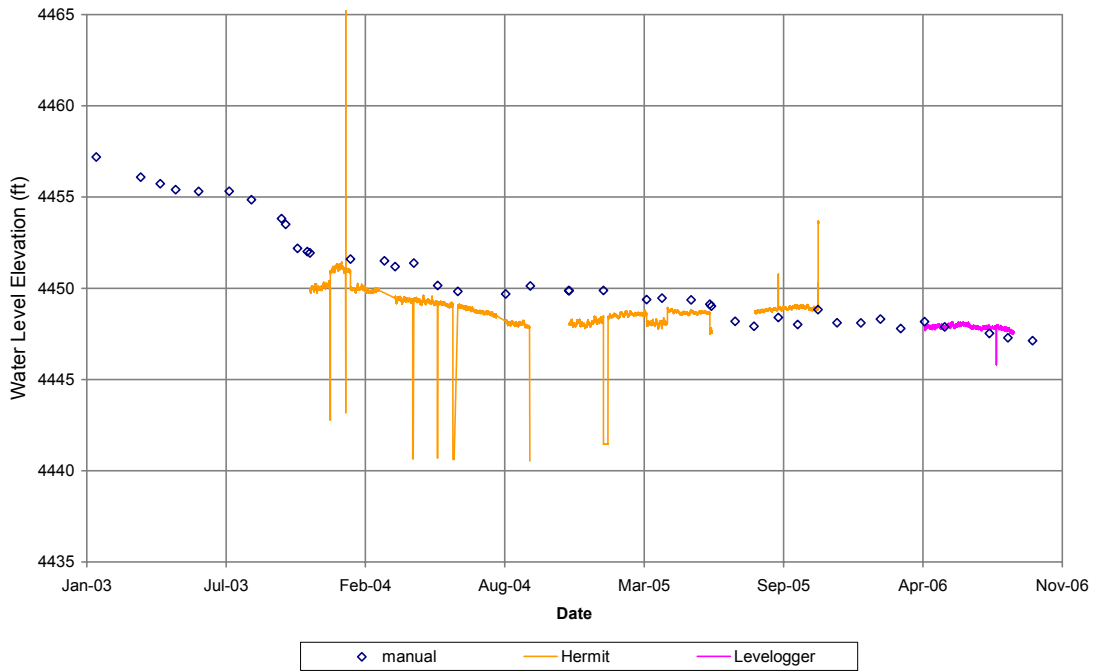


Aquifer Well Hydrographs

MW-18-4



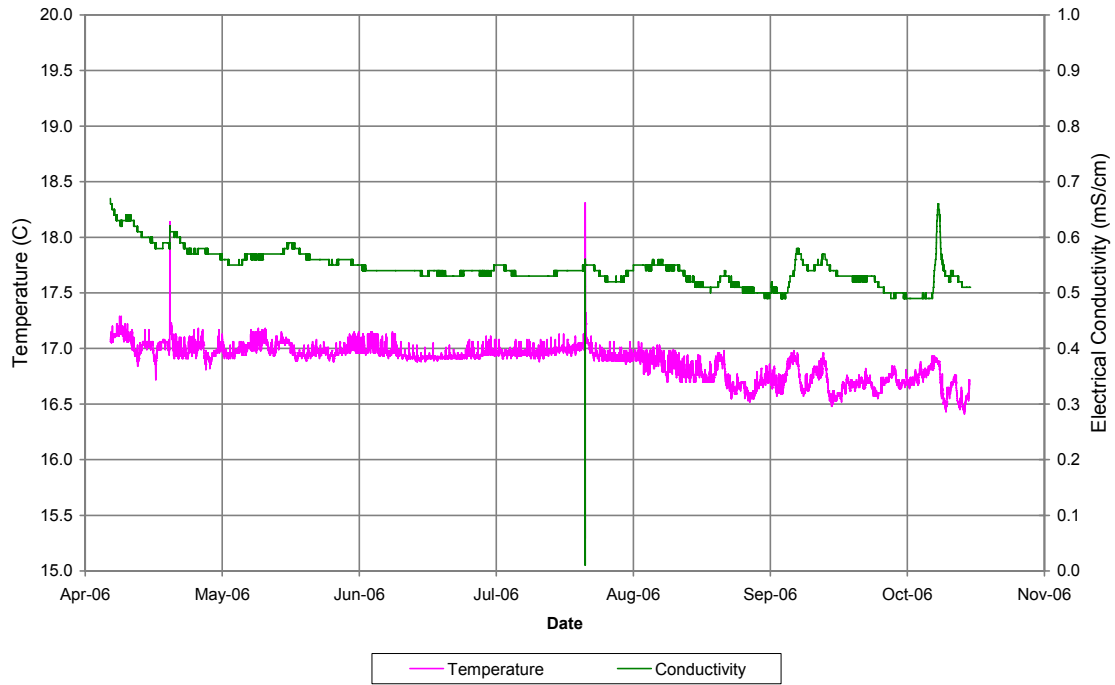
ICPP-MON-A-230



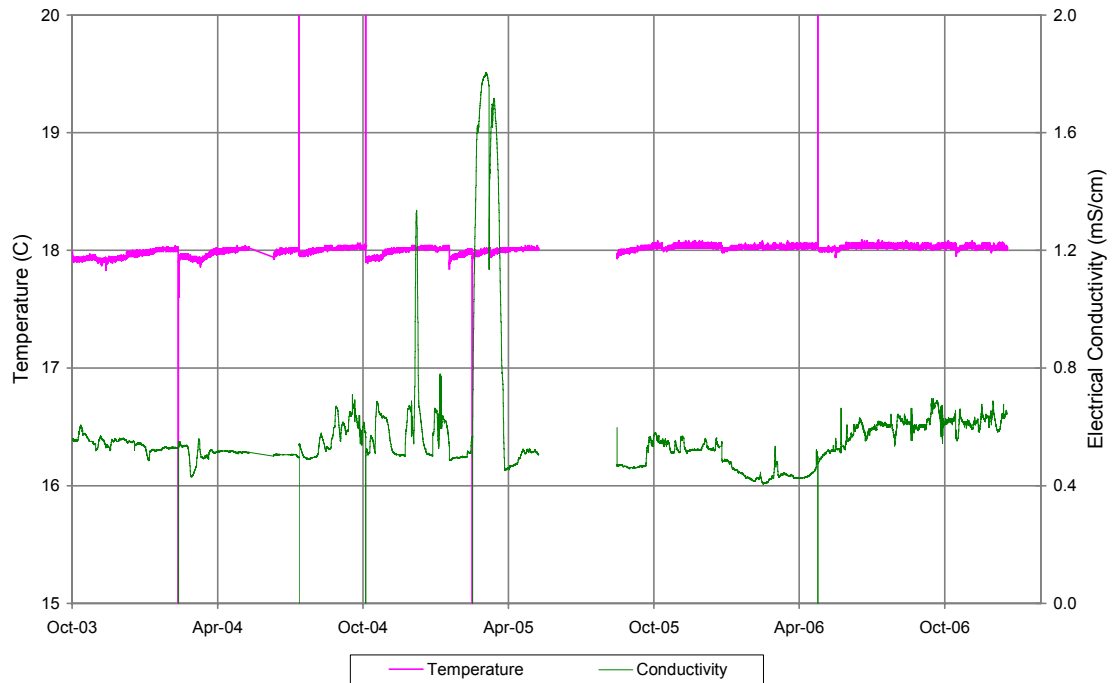
Appendix D

Perched Water Temperature and Electrical Conductivity Plots

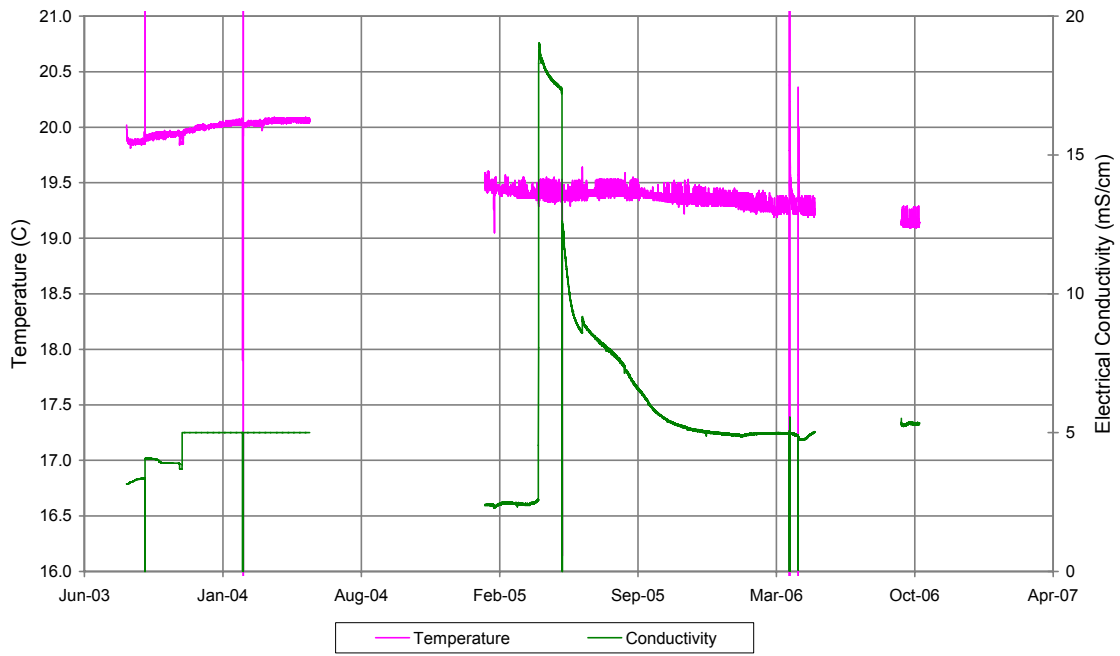
Temperature and Conductivity at 33-1



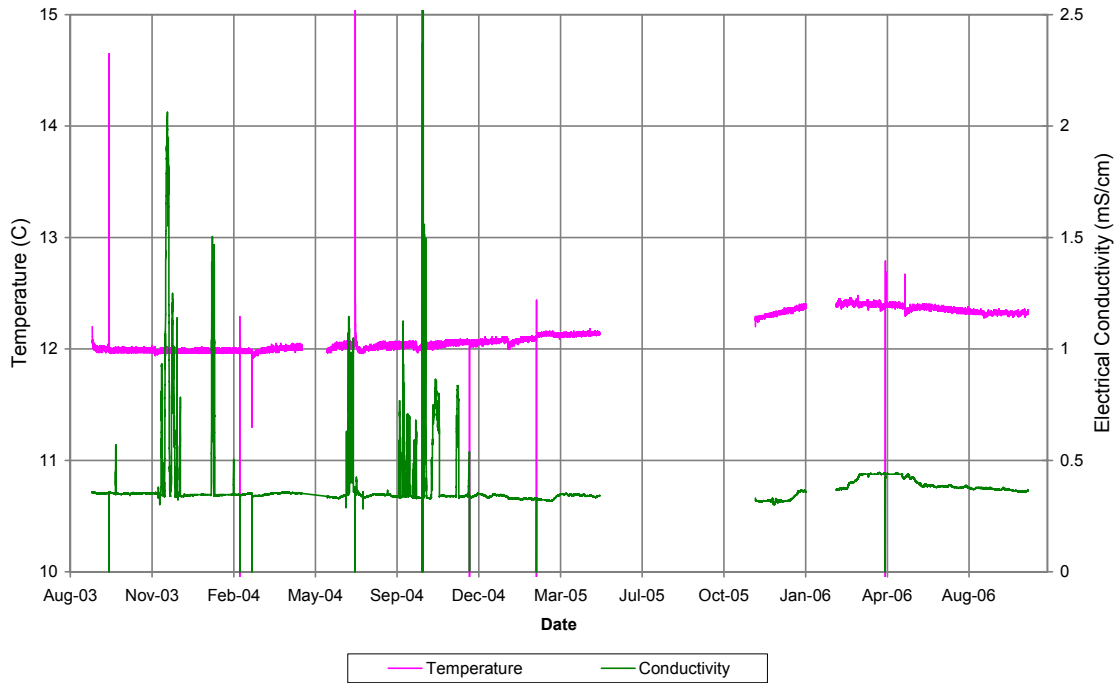
Temperature and Conductivity in 33-2



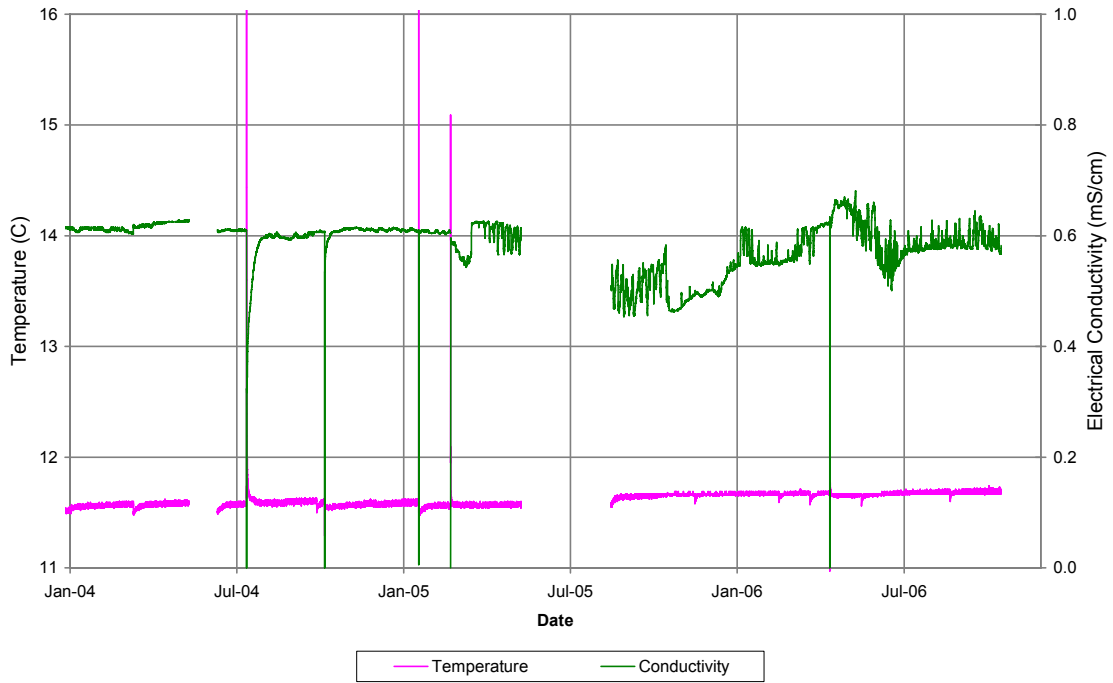
Temperature and Conductivity in 33-3



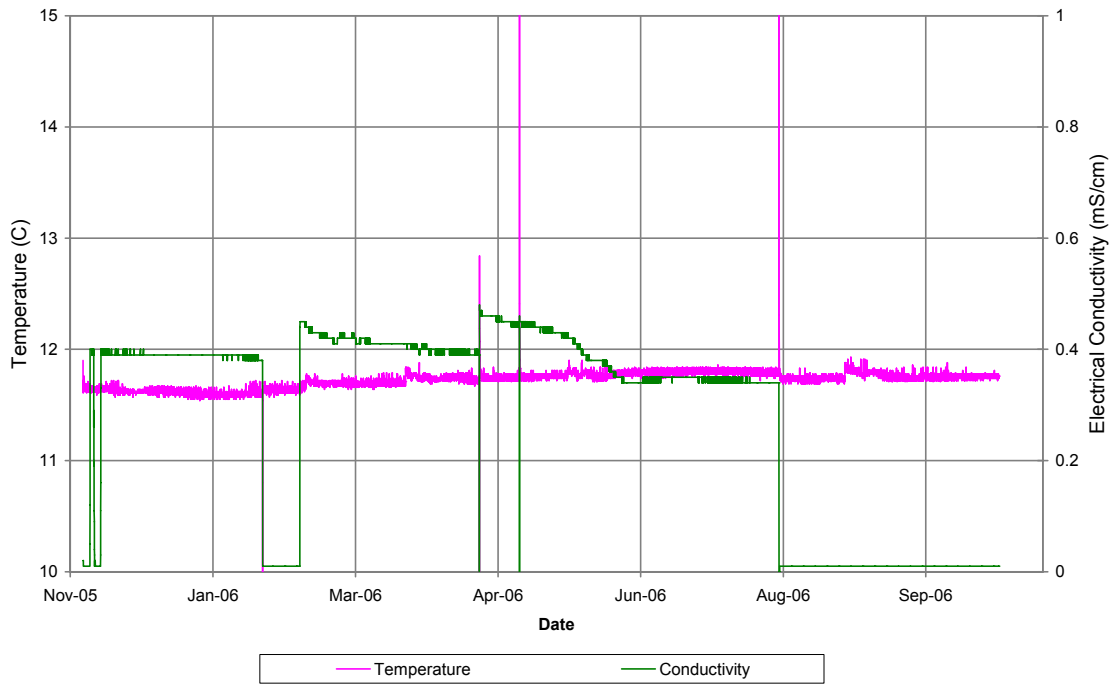
Temperature and Conductivity in 33-4-1



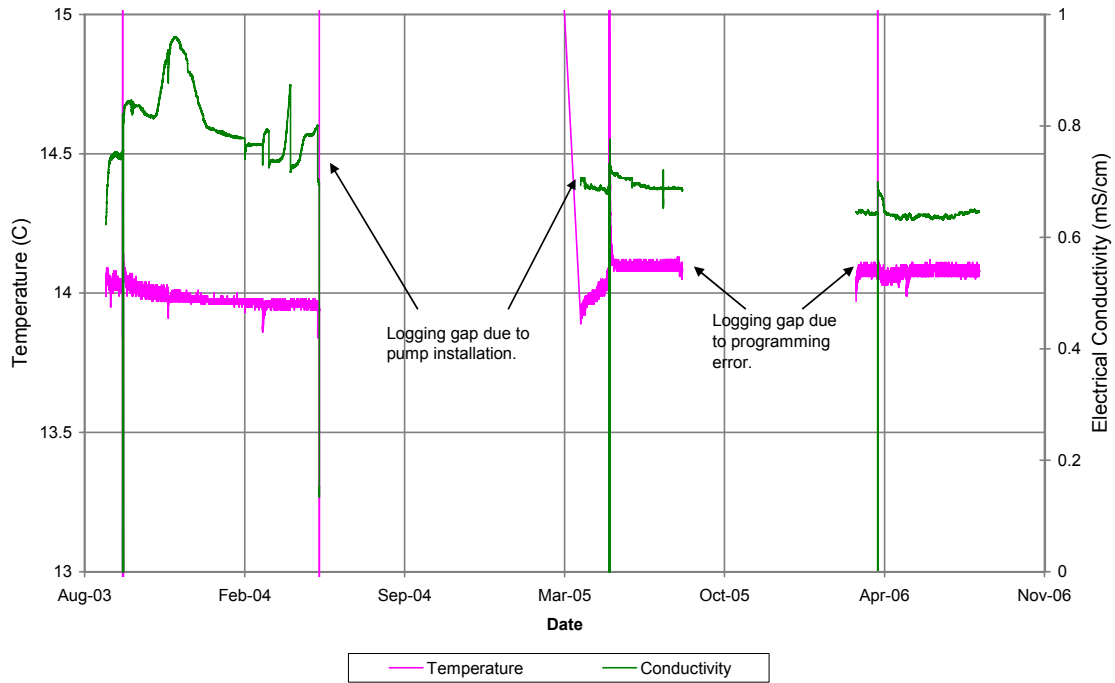
Temperature and Conductivity in 37-4



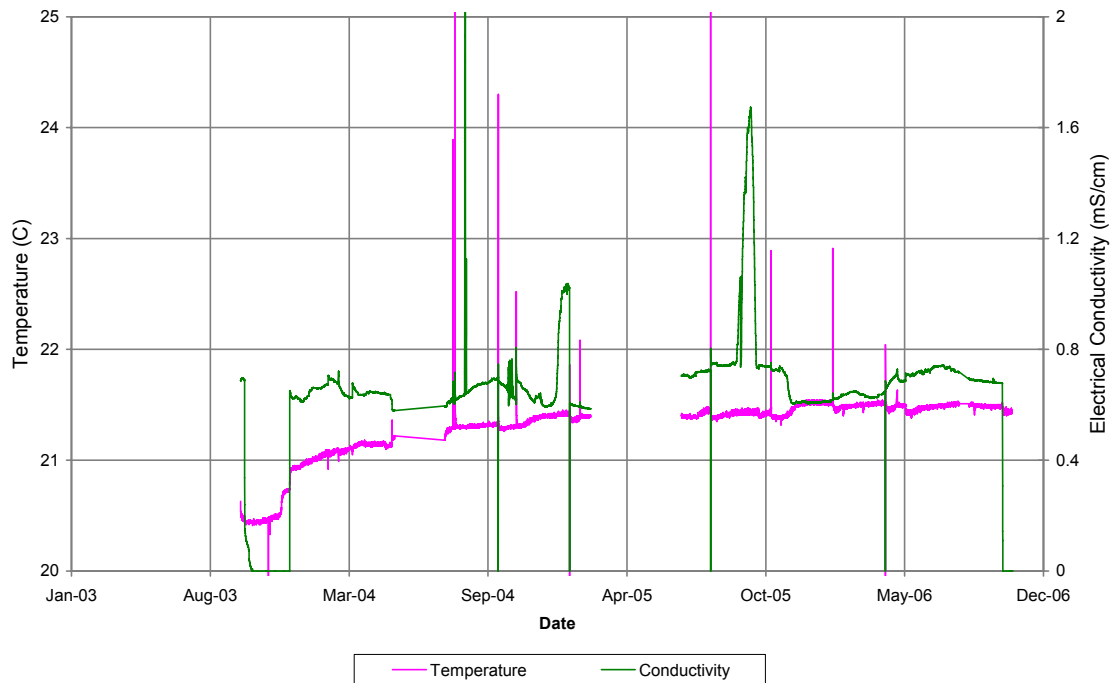
Temperature and Conductivity in 55-06



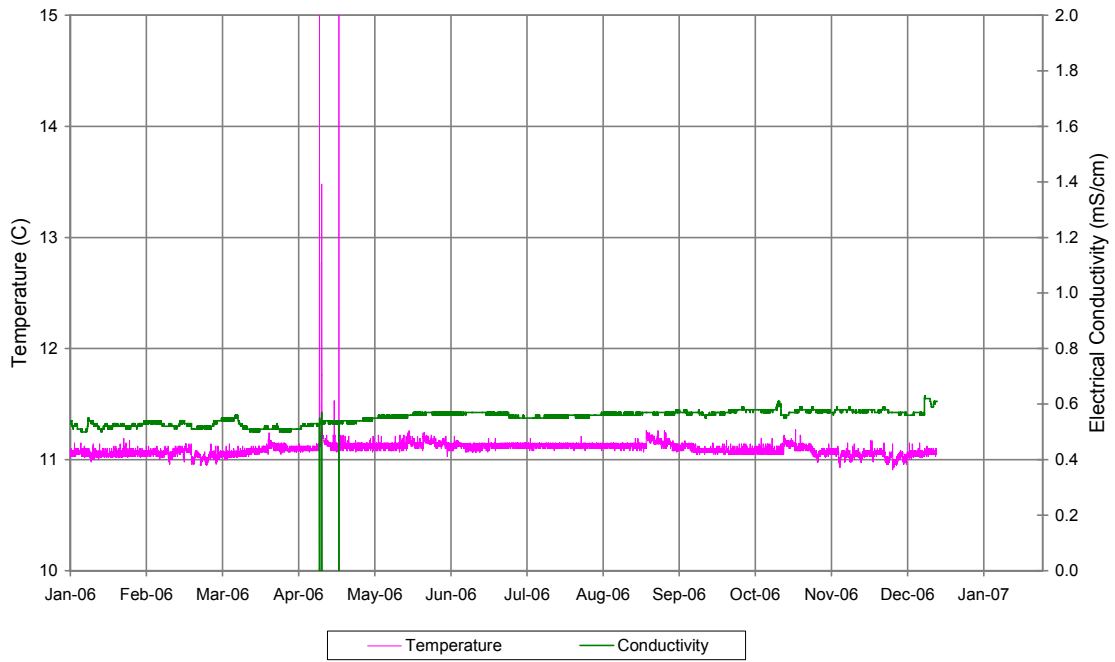
Temperature and Conductivity in MW-1-4



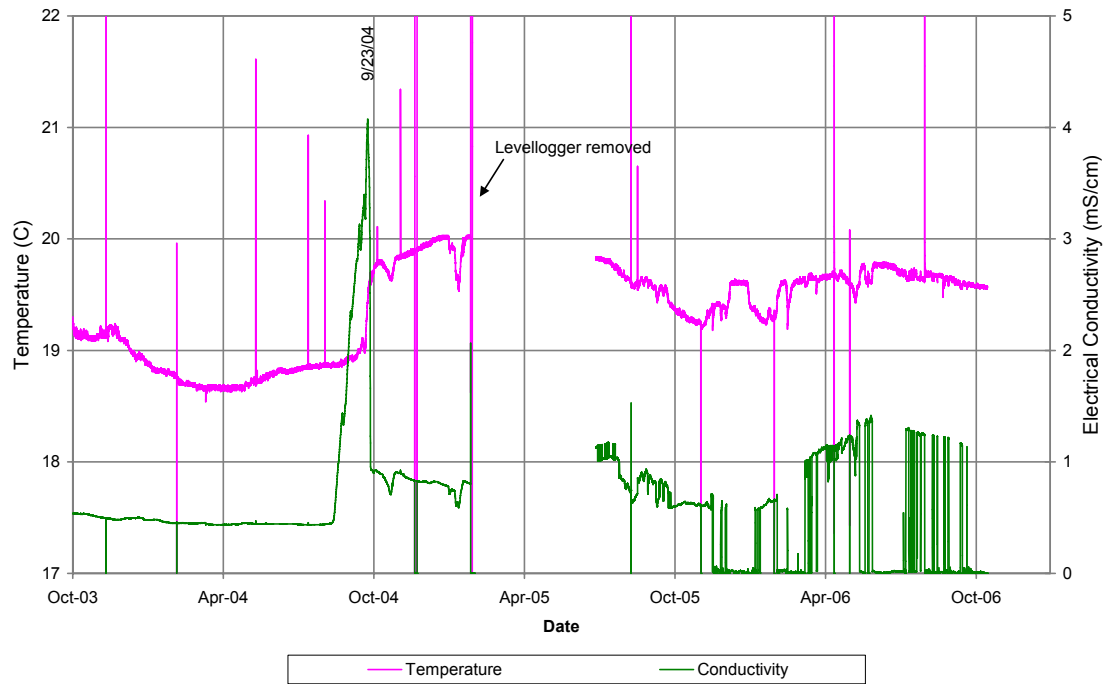
Temperature and Conductivity in MW-2



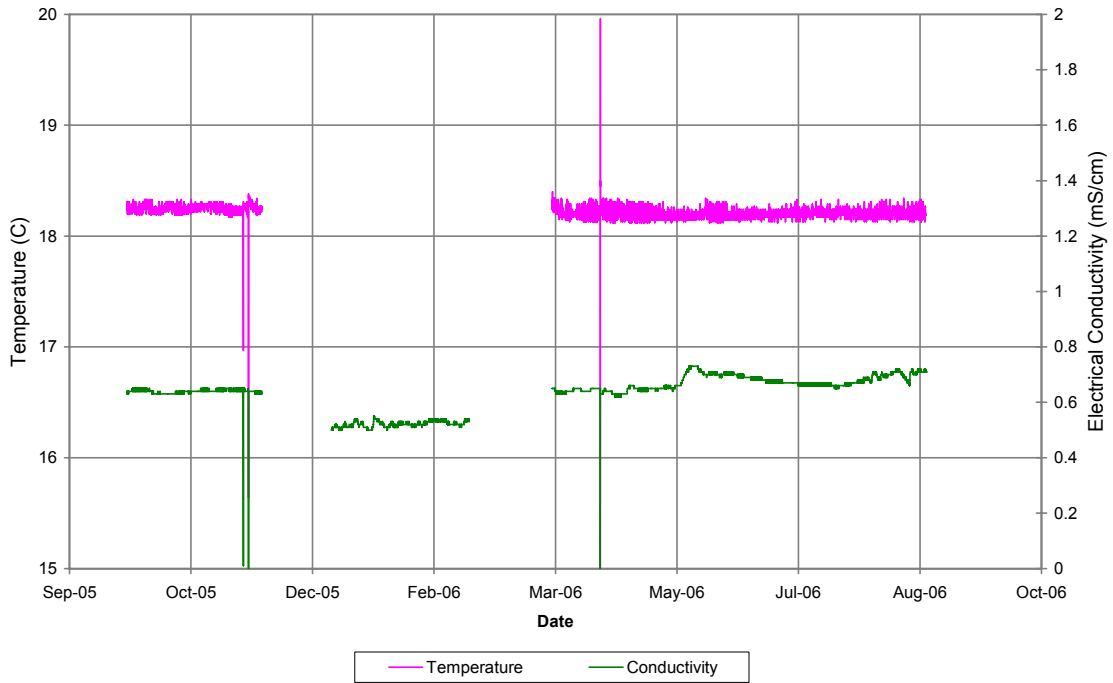
MW-4-2



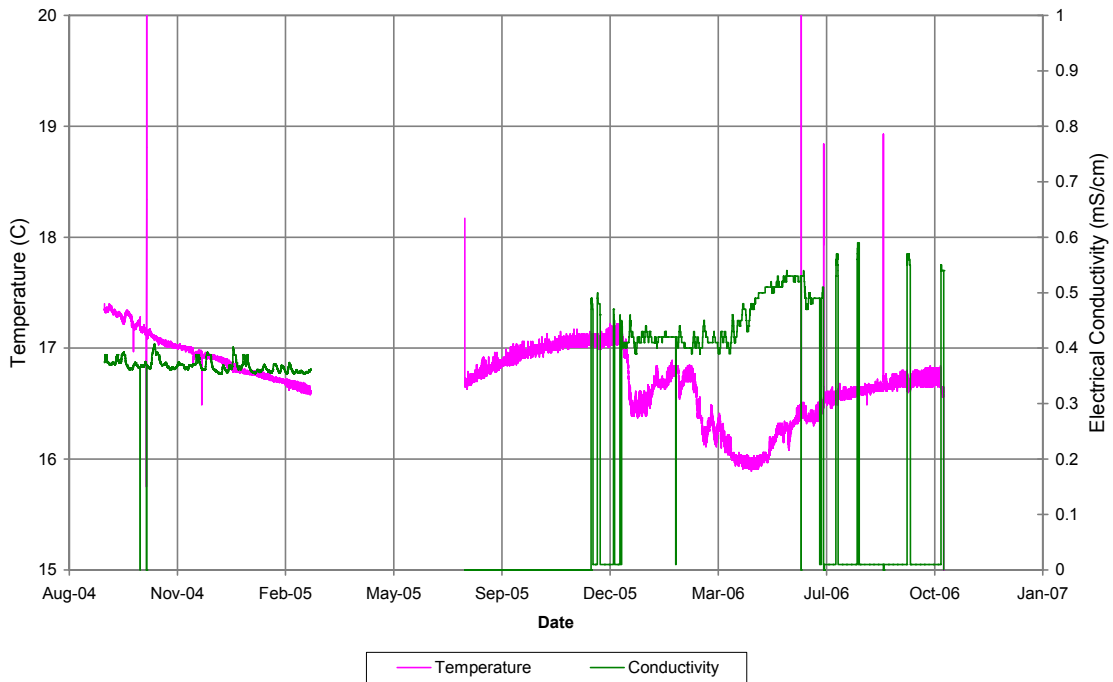
MW-5-2



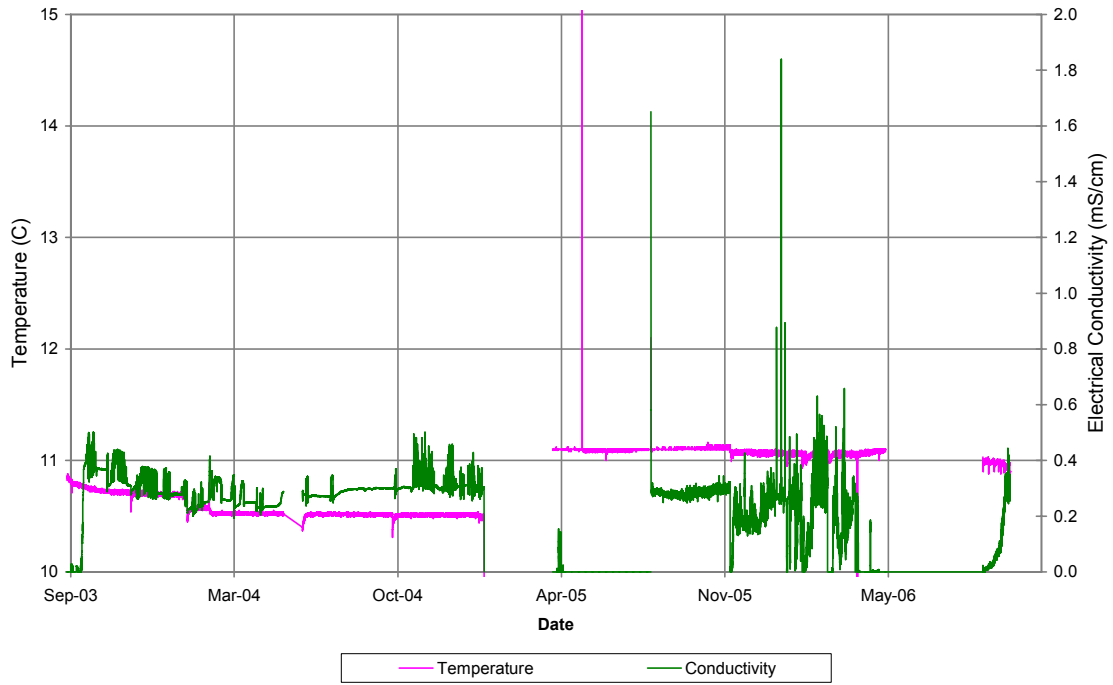
Temperature and Conductivity in MW-6



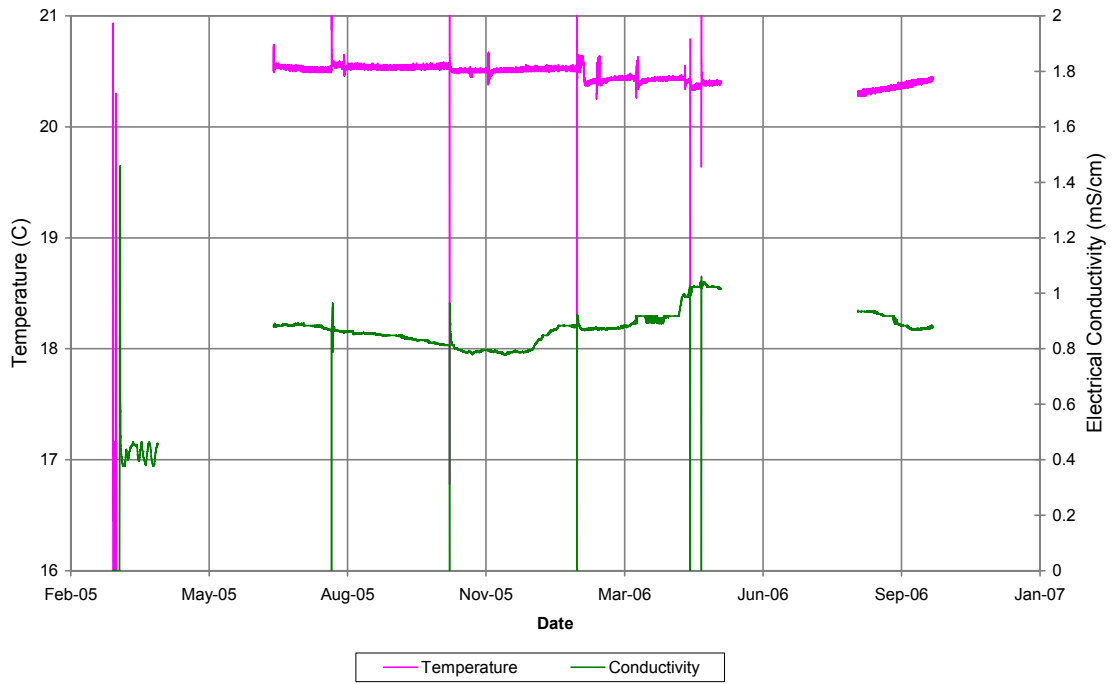
Temperature and Conductivity in MW-15



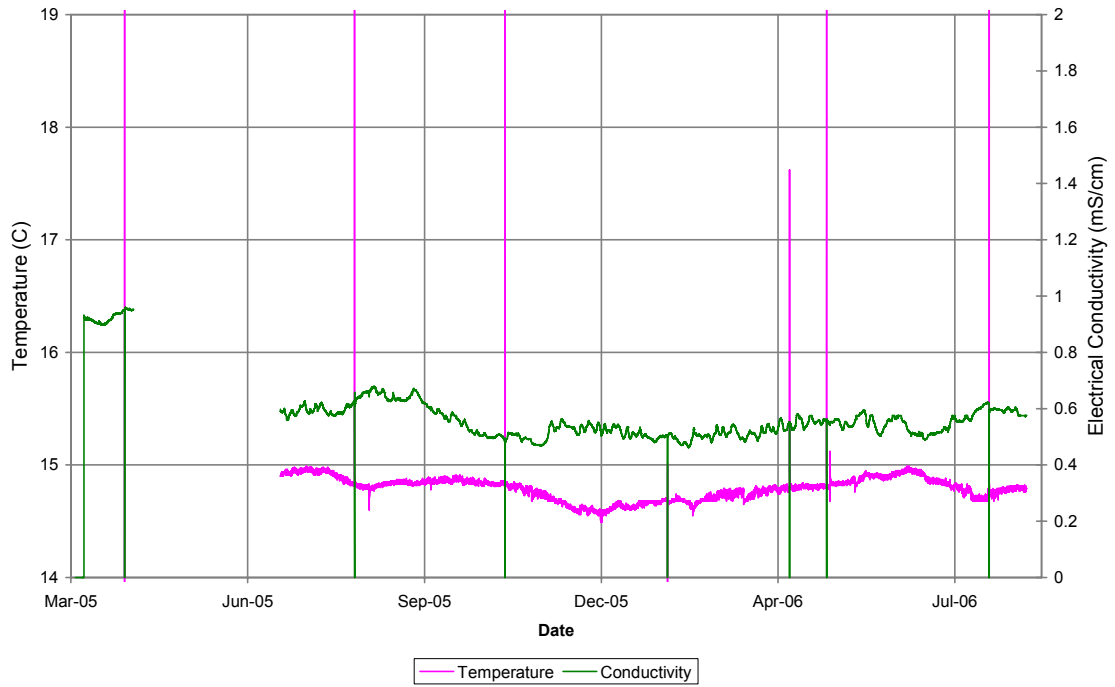
Temperature and Conductivity in BLR-CH



Temperature and Conductivity in ICPP-2018



Temperature and Conductivity in ICPP-2019



Appendix E
Tensiometer Graphs

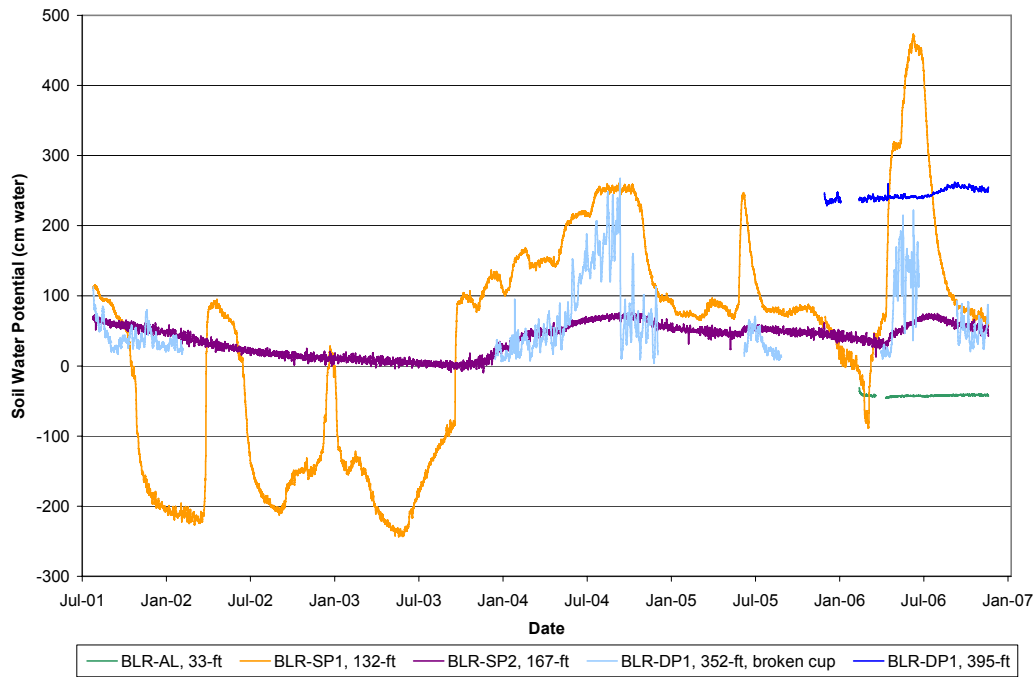


Figure E-1. Big Lost River Well Set tensiometer graphs.

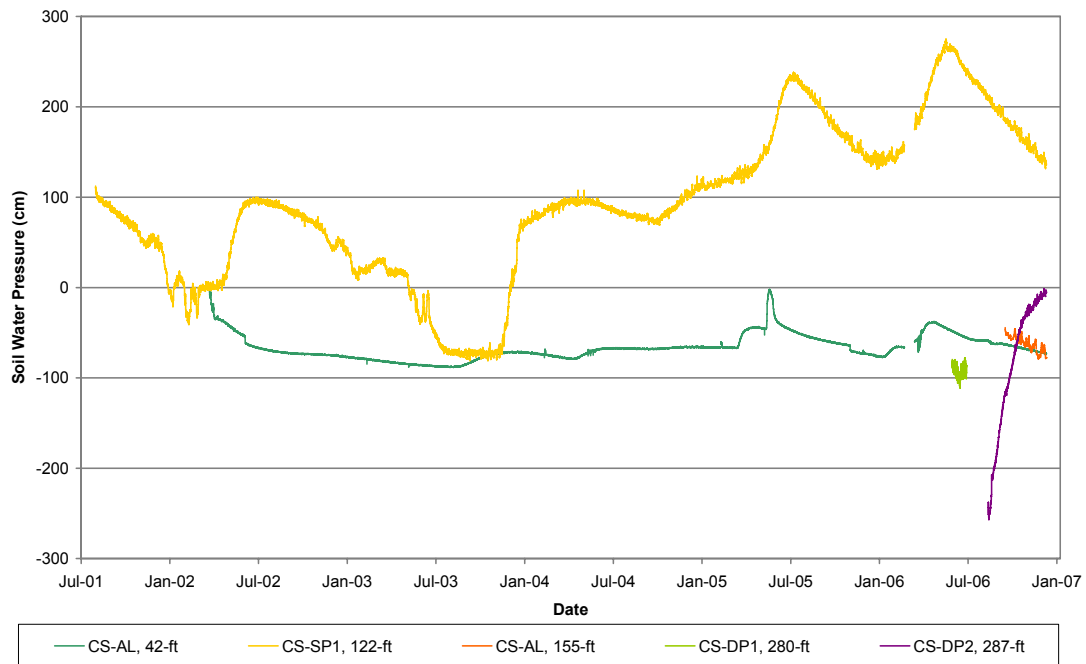


Figure E-2. Central Set tensiometer graphs.

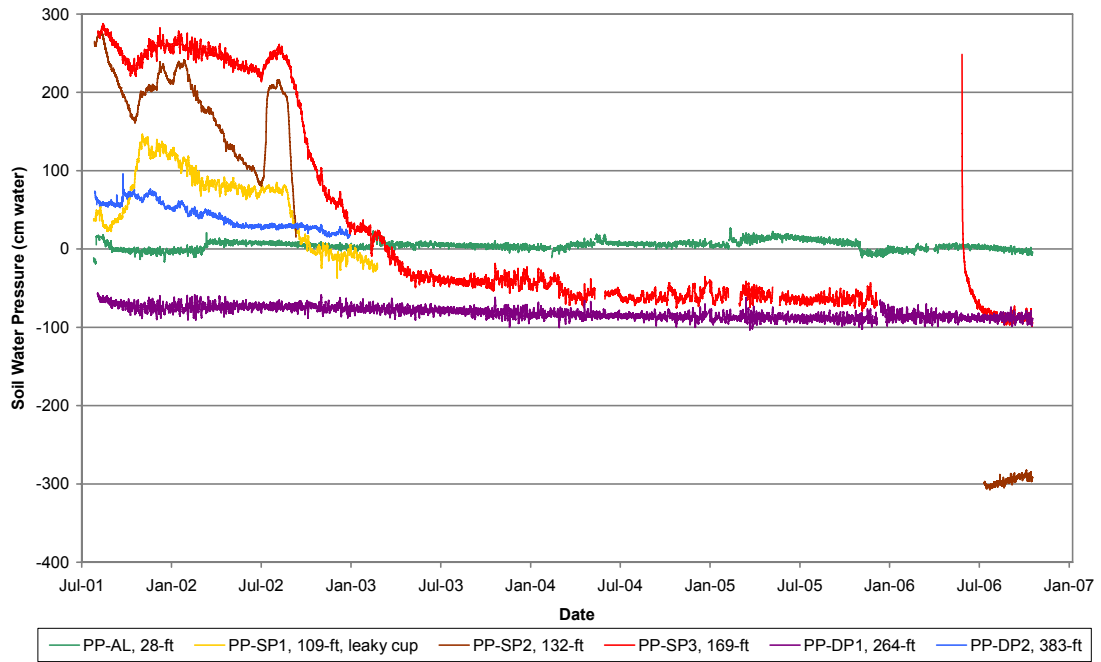


Figure E-3. Percolation Pond Set tensiometer graphs.

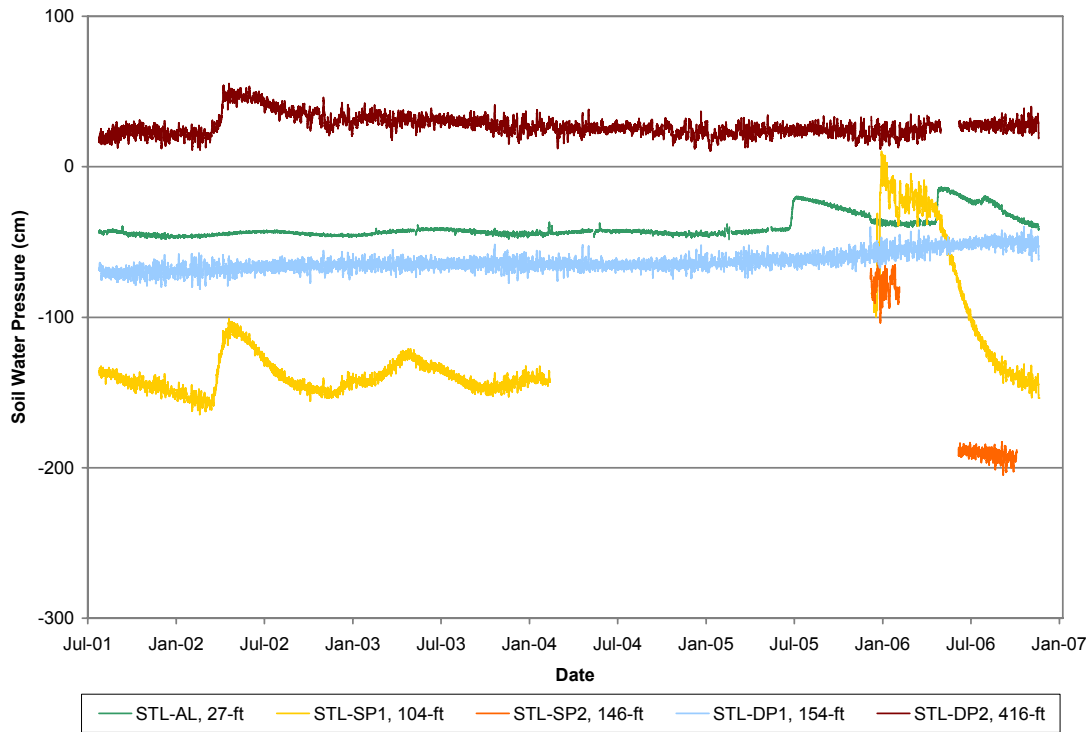


Figure E-4. STL Set tensiometer graphs.

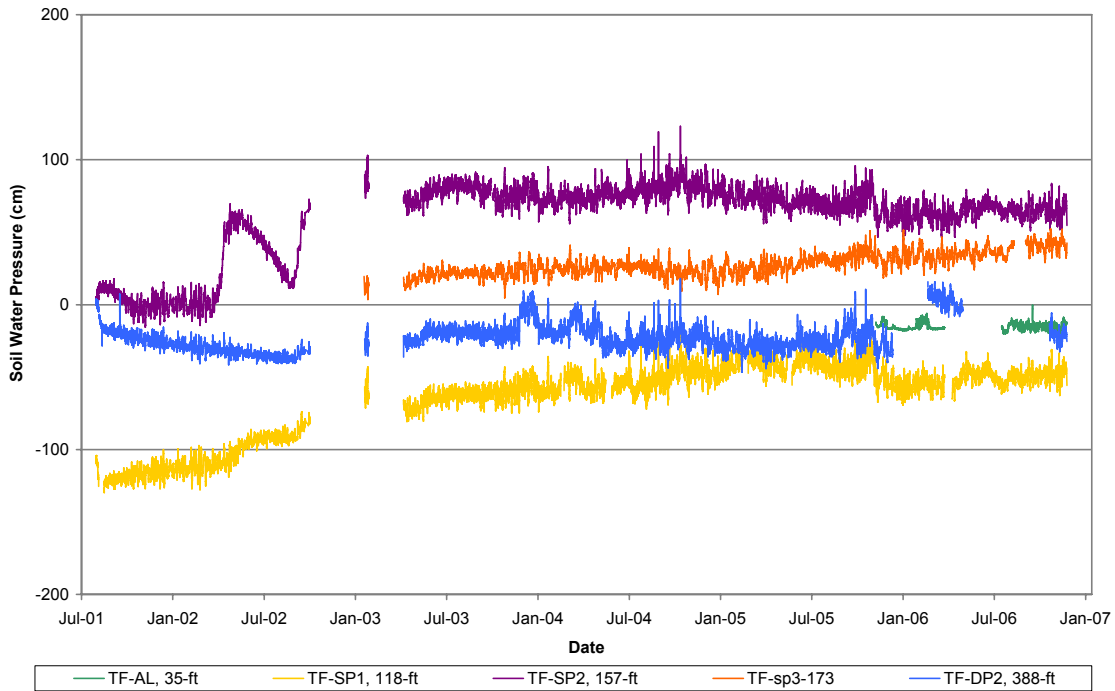


Figure E-5. Tank Farm Set tensiometer graphs.

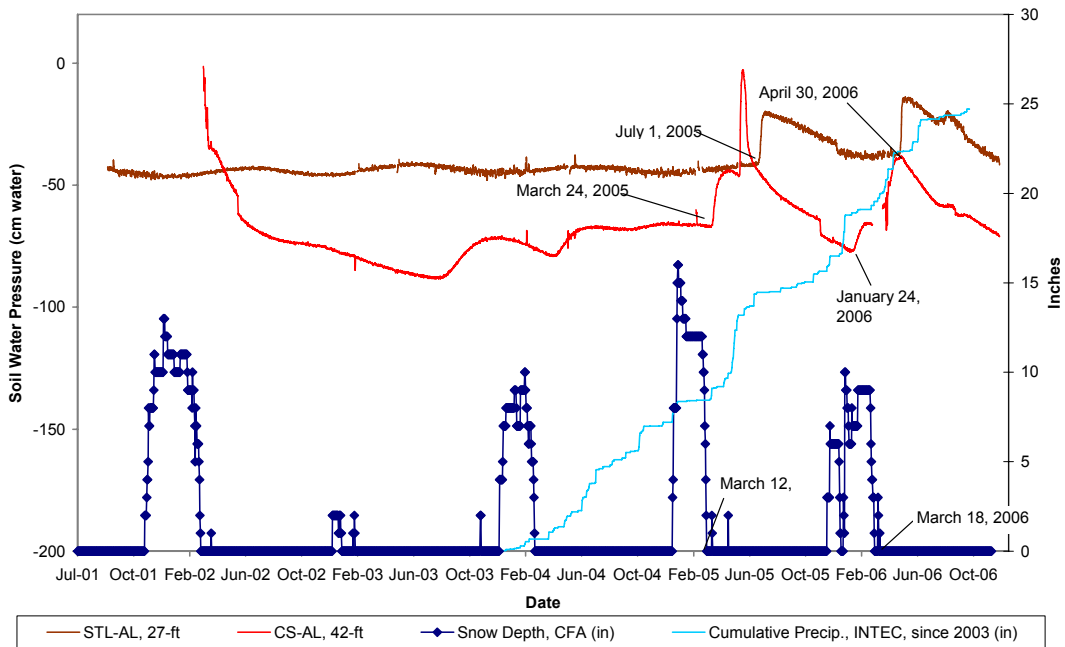


Figure E-6. Water potentials for selected tensiometers showing correlation with snow depth and cumulative precipitation at INTEC.

Appendix F

Quarterly INTEC Water Balance Reports

Appendix F

Quarterly INTEC Water Balance Reports

F-1. QUARTERLY INTEC WATER BALANCE (JULY 12, 2005–SEPTEMBER 30, 2005)

F-1.1 Introduction

This quarterly water balance is meant to serve as a tool for tracking and summarizing water usage at INTEC. The basic organization of this summary report was derived from the *INTEC Water Balance Report for Operable Unit 3-13, Group 4, Perched Water* (DOE-ID 2005). Figure F-1 is a schematic representation of inputs and outputs of anthropogenic water at INTEC.

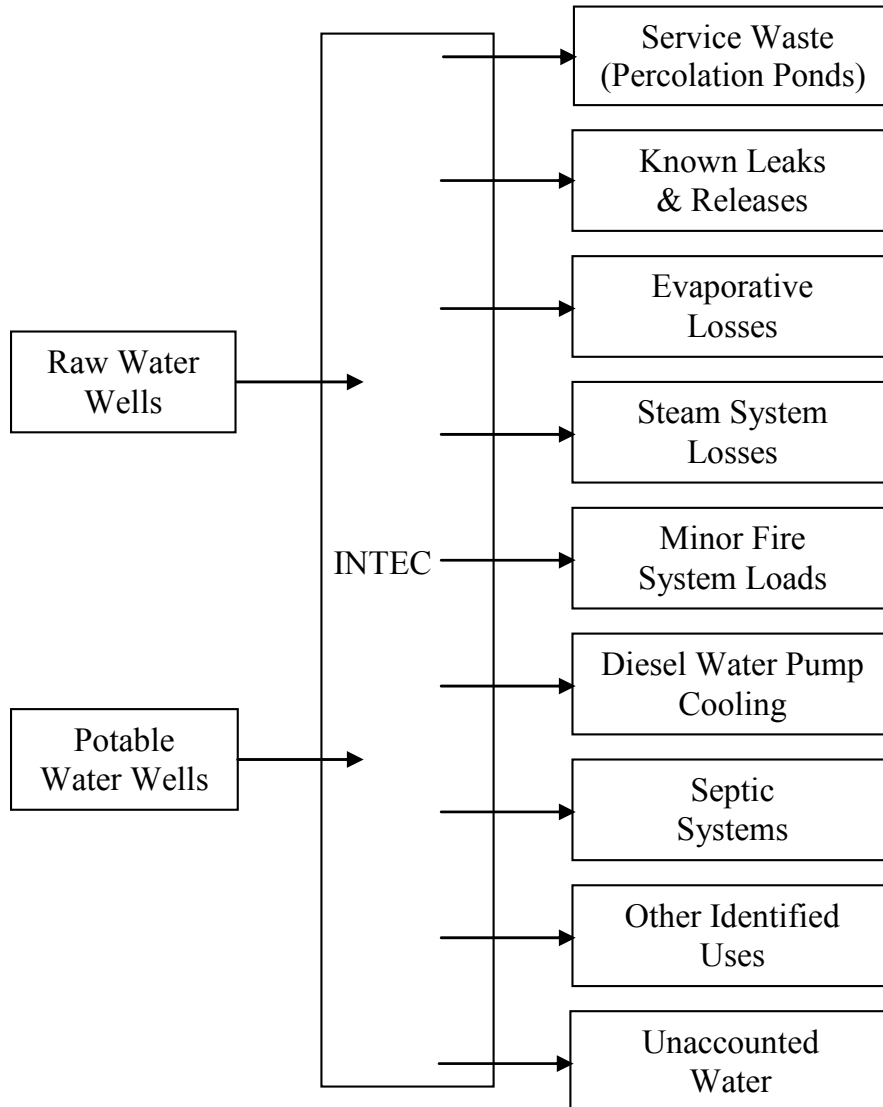


Figure F-1. Schematic representation of water system inputs and outputs for INTEC.

F-1.1.1 Inputs

Two main sources provide input for water systems at INTEC. These sources are raw water wells and potable water wells. Table F-1 lists summary water input totals for INTEC from July 12, 2005, through September 30, 2005.

Table F-1. Total gallons of input water at INTEC from July 12 through September 30, 2005.

Input	July ^a	August	September	Total
Raw water	27,337,000	40,673,000	41,225,000	109,235,000
Potable water	419,197 ^b	724,723	614,093	1,758,013
Total	27,756,197	41,397,723	41,839,093	110,993,013

a. Monthly value is from July 12, 2005, through July 31, 2005.

b. Data for Friday, July 15, and Saturday, July 16, were unavailable. Because of this, a flow total was assumed for these days by determining the average total for Fridays and Saturdays during the months of May through August 2005. This average was 18,000 gal and was added to potable water use during the month of July 2005 to compensate for the unavailable data.

F-1.1.2 Outputs

Several output pathways for INTEC were identified in the *INTEC Water Balance Report for Operable Unit 3-13, Group 4, Perched Water* (DOE-ID 2005). Summary value estimates for INTEC outputs are listed in Table F-2 for the time period of July 12, 2005, through September 30, 2005. These values are not inclusive of fire water used while diesel fire water pumps were running, CPP-603 uses, and ICDF uses. These unquantified uses may be a significant source of output.

F-1.1.3 Water Balance Summary

Table F-3 provides a summary listing of the quarterly water balance for the time duration of July 12, 2005, through September 30, 2005. Compared to results listed in the *INTEC Water Balance Report for Operable Unit 3-13, Group 4, Perched Water* (DOE-ID 2005), this quarterly water balance summary appears consistent, if not slightly better. Unaccounted water for this time period was determined to be 7.1%, compared to 9.1% from DOE-ID (2005).

Table F-2. Total gallons of output water at INTEC from July 12 through September 30, 2005.

Output	July ^a	August	September	Total	% of Input
Service waste	24,462,000	37,844,000	37,647,000	99,953,000	90.1%
Known leaks ^b	195,900	205,920	0	401,820	0.4%
Fire hydrants ^b	187,200	205,920	0	393,120	
Potable water leak ^c	8,700	0	0	8,700	
Evaporative losses	163,528	228,039	166,516	558,083	0.5%
CPP-666 basins	16,000 ^d	21,000 ^d	21,000 ^d	58,000	
Sewage lagoons	147,528 ^e	207,039 ^e	145,516 ^e	500,083	
Steam system losses ^f	73,579	53,360	31,700	158,639	0.1%
Minor fire system loads	119,826 ^g	185,730 ^g	179,739 ^g	485,295	0.4%
Diesel water pumps	58,622	132,308	238,082	429,012	0.4%
Raw water pumps	1,500 ^h	1,500 ^h	1,500 ^h	4,500	
Fire water pumps	57,122 ⁱ	130,808 ⁱ	236,582 ⁱ	424,512	
Septic systems	9,270	15,773	14,264	39,307	<0.1%
CPP-656	6,525 ^j	11,138 ^j	10,049 ^j	27,712	
CPP-655	1,155 ^j	1,995 ^j	1,785 ^j	4,935	
CPP-626	1,590 ^j	2,640 ^j	2,430 ^j	6,660	
Other identified uses ^k	309,940	419,406	374,909	1,104,255	1.0%
Process equipment waste (PEW) uses	60,000 ^l	32,000 ^l	0 ^l	92,000	
Evaporative coolers	44,904 ^m	69,601 ^m	67,356 ^m	181,861	
Other lawn irrigation	205,036 ^m	317,805 ^m	307,553 ^m	830,394	
Total	25,392,665	39,084,536	38,652,210	103,129,411	92.9%

a. Monthly value is from July 12, 2005, through July 31, 2005.

b. Hydrants 1505 and 6511 had a combined leak rate of 6.5 gpm. Hydrants were repaired by August 22, 2005.

c. Leak was discovered on July 21, 2005, and isolated within 30 minutes. Volume is based on recorded flow data.

d. Value was estimated based on average transfer volumes from January 11, 2005, through July 11, 2005, and based on the number of transfers that occurred during May through June 2005 (summer months). A more precise accounting can be obtained by summing the actual transfers from the operations logs.

e. Values were estimated using the same methods as listed in Appendix E of *INTEC Water Balance Report for Operable Unit 3-13, Group 4, Perched Water* (DOE-ID 2005). These values assume precipitation is negligible.

f. Steam system losses are assumed to be approximately 12.5% of the boiler feed makeup water.

g. Value only accounts for lawn watering fed from the fire water system. It does not include other minor water loads.

h. Value is based on approximately 50 minutes of run time per month at 30 gpm.

i. Value is elevated due to high use of fire water by deactivation, decontamination, and decommissioning work for dust suppression. Based on flow data, the diesel pumps ran for approximately 10,155 minutes with cooling water use of approximately 40 gpm. This value also includes gland leak-off at a constant rate of 0.157 gpm.

j. Values were estimated using the same methods as listed in Appendix I of *INTEC Water Balance Report for Operable Unit 3-13, Group 4, Perched Water* (DOE-ID 2005).

k. Values do not include uses from ICDF.

l. Values were estimated based on PEW transfers.

m. Values were estimated using the same methods as listed in Appendix J of *INTEC Water Balance Report for Operable Unit 3-13, Group 4, Perched Water* (DOE-ID 2005).

Table F-3. Water balance summary at INTEC from July 12 to September 30, 2005.

Input	July	August	September	Total
Identified inputs	27,756,197	41,397,723	41,839,093	110,993,013
Identified outputs	25,392,665	39,084,536	38,652,210	103,129,411
Unaccounted outputs	2,363,532	2,313,187	3,186,883	7,863,602

F-2. QUARTERLY INTEC WATER BALANCE (OCTOBER 1, 2005–DECEMBER 31, 2005)

F-2.1 Introduction

This quarterly water balance is meant to serve as a tool for tracking and summarizing water usage at INTEC. The basic organization of this summary report was derived from the *INTEC Water Balance Report for Operable Unit 3-13, Group 4, Perched Water* (DOE-ID 2005). Figure F-2 is a schematic representation of inputs and outputs of anthropogenic water at INTEC.

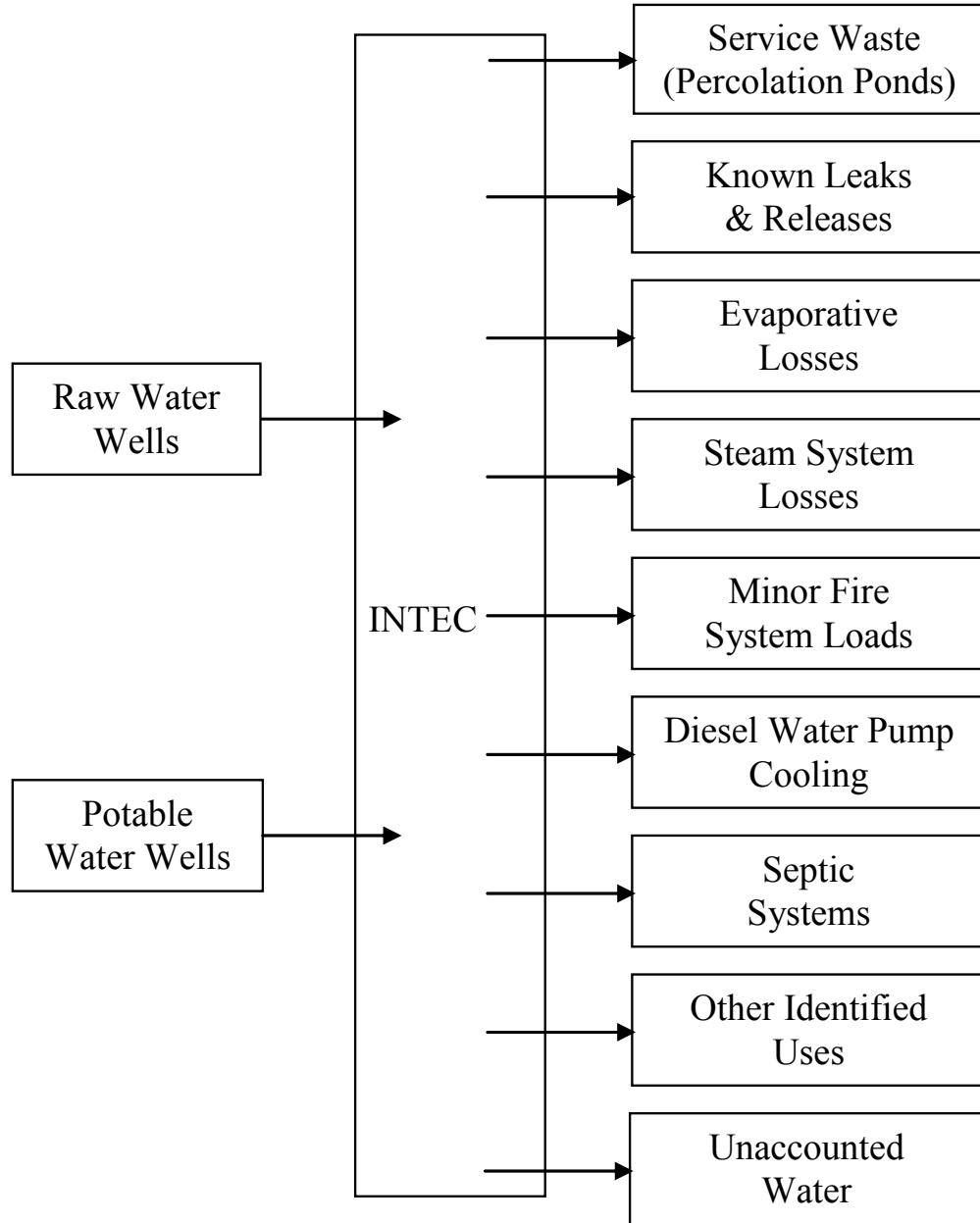


Figure F-2. Schematic representation of water system inputs and outputs for INTEC.

F-2.1.1 Inputs

Two main sources provide input for water systems at INTEC. These sources are raw water wells and potable water wells. Table F-4 lists summary water input totals for INTEC from October 1, 2005, through December 31, 2005.

Table F-4. Total gallons of input water at INTEC from October 1 through December 31, 2005.

Input	October	November	December	Total
Raw water	47,180,000	49,111,000	51,734,000	148,025,000
Potable water	495,902	453,173	558,366	1,507,441
Total	47,675,902	49,564,173	52,292,366	149,532,441

F-2.1.2 Outputs

Several output pathways for INTEC were identified in the *INTEC Water Balance Report for Operable Unit 3-13, Group 4, Perched Water* (DOE-ID 2005). Summary value estimates for INTEC outputs are listed in Table F-5 for the time period of October 1, 2005, through December 31, 2005. These values are not inclusive of fire water used while diesel fire water pumps were running, CPP-603 uses, and ICDF uses.

F-2.1.3 Water Balance Summary

Table F-6 provides a summary listing of the quarterly water balance for the time duration of October 1, 2005, through December 31, 2005. Compared to results listed in the *INTEC Water Balance Report for Operable Unit 3-13, Group 4, Perched Water* (DOE-ID 2005) and compared to the previous quarterly balance, this quarterly water balance summary appears consistent. Unaccounted water for this time period was determined to be 6.8%, compared to 9.1% from DOE-ID (2005) and 7.1% from the previous quarterly balance.

Table F-5. Total gallons of output water at INTEC from October 1 through December 31, 2005.

Output	October	November	December	Total	% of Input
Service waste	45,235,000	45,365,000	47,957,000	138,557,000	92.7%
Known leaks ^a	0	0	0	0	0%
Evaporative losses	101,793	11,743	11,743	125,279	<0.1%
CPP-666 basins	11,743 ^b	11,743 ^b	11,743 ^b	35,229	
Sewage lagoons	90,050 ^c	0 ^c	0 ^c	90,050	
Steam system losses ^d	108,955	128,963	188,988	426,906	0.3%
Minor fire system loads ^e	0	0	0	0	0%
Diesel water pumps	147,308	51,882	17,308	216,498	0.1%
Raw water pumps	1,500 ^f	1,500 ^f	1,500 ^f	4,500	
Fire water pumps ^g	145,808	50,382	15,808	211,998	
Septic systems	14,333	14,265	11,453	40,051	<0.1%
CPP-656	10,088 ^h	10,050 ^h	7,988 ^h	28,126	
CPP-655	1,785 ^h	1,785 ^h	1,365 ^h	4,935	
CPP-626	2,460 ^h	2,430 ^h	2,100 ^h	6,990	
Other identified uses ⁱ	48,000	2,200	0	50,200	<0.1%
PEW uses	48,000 ^j	2,200 ^j	0 ^j	50,200	
Evaporative coolers	0 ^k	0 ^k	0 ^k	0	
Other lawn irrigation	0 ^k	0 ^k	0 ^k	0	
Total	45,655,389	45,574,053	48,186,492	139,415,934	93.2%

a. No leaks were identified and/or quantified during the time period for this water balance.

b. Value was estimated based on average transfer volumes from January 11, 2005, through July 11, 2005, and based on the number of transfers that occurred during January through March 2005 (winter months). A more precise accounting can be obtained by summing the actual transfers from the operations logs.

c. Values were estimated using the same methods as listed in Appendix E of *INTEC Water Balance Report for Operable Unit 3-13, Group 4, Perched Water* (DOE-ID 2005). These values assume precipitation is negligible.

d. Steam system losses are assumed to be approximately 12.5% of the boiler feed makeup water.

e. For this time period, no significant minor fire system loads were identified that do not feed into the service waste system.

f. Value is based on approximately 50 minutes of run time per month at 30 gpm.

g. Based on flow data, the diesel pumps ran for approximately 4,780 minutes with cooling water use of approximately 40 gpm. This value also includes gland leak-off at a constant rate of 0.157 gpm.

h. Values were estimated using the same methods as listed in Appendix I of *INTEC Water Balance Report for Operable Unit 3-13, Group 4, Perched Water* (DOE-ID 2005).

i. Values do not include uses from ICDF.

j. Values were estimated based on recorded PEW transfers.

k. Values were estimated using the same methods as listed in Appendix J of *INTEC Water Balance Report for Operable Unit 3-13, Group 4, Perched Water* (DOE-ID 2005).

Table F-6. Water balance summary at INTEC from October 1 through December 31, 2005.

Balance Constituent	October	November	December	Total
Identified inputs	47,675,902	49,564,173	52,292,366	149,532,441
Identified outputs	45,655,389	45,574,053	48,186,492	139,415,934
Unaccounted outputs	2,020,513	3,990,120	4,105,874	10,116,507

F-3. QUARTERLY INTEC WATER BALANCE REPORT (JANUARY 1, 2006–MARCH 31, 2006)

F-3.1 Introduction

This report summarizes water usage at INTEC for the time period January 1, 2006, through March 31, 2006, and is organized in a manner similar to that found in the *INTEC Water Balance Report for Operable Unit 3-13, Group 4, Perched Water* (DOE-ID 2005). The organization is similar so the data and information can be directly input into an annual report of familiar format, if necessary. Figure F-3 is a schematic representation of anthropogenic water inputs to INTEC and subsequent outputs through various systems.

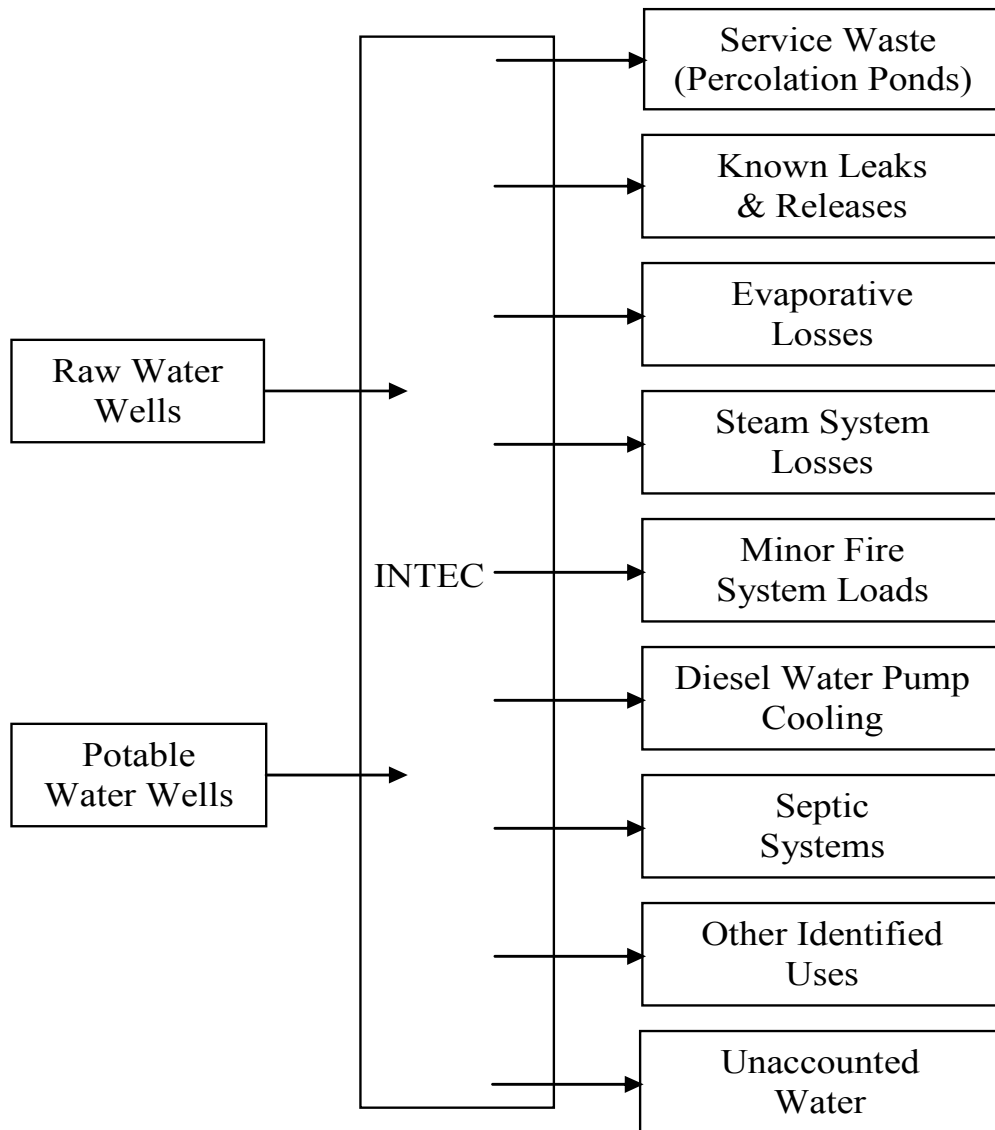


Figure F-3. Schematic representation of water system inputs and outputs for INTEC.

F-3.1.1 INTEC Water Inputs

Two main sources provide input for water systems at INTEC. These sources are raw water wells and potable water wells. Two raw water wells (CPP-01 and CPP-02) are located within the INTEC perimeter fence and supply the majority of water for INTEC operations. Two potable water wells (CPP-04 and CPP-05) are located outside and north of the INTEC perimeter fence. Table F-7 lists summary water input totals for INTEC from these four wells for the period January 1, 2006, through March 31, 2006.

Table F-7. Total volume (gallons) of anthropogenic water used at INTEC from January 1, 2006, through March 31, 2006.

Input	January	February	March	Total
Raw water	55,054,000	43,682,000	49,981,000	148,717,000
Potable water	713,867	642,919	647,752	2,004,538
Total	55,767,867	44,324,919	50,628,752	150,721,538

F-3.1.2 INTEC Water Outputs

The well water is used at INTEC to support operations and provide comfort and sanitary conditions for the work force located there. The “used” water is subsequently discharged to the environment through several output systems, which were previously identified and described in the *INTEC Water Balance Report for Operable Unit 3-13, Group 4, Perched Water* (DOE-ID 2005). The discharge systems and output values are summarized in Table F-8. The values presented represent measured flows and volumes for systems that are monitored closely and estimated values for other systems not readily measured directly. The table does not include values for the volume of fire water discharged during the periodic operation and maintenance checks performed while the fire water system is supplied and pressurized with use of diesel-operated water pumps. Coolant water supplying the diesel engines during their brief operation is, however, included. The table also does not account for discharges from CPP-603.

F-3.1.3 Water Balance Summary

Table F-9 provides a summary of the INTEC quarterly water balance for the time duration January 1, 2006, through March 31, 2006. Unaccounted-for water during this time period was determined as 6.7% of the total input water. Unaccounted-for water for previous quarters is shown in Table F-10.

Table F-8. Total gallons of output water at INTEC from January 1 through March 31, 2006.

Output	January	February	March	Total	% of Input
Service waste	51,413,700	42,405,200	45,867,100	139,686,000	92.7%
Known leaks ^a	2,678	2,419	2,678	7,775	<0.1%
Evaporative losses	11,743	11,743	11,743	35,229	<0.1%
CPP-666 basins ^b	11,743	11,743	11,743	35,229	
Sewage lagoons ^c	0	0	0	0	
Steam system losses ^d	232,005	179,071	180,979	592,055	0.4%
Minor fire system loads ^e	0	0	0	0	<0.1%
Diesel pump cooling water	22,080	20,158	61,358	103,597	<0.1%
Raw water pumps ^f	1,350	1,350	1,350	4,050	
Fire water pumps ^g	20,730	18,808	60,008	99,547	
Septic systems ^h	15,053	13,410	15,053	43,515	<0.1%
CPP-656	10,613	9,450	10,613	30,675	
CPP-655	1,890	1,680	1,890	5,460	
CPP-626	2,550	2,280	2,550	7,380	
Other identified uses	88,649	20,110	45,250	154,009	0.1%
ICDF uses ⁱ	5,200	5,200	5,200	15,600	
PEW uses ^j	83,449	14,910	40,050	138,409	
Evaporative coolers ^k	0	0	0	0	
Other lawn irrigation ^l	0	0	0	0	
Total	51,785,908	42,652,111	46,184,161	140,622,180	93.3%

a. A steam leak near CPP-640 (in MAH-YDC-HS-036) started around mid-December and continued through this quarter. The leak was estimated at about 30 lb/hr (3.6 gal/hr).

b. Value was estimated based on average transfer volumes from January 11, 2005, through July 11, 2005, and based on the number of transfers that occurred during January through March 2005 (winter months). A more precise accounting can be obtained by summing the actual transfers from the operations logs.

c. Values were estimated using the same methods as listed in Appendix E of *INTEC Water Balance Report for Operable Unit 3-13, Group 4, Perched Water* (DOE-ID 2005). These values assume precipitation is negligible.

d. Steam system losses are assumed to be approximately 12.5% of the boiler feed makeup water.

e. For this time period, no significant minor fire system loads were identified that do not feed into the service waste system.

f. Value is based on approximately 45 minutes of run time per month at 30 gpm (DOE-ID 2005).

g. Based on flow data. This value also includes gland leak-off at a constant rate of 0.157 gpm.

h. Values were estimated using the same methods as listed in Appendix I of *INTEC Water Balance Report for Operable Unit 3-13, Group 4, Perched Water* (DOE-ID 2005).

i. ICDF water usage for systems that do not dump into the Service Waste System; includes Staging, Storage, Sizing, and Treatment Facility.

j. Values were estimated based on recorded PEW transfers.

k. Values were estimated using the same methods as listed in Appendix J of *INTEC Water Balance Report for Operable Unit 3-13, Group 4, Perched Water* (DOE-ID 2005).

l. Lawn irrigation has been discontinued.

Table F-9. Water balance summary at INTEC from January 1 through March 31, 2006.

Balance Constituent	January	February	March	Total
Identified inputs	55,767,867	44,324,919	50,628,752	150,721,538
Identified outputs	51,785,908	42,652,111	46,184,161	140,622,180
Unaccounted outputs	3,981,959	1,672,808	4,444,591	10,099,358

Table F-10. INTEC water balance summary for this and previous quarters.

Balance Constituent	2005		2006
	Q3	Q4	Q1
Identified inputs	110,993,013	149,532,441	150,721,538
Identified outputs	103,129,411	139,415,934	140,622,180
Unaccounted outputs	7,863,602	10,116,507	10,099,358
Percent unaccounted	7.1%	6.8%	6.7%

F-4. QUARTERLY INTEC WATER BALANCE REPORT (APRIL 1, 2006–JUNE 30, 2006)

F-4.1 Introduction

This report summarizes water usage at INTEC for the time period April 1, 2006, through June 30, 2006, and is organized in a manner similar to that found in the *INTEC Water Balance Report for Operable Unit 3-13, Group 4, Perched Water* (DOE-ID 2005). The organization is similar so the data and information can be directly input into an annual report of familiar format, if necessary. Figure F-4 is a schematic representation of anthropogenic water inputs to INTEC and subsequent outputs through various systems.

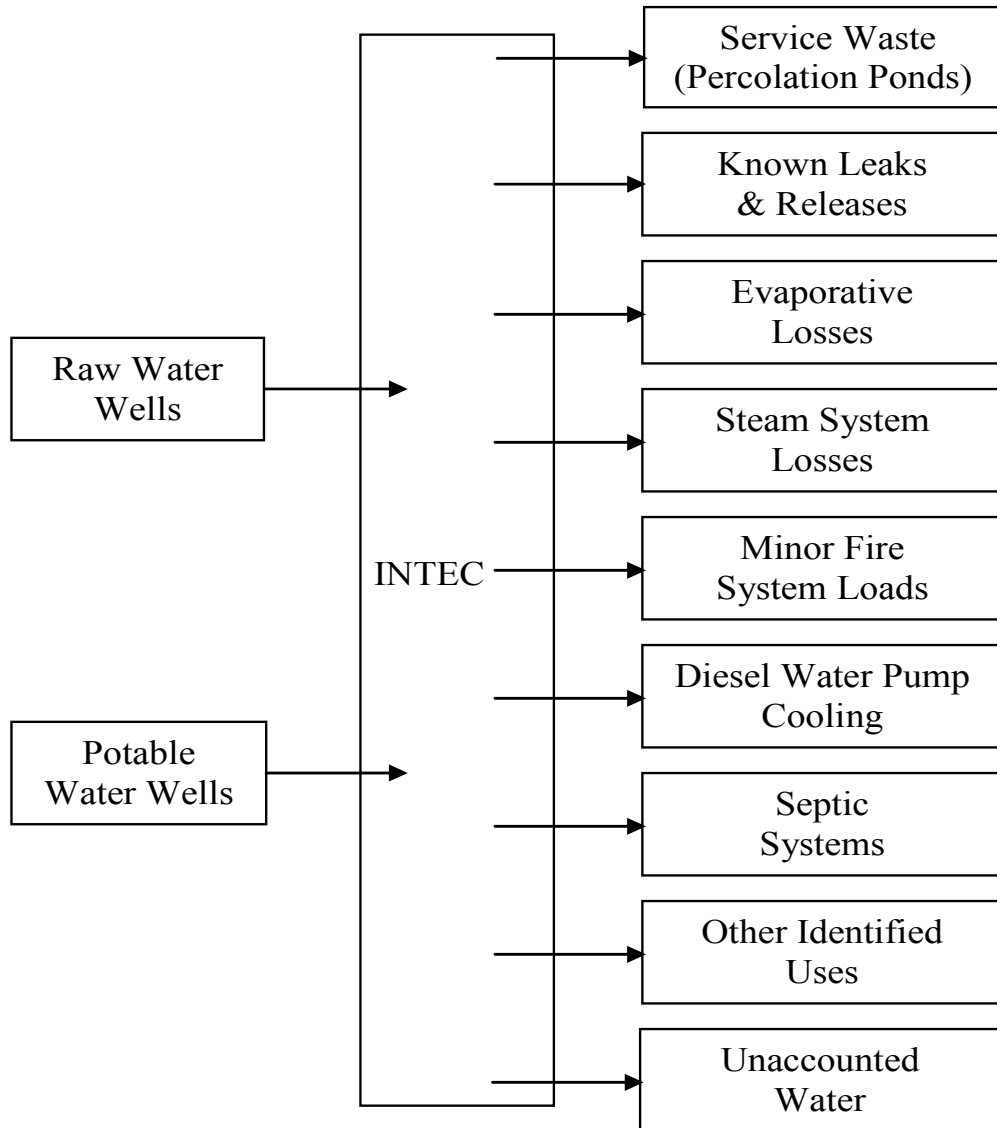


Figure F-4. Schematic representation of water system inputs and outputs for INTEC.

F-4.1.1 INTEC Water Inputs

Two main sources provide input for water systems at INTEC. These sources are raw water wells and potable water wells. Two raw water wells (CPP-01 and CPP-02) are located within the INTEC perimeter fence and supply the majority of water for INTEC operations. Two potable water wells (CPP-04 and CPP-05) are located outside and north of the INTEC perimeter fence. Table F-11 lists summary water input totals for INTEC from these four wells for the period April 1, 2006, through June 30, 2006.

Table F-11. Total volume (gallons) of anthropogenic water used at INTEC from April 1, 2006, through June 30, 2006.

Input	April	May	June	Total
Raw water	47,727,000	44,820,000	38,750,000	131,297,000
Potable water	519,498	512,885	466,579	1,498,962
Total	48,246,498	45,332,885	39,216,579	132,795,962

F-4.1.2 INTEC Water Outputs

The well water is used at INTEC to support operations and provide comfort and sanitary conditions for the work force located there. The “used” water is subsequently discharged to the environment through several output systems, which were previously identified and described in the *INTEC Water Balance Report for Operable Unit 3-13, Group 4, Perched Water* (DOE-ID 2005). The discharge systems and output values are summarized in Table F-12. The values presented represent measured flows and volumes for systems that are monitored closely and estimated values for other systems not readily measured directly. The table does not include values for the volume of fire water discharged during the periodic operation and maintenance checks performed while the fire water system is supplied and pressurized with use of diesel-operated water pumps, as these flows are not currently metered. Coolant water supplying the diesel engines during their brief operation is, however, included. The table also does not account for discharges from CPP-603.

F-4.1.3 Water Balance Summary

Table F-13 provides a summary of the INTEC quarterly water balance for the time duration April 1, 2006, through June 30, 2006. Unaccounted-for water during this time period was determined as 6.3% of the total input water. Unaccounted-for water for this and three previous quarters is shown in Table F-14.

Table F-12. Total gallons of output water at INTEC from April 1 through June 30, 2006.

Output	April	May	June	Total	% of Input
Service waste	45,336,600	41,000,000	36,993,500	123,330,100	92.9%
Known leaks ^a	2,588	96,004	0	98,592	<0.1%
Evaporative losses	58,926	164,145	178,355	401,426	0.3%
CPP-666 basins ^b	13,878	16,192	25,444	55,514	
Sewage lagoons ^c	45,047	147,953	152,912	345,912	
Steam system losses ^d	114,921	40,722	33,310	188,953	0.1%
Minor fire system loads ^e	109	210	46,967	47,286	<0.1%
Diesel pump cooling water	88,932	53,358	92,732	235,023	0.2%
Raw water pumps ^f	1,350	1,350	1,350	4,050	
Fire water pumps ^g	87,582	52,008	91,382	230,973	
Septic systems ^h	13,545	15,053	14,265	42,863	<0.1%
CPP-656	9,525	10,613	10,050	30,188	
CPP-655	1,680	1,890	1,785	5,355	
CPP-626	2,340	2,550	2,430	7,320	
Other identified uses	24,500	53,978	68,656	147,133	0.1%
ICDF uses ⁱ	400	400	400	1,200	
PEW uses ^j	24,100	19,900	900	44,900	
Evaporative coolers ^k	0	33,678	67,356	101,033	
Other lawn irrigation ^l	0	0	0	0	
Total	45,640,121	41,423,469	37,427,786	124,491,375	93.7%

a. A steam leak near CPP-640 (in MAH-YDC-HS-036) started around mid-December 2005 and continued through May 13, 2006. The leak was estimated at about 30 lb/hr (3.6 gal/hr).

A fire water main rupture near CPP-666 was noticed and repaired on May 30. Based on daily fire water flow, the leak is assumed to have started on May 25. The expected flow for May 25–May 29 was estimated using regression on daily flows from April through June. The difference between estimated expected flow and measured flow gives a leak estimate of 94,924 gal.

A leak from a 2-in. fire line near CPP-641 was noticed on June 14 and repaired on June 19. There is no estimate of the leaked volume.

b. Value was estimated based on average transfer volumes from January 11, 2005, through July 11, 2005, and based on the number of transfers that occurred during April through June 2005. A more precise accounting can be obtained by summing the actual transfers from the operations logs.

c. Values were estimated using the same methods as listed in Appendix E of *INTEC Water Balance Report for Operable Unit 3-13, Group 4, Perched Water* (DOE-ID 2005), using average evaporation values for each month and recorded average temperature and total precipitation.

d. Steam system losses are assumed to be approximately 12.5% of the boiler feed makeup water.

e. The minor fire system loads included the annual hydrant test in June (46,750 gal) and 7 gal/day from May 15 through June 30 for the CPP-697 heat pump.

f. Value is based on approximately 45 minutes of run time per month at 30 gpm (DOE-ID 2005).

g. Based on flow data. This value also includes gland leak-off at a constant rate of 0.157 gpm.

h. Values were estimated using the same methods as listed in Appendix I of *INTEC Water Balance Report for Operable Unit 3-13, Group 4, Perched Water* (DOE-ID 2005).

i. ICDF water usage for systems that do not dump into Service Waste System; includes Staging, Storage, Sizing, and Treatment Facility.

j. Values were obtained from recorded PEW transfers.

k. Values were estimated using the same methods as listed in Appendix J of *INTEC Water Balance Report for Operable Unit 3-13, Group 4, Perched Water* (DOE-ID 2005).

l. Lawn irrigation has been discontinued.

Table F-13. Water balance summary at INTEC from April 1 to June 30, 2006.

Balance Constituent	April	May	June	Total
Identified inputs	48,246,498	45,332,885	39,216,579	132,795,962
Identified outputs	45,640,121	41,423,469	37,427,786	124,491,375
Unaccounted outputs	2,606,377	3,909,416	1,788,793	8,304,587

Table F-14. INTEC water balance summary for this and previous quarters.

Balance Constituent	2005		2006	
	Q3	Q4	Q1	Q2
Identified inputs	110,993,013	149,532,441	150,721,538	132,795,962
Identified outputs	103,129,411	139,415,934	140,622,180	124,491,375
Unaccounted outputs	7,863,602	10,116,507	10,099,358	8,304,587
Percent unaccounted	7.1%	6.8%	6.7%	6.3%

F-5. REFERENCES

DOE-ID, 2005, *INTEC Water Balance Report for Operable Unit 3-13, Group 4, Perched Water*, DOE/ID-11248, Rev. 0, U.S. Department of Energy Idaho Operations Office, November 2005.