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02-WMD-0232

JUL 15 2002

Ms. Jane Hedges
Cleanup Section Manager
Nuclear Waste Program
State of Washington
Department of Ecology
1315 West Fourth Avenue
Kennewick, Washington 99336

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EDMC

Dear Ms. Hedges:

TRANSMITTAL OF 100-D/DR AREA IN SITU REDOX MANIPULATION SECOND QUARTER FISCAL YEAR 2002 TECHNICAL MEMORANDUM

Attached for your information is the subject document. This document presents the quarterly summary of observations, activities, and groundwater quality monitoring data for the In Situ Redox Manipulation (ISRM) treatment zone in the 100-D Area chromium plume west of the 100-D/DR Reactors within the 100-HR-3 Operable Unit. This technical memorandum satisfies the quarterly reporting requirement specified in the "Remedial Design Report and Remedial Action Work Plan for the 100-HR-3 Groundwater Operable Unit In Situ Redox Manipulation, DOE/RL-99-51, Rev. 1."

This report includes information on the Phase III ISRM barrier emplacement activities obtained from January 1 through March 31, 2002. The data presented in this report are limited to those that were available as of March 31, 2002.

If you have any questions, please contact me at 373-9631.

Sincerely,

Arlene C. Tortoso

Arlene C. Tortoso, Project Manager
Waste Management Division

WMD:ACT

Attachment

cc w/attach:
L. E. Gadbois, EPA
D. Maddox, EM-40
J. Price, Ecology
W. W. Soper, Ecology
Administrative Record (100-HR-3)

cc w/o attach:
J.V. Borghese, FHI
J.D. Isaacs, FHI

100-D/DR In Situ Redox Manipulation Second Quarter Fiscal Year 2002 Technical Memorandum

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100-D/DR In Situ Redox Manipulation Second Quarter Fiscal Year 2002 Technical Memorandum

Author

C. A. Sump
CH2M HILL, Inc.

Date Published

June 2002

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1.0 IN SITU REDOX MANIPULATION SUMMARY

1.1 INTRODUCTION

This technical memorandum summarizes construction activities and performance monitoring results for the In Situ Redox Manipulation (ISRM) treatment zone west of the D/DR Reactors in the 100-D Area of the Hanford Site. The report covers the second quarter of fiscal year (FY) 2002, beginning January 1, 2002 through March 31, 2002.

Deployment of ISRM is specified in the interim remedial action record of decision (ROD) amendment for the 100-HR-3 Operable Unit (EPA et al. 1999). The ISRM treatment zone is being constructed and implemented in accordance with the *Remedial Design Report and Remedial Action Work Plan for the 100-HR-3 Groundwater Operable Unit In Situ Redox Manipulation* (RDR/RAWP) (DOE-RL 2000). Phase III treatment zone construction activities began at the start of FY 2002. The data presented in this report are limited to those available as of March 31, 2002.

The remedial action objectives (RAOs) for this action are those stated in the 100-HR-3 Operable Unit ROD (EPA et al. 1996) for the pump-and-treat technology. The specific RAOs are as follows:

- Protect aquatic receptors in the river bottom substrate from the chromium contamination in the groundwater entering the Columbia River.
- Protect human health by preventing exposure to contaminants in the groundwater.
- Provide information that will lead to the final remedy.

Treatment system and aquifer performance data collected during the period are evaluated in relation to the RAOs and key design elements identified in the ROD Amendment (EPA et al. 1999).

Included in this technical memorandum are summaries of design upgrades, injection/extraction activities, and hydraulic and contaminant monitoring. Discussions of quality assurance for sample data, conclusions from reported data, and recommendations are also presented.

1.2 BACKGROUND

A plume of hexavalent chromium in the groundwater was discovered to the west of the D/DR Reactors in the 100-D Area during groundwater monitoring activities. This chromium plume is not located within the established capture zone of the groundwater pump-and-treat system for the 100-HR-3 Operable Unit interim remedial action. The ISRM technology chosen to remediate this site creates a permeable treatment zone that removes hexavalent chromium in the groundwater by converting it to trivalent chromium (EPA et al. 1999). A reducing agent (sodium dithionite) is injected into the aquifer and allowed to react with the sediments for a short

period of time (approximately 24-36 hours), reducing ferric iron (Fe^{+3}) to ferrous iron (Fe^{+2}), among numerous other reactions. After the reaction period, the residual reagent and reaction byproducts are extracted from the aquifer and disposed in an approved manner. Hexavalent chromium in groundwater flowing through the treated zone reacts with the ferrous iron and is reduced to trivalent chromium. The resulting trivalent chromium has very low water solubility and is significantly less toxic to aquatic receptors than hexavalent chromium. The results of the technology evaluation are reported in *100-D Area In Situ Redox Treatability Test for Chromate-Contaminated Groundwater* (PNNL 2000).

1.3 SUMMARY OF IMPLEMENTATION PLAN AND PREVIOUS WORK ACTIVITIES

The full-scale design and implementation strategy for the treatment zone is discussed in the RDR/RAWP (DOE-RL 2000). A 3-year emplacement schedule consisting of three phases (Phases I, II, and III) coincides with FY 2000, FY 2001, and FY 2002. The ISRM treatment zone is being constructed outward from the existing treatability test phase in the center of the identified groundwater plume. The treatment zone will be expanded to the edges defined by the 20 µg/L hexavalent chromium concentration isopleth, as identified in the RDR/RAWP (DOE-RL 2000).

Phase I construction activities were completed in FY 2000 and included the installation of 14 treatment zone wells and 2 compliance monitoring wells. Ten treatment zone wells were injected, extending the previously established treatability test zone length to a total of approximately 152 m (500 ft). Well drilling and injection activities focused on extending the treatment zone outward from the treatability test phase constructed in FY 1997 and FY 1998. The four wells closest to the existing treatment zone were drilled with the cable tool method to reduce the potential for reoxidizing the established reduced zone through air injected during rotary drilling.

An evaporation pond was constructed in FY 2000 to receive extraction water generated during the treatment zone emplacement process. The pond provides another disposal option along with disposal to PSTF and to the ground through a drip irrigation system as originally proposed. It was recognized that disposing large volumes of extraction water to the ground could potentially elevate sulfate levels downgradient of the treatment zone. The evaporation pond is a proactive effort to minimize the increase of sulfate levels associated with implementing the ISRM technology.

Dissolved oxygen monitoring conducted during FY 2000 drilling activities suggested minimal impact from air rotary drilling at a distance of 34 m (110 ft), although the validity of some of the data was questionable. To further minimize the risk of drilling-induced reoxidation, a 50% safety factor was added to this distance, resulting in a 50-m (165-ft) buffer zone for air rotary drilling near the established treatment zone. This buffer zone was implemented beginning with Phase II drilling activities in FY 2001.

Phase II construction activities were completed in FY 2001 and included the installation of 28 treatment zone wells and 4 compliance monitoring wells. Drilling began using air rotary

methods to install the remaining wells on the eastern end of the treatment zone. Continuing concern over the potential impact of air rotary drilling on the established reduced aquifer environment prompted a modification to the drilling procedures for wells completed to the west of the existing treatment zone. Air rotary drilling was restricted to the vadose zone, and only methods that did not inject air (e.g., cable tool) were used below the water table. Twenty-eight treatment zone wells were injected, extending the total established treatment zone length to approximately 440 m (1,445 ft). The treatment zone was completed to design limits on the eastern end, and additional wells were completed toward the western termination point.

1.4 FY 2001 ISRM HOLD POINT

A project "hold point" review was conducted to implement the lessons learned between completed Phase II FY 2001 treatment zone installations and planned Phase III FY 2002 treatment zone emplacement activities. The objective of the hold point review was to provide baseline guidance to Phase III FY 2002 treatment zone emplacements as determined from knowledge and understanding gained from Phase I FY 2000 and Phase II FY 2001. Conclusions from the review process and modifications to be implemented during Phase III activities are briefly discussed below. This is a requirement of the RDR/RAWP (DOE-RL 2000).

Phase III FY 2002 Well Installations – Drilling Methods. The drilling protocol selected for the Phase III FY 2002 well installations includes the restriction of air rotary drilling to the vadose zone only. The cable tool method, or other non-air-driven method, will be used from approximately 20 m (65 ft) below ground surface through the saturated portion of the aquifer. No air rotary drilling will be performed within approximately 46 m (150 ft) from the established treatment zone.

Phase III FY 2002 Chemical Treatment. Chemical treatment protocols planned for Phase III FY 2002 will be similar to those used for Phase II FY 2001 activities. A 2-hour, post-injection "push stage," at a minimum, will be continued for Phase III FY 2002 activities. Injections will, in general, be performed when groundwater level at the injection well is such that the aquifer thickness (i.e. top of RUM unit to top of water level) is within 20% of the aquifer thickness based on historical average water level elevation, as advised by Pacific Northwest National Laboratory based on knowledge gained during ISRM development and deployment. The average water level elevation in the vicinity of the treatment zone has been estimated to be approximately 118.25 m above mean sea level. This 20% criterion is a recommendation established as an interim hold point for Phase III FY 2002 emplacements, requiring further evaluation if the 20% criterion is not attainable.

Performance Monitoring Activities. Groundwater monitoring planned for Phase III FY 2002 will be the same as for Phase II FY 2001. The objective of groundwater monitoring is to define and perform the appropriate sampling necessary to collect the data required to track plume movement and evaluate the success of ISRM in meeting the interim action RAOs. Groundwater monitoring includes monitoring groundwater wells downgradient of the proposed treatment zone to demonstrate compliance with regulatory requirements and monitoring groundwater wells upgradient, downgradient, and along the treatment zone to evaluate ISRM performance. The

specific monitoring criteria developed to determine compliance and performance of the ISRM treatment zone are described in Section 5.0 of the RDR/RAWP (DOE-RL 2000).

Treatment Zone Degradation Mitigation Activities. A mitigation plan (BHI 2001) was developed to address a significant trend of increasing hexavalent chromium concentrations observed in the central treatability test portion of the ISRM treatment zone and some Phase I and Phase II injection wells. Previous hexavalent chromium measurements were near or below detection limits since dithionite injections/extractions occurred in 1997 and 1998.

FY 2002 mitigation activities include the drilling of three boreholes near the existing ISRM treatability test treatment zone. Collection of intact aquifer sediment samples and preserving their in situ oxidation state will be the main objective of the drilling activities. Geotechnical and geochemical analysis and testing will be performed on the collected soil samples. A geotechnical/geochemical evaluation report will be prepared by Pacific Northwest National Laboratory, emphasizing residual reductive capacity in the area and corrective measures for reestablishing the existing treatability portion of the treatment zone.

2.0 ISRM SECOND QUARTER WORK ACTIVITIES COMPLETED

Work activities completed during the second quarter of FY 2002 consisted of drilling the remaining 14 of 17 Phase III injection wells and beginning Phase III injection activities for the final 22 treatment zone wells. Phase III drilling activities were started in late December, and 3 of the 17 total wells were in progress at the end of the previous quarter. Figure 2-1 presents a site overview map showing the wells installed and treated to date.

2.1 ISRM WELL CONSTRUCTION ACTIVITIES

Phase III drilling activities completed during the second quarter of FY 2002 are discussed below and summarized in Table 2-1. A detailed summary of Phase III well drilling activities is discussed in *ISRM Barrier Well Completion Report for the 100-HR-3 Groundwater Operable Unit, Fiscal Year 2002* (BHI 2002a).

2.1.1 Treatment Zone Well Drilling

The final 17 planned treatment zone wells were installed on the western end of the treatment zone in FY 2002. Drilling of 3 wells began at the end of the first quarter of FY 2002, and the remaining 14 wells were completed during the second quarter. The drilling protocol for the Phase III treatment wells was modified in the ISRM hold point review. Air rotary drilling was permitted to maximum of 20 m (65 ft) below ground surface (approximately 3 to 4.6 m [10 to 15 ft] above the saturated zone). Below 20 m (65 ft), only non-air-driven (i.e., cable tool method) drilling methods were to be used. Drilling began in December 2001 with well 199-D4-68 using the cable tool method. Cable tool drilling rates on the western end of the treatment zone were good, averaging 4 to 5 days to advance the borehole approximately 34 m (113 ft) to the Ringold Upper Mud Unit. For logistical reasons, the decision was made to complete all the remaining treatment zone wells using the cable tool method.

A more rigorous well development procedure was employed during the second quarter to ensure maximum well response to pumping and injection. After the cement seal was installed to ground surface, the entire screened interval was resurged with the dual-flange surge block in an effort to increase the removal of fine material. After surging was complete, the well was alternately pumped and rawhided for 10-minute intervals. Well development ended with final pumping. Standard field parameters were monitored, including dissolved oxygen, pH, conductivity, temperature, and turbidity. After well development was complete, most of the wells were subjected to a constant rate pumping test targeted at either 50% drawdown of the screened interval or the maximum capacity of the development pump (117 L/min [31 gal/min]). All of the wells sustained the maximum pumping rate for short durations of time. The additional limited pumping test was not performed on the last few wells due to limited purgewater handling capacity at the Modutanks.

2.1.2 Mitigation Borehole Drilling

Three characterization boreholes (199-D4-87, 199-D4-88, and 199-D4-89) were installed in the vicinity of the 1997/1998 treatability test area and completed as 2-in. diameter monitoring wells. The three wells were drilled using a sonic drilling method, and continuous samples were collected through the entire thickness of the aquifer. The samples were collected in Lexan® liners and the sampler was opened in an inert gas environment (i.e., argon-filled glovebox) to preserve the in situ oxidation state of the sediments. Geotechnical and geochemical tests will be performed on the samples, including the measurement of reductive capacity, to aid in understanding why concentrations of hexavalent chromium are increasing within the established treatment zone. Results are not expected until later in FY 2002. The three wells were screened across discrete 0.6-m (2-ft) intervals spanning the upper, middle, and lower portions of the aquifer. Additional information on the construction of these wells can be found in *ISRM Barrier Well Completion Report for the 100-HR-3 Groundwater Operable Unit, Fiscal Year 2002* (BHI 2002a).

2.2 SUMMARY OF TREATMENT ZONE EMPLACEMENT ACTIVITIES

Phase III construction activities include the treatment of the remaining 22 treatment zone wells to complete the designed treatment zone to its western extent. Emplacement activities began at the end of the second quarter with the injection of well 199-D4-64 starting on March 27, 2002. This was the only well treated during the reporting period. Well 199-D4-64 and adjacent wells 199-D4-63 and 199-D4-65 were monitored for field parameters (dissolved oxygen, temperature, oxidation-reduction potential [Eh], and conductivity), water level, and reagent concentration. A summary of these parameters is presented in Appendix A.

Pre-injection water level in well 199-D4-64 was approximately 84.9 ft bgs based on the transducer installed in the well. This water level corresponds to an aquifer thickness of 25.6 ft and top of the water table was within 0.3 ft of the top of the screen (84.6 ft bgs). The aquifer thickness in this well relative to the historic average water level elevation (118.25 m) is approximately 26.6 ft. The water level at the time of injection represents an aquifer thickness greater than 90% of the historical average, and therefore meets the Phase III hold point requirement of being with 20%.

Significant mounding occurred during the injection of well 199-D4-64. The injection rate was decreased to approximately 66.6 L/min (17.6 gal/min), resulting in an injection period that lasted more than 60 hours. Well development data for this well were incomplete but indicated significant drawdown when pumped at 76 L/min (20 gal/min). As treatment activities move to the west, the permeability of the aquifer increases, and the injection/extraction process should require less time. No extraction water was generated during the reporting period and no water was removed from the evaporation pond except for natural and accelerated (i.e., blower-assisted) evaporation.

® Lexan is a registered trademark of General Electric Company, USA.

A summary of treatment zone emplacement activities, including performance sampling, will be discussed in the third quarter ISRM technical memorandum. To date, 45 of a planned 66 wells have been treated.

2.3 DESIGN UPGRADES

The following is a brief summary of design upgrades completed during the second quarter of FY 2002. Complete system design information can be found *System Design Description for 100-D/DR Area In-Situ Redox Manipulation* (BHI 2002b):

- Changed maximum range of the fresh water flowmeter from 265 L/min (70 gal/min) to 379 L/min (100 gal/min) to allow for higher fresh water flow rates.
- Changed injection and fresh water flex hoses from 2" to 3" diameter to increase volume handling capacity.
- Increased length of all four injection piping well sets to 100 ft below top of casing and extraction well sets to 109 ft below top of casing.
- Sampling manifold modifications included relocating dissolved oxygen and pH/oxidation-reduction potential probes, adding an air release valve, and replacing existing rotameters with turbine-type digital flowmeter/totalizers.
- Major electrical system modifications. These are described in *Exhibit D, Scope of Work 100-D In-Situ REDOX Electrical Power Upgrades* (BHI 2002c).

Figure 2-1. Second Quarter Plan View Base Map.

This map is intended to convey general information and is not intended to be a construction as-built drawing.

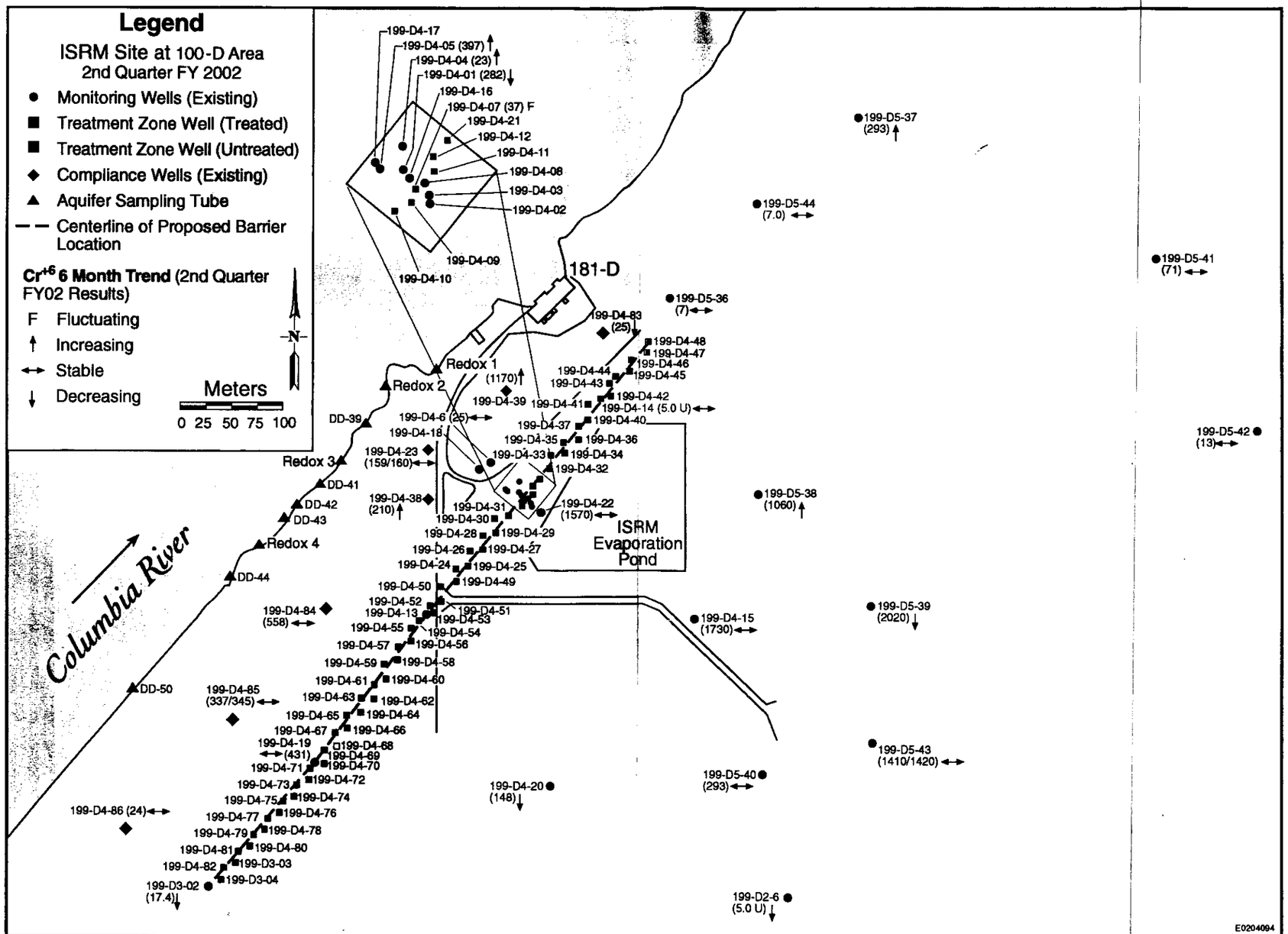

Table 2-1. FY 2002 Phase III Well Construction Summary.

Well ID	Well Name	Well Type	Drilling Start Date	Water Level (ft bgs)	RUM Top (ft bgs)	Screen Top (ft bgs)	Screen Bottom (ft bgs)	Screen Length (ft)	Final Flow Rate (gal/min)	Final Drawdown (ft)	Hexavalent Chromium (μg/L)
C3298	199-D4-68	I	12/20/01	82.76	112.0	80.52	110.48	29.96	30	4.80	344
C3299	199-D4-69	I	01/07/02	81.79	110.0	83.16	108.18	25.02	31	5.92	323
C3300	199-D4-70	I	12/28/01	81.79	110.5	81.87	106.87	25.00	30	6.30	339
C3301	199-D4-71	I	01/30/02	82.05	110.5	79.38	109.41	30.03	31	3.19	412
C3302	199-D4-72	I	02/04/02	81.83	111.0	79.92	109.95	30.03	31	0.55	430
C3303	199-D4-73	I	02/11/02	80.40	111.5	80.50	110.50	30.00	30	0.14	344
C3304	199-D4-74	I	02/11/02	81.44	111.5	80.94	110.94	30.00	31	3.40	467
C3305	199-D4-75	I	02/19/02	82.25	113.5	81.97	112.00	30.03	31	2.77	388
C3306	199-D4-76	I	02/14/02	81.70	112.5	81.13	111.15	30.02	31	0.65	311
C3307	199-D4-77	I	01/20/02	81.72	111.0	79.90	110.01	30.11	31	0.93	240
C3308	199-D4-78	I	02/25/02	82.02	112.0	80.94	110.95	30.01	31	1.43	192
C3309	199-D4-79	I	03/04/02	83.91	113.0	81.33	111.35	30.02	31	0.50	187
C3310	199-D4-80	I	03/04/02	83.45	112.8	81.03	111.06	30.03	31	0.93	130
C3311	199-D4-81	I	02/26/02	83.11	112.5	81.25	111.30	30.05	31	0.35	70
C3312	199-D3-3	I	01/23/02	81.90	113.5	82.04	112.07	30.03	31	0.20	57
C3313	199-D4-82	I	01/17/02	81.91	113.5	82.00	112.02	30.02	31	0.60	52
C3314	199-D3-4	I	12/26/01	82.47	113.0	82.30	112.26	29.96	31	4.00	79
C3799	199-D4-87	B	03/05/02	83.71	97.2	87.34	89.54	2.20	1.3	N/A	N/A
C3800	199-D4-88	B	03/08/02	83.20	ND	81.79	83.99	2.20	N/A	N/A	N/A
C3801	199-D4-89	B	03/12/02	83.90	97.0	93.20	95.42	2.22	2	1.87	N/A

B = mitigation borehole
I = treatment zone injection well
N/A = data not available
ND = not determined
RUM = Ringold Upper Mud

3.0 AQUIFER RESPONSE

3.1 HYDRAULIC MONITORING

Water-level data reported in this technical memorandum were collected with an automated network of pressure transducers and dataloggers. During the second quarter of FY 2002, data were collected from seven monitoring wells and one river station in the vicinity of the ISRM site. Data from these systems are regularly downloaded remotely using a radiotelemetry system.

Wells 199-D4-13, 199-D4-20, 199-D4-38, 199-D5-38, and 199-D5-43 are part of the permanent, automated water-level monitoring network established at the ISRM site. Wells 199-D4-84 and 199-D4-85 are FY01 installed compliance monitoring wells located approximately 60 m downgradient from the treatment zone. Water-level monitoring in these wells began at the start of FY 2002 (October 1, 2001).

Wells 199-D4-38, 199-D4-84, and 199-D4-85 are compliance monitoring wells located between the treatment zone and the river (see Figure 2-1). The water levels in these wells exhibit substantial seasonal and diurnal variations that are directly related to the stage of the Columbia River. Well 199-D4-13 is a monitoring well located within the treatment zone and exhibits attenuated water fluctuations tied to the river stage. Wells 199-D4-20, 199-D5-38, and 199-D5-43 are located upgradient (i.e., inland) of the ISRM site. The water levels in these wells exhibit seasonal variations similar to the well nearest the river, but the fluctuations are dampened in both frequency and amplitude.

A summary of water-level data collected during the second quarter of FY 2002 is presented in Table 3-1. In general, groundwater levels generally mimic the river stage with varying degrees of lag time depending on distance inland. Peak river stage occurred on or about February 1, 2002. Maximum water level was observed in compliance monitoring wells 199-D4-84 and 199-D4-85 approximately 2 weeks later on February 14, 2002. Well 199-D4-13 recorded its maximum water level on February 17, 2002, followed in succession by the remaining monitoring wells. The one exception is well 199-D4-38. Water levels in this well were highest at approximately the same time as the river, 14 days sooner than wells 199-D4-84 and 199-D4-85, but located approximately the same distance from the river. This difference in response suggests different degrees of connectivity between these wells and the river due to aquifer heterogeneity. Hydrographs for each of the wells compared to the stage of the Columbia River near the 100-D Area are provided in Appendix B.

Well 199-D5-38 recorded the highest maximum water level during the reporting period. This is significant given that this well is located approximately 345 m closer the river than monitoring well 199-D5-43 and the general site wide hydraulic gradient oriented towards the river. The elevated water levels recorded in 199-D5-38 may be the result river water leaking from the 182-D Reservoir. If this is the case, then this fresh water mound may play a significant role influencing plume movement. The installation of additional monitoring wells, planned for FY 2003, will aid in interpreting groundwater movement in this area.

3.2 CONTAMINANT MONITORING

Groundwater in the vicinity of the ISRM treatment facility is sampled quarterly to monitor plume movement and assess treatment performance. For the second quarter of FY 2002, a total of 32 treatment zone, compliance, and monitoring wells were sampled and analyzed for hexavalent chromium and other constituents. Table 3-2 summarizes which wells were sampled during the second quarter and presents the analytical results for hexavalent chromium, sulfate, manganese, Eh, and dissolved oxygen. Tabulated results for all constituents of each well sampled during the second quarter of FY 2002 are included in Appendix C. Table 3-3 summarizes the reported hexavalent chromium concentrations quarterly to approximately 1 year prior and evaluates trends over the last 6-month interval. Specifically, a trend is defined as a change in concentration greater than ±20% relative to the fourth quarter FY 2001 sampling event.

A discussion of the reported hexavalent chromium and sulfate concentrations is provided in the following subsections. In addition to scheduled quarterly sampling, supplemental sampling on selected treatment zone and monitoring wells occurred during the second quarter of FY 2002. These data, collected in January, provide indications of the effectiveness of the treatment zone emplacement. Supplemental operational sampling results for the second quarter of FY 2002 are summarized in Table 3-4.

3.2.1 Downgradient Compliance and Monitoring Wells

Eleven monitoring and compliance wells downgradient of the treatment zone were sampled during the second quarter of FY 2002. Sample results from downgradient wells are used to evaluate the performance of the established treatment zone. Ideally, groundwater that has passed through the reduced zone should exhibit values of hexavalent chromium less than the RAO of 20 µg/L. Results of the second quarter sampling efforts are discussed below and presented in Table 3-2.

- Monitoring wells 199-D4-1, 199-D4-4, 199-D4-5, and 199-D4-6 are located downgradient from the treatability test phase treatment zone established in 1997/1998. Wells 199-D4-1 and 199-D4-5 exhibited elevated hexavalent chromium concentrations (282 µg/L and 397 µg/L, respectively). Hexavalent chromium concentrations in both of these wells have exceeded the RAO of 20 µg/L since February 2001. Well 199-D4-1 exhibited a decreasing trend over the past 6 months while well 199-D4-5 exhibited an increasing trend. Wells 199-D4-4 and 199-D4-6 exhibited low hexavalent chromium concentrations (23 µg/L and 25 µg/L, respectively). Well 199-D4-4 exhibited an increase from nondetect the previous quarter and well 199-D4-6 exhibited a stable trend just above the RAO of 20 µg/L. The different responses for wells clustered relatively close together suggest a complex hydrogeology and groundwater flow regime in this area.

- Downgradient compliance monitoring wells 199-D4-23, 199-D4-38, and 199-D4-39 all exhibited hexavalent chromium concentrations greater than the RAO. Well 199-D4-23 (159/160 µg/L, duplicates) exhibited a stable 6-month trend, but has decreased from 302 µg/L a year ago. This well also exceeds the secondary drinking water standard (SDWS)

of 250 mg/L for sulfate (280/288 mg/L, duplicates). Well 199-D4-38 (210 μg/L) exhibited an increasing hexavalent chromium concentration after a low of 29.8 μg/L reported the previous quarter. Well 199-D4-39 (1,170 μg/L) exhibited a steadily increasing hexavalent chromium trend since the last nondetect in February 2001. Again, the different trends in hexavalent chromium concentrations suggest a complex hydrogeology and groundwater flow regime.

- Downgradient compliance monitoring wells 199-D4-83 through 199-D4-86 were installed in FY 2001. Well 199-D4-83 (25 μg/L) is located downgradient of the eastern end of the treatment zone. This portion of the treatment zone was injected in the latter half of FY 2001. The low hexavalent chromium concentration is believed to reflect the arrival of treated groundwater at this location. Compliance monitoring wells 199-D4-84 through 199-D4-86 are located downgradient from the western portion of the treatment zone either treated in the latter half of FY 2001 or scheduled to be treated in FY 2002. Therefore, hexavalent chromium concentrations are expected to reflect untreated groundwater. Well 199-D4-86 (24 μg/L) is believed to represent the western edge of the contaminant plume.

3.2.2 Wells Located Within the Established Treatment Zone

During the second quarter of FY 2002, quarterly samples were collected from nine treatment zone injection wells. Results of the second quarter sampling efforts are discussed below and presented in Table 3-2.

- Injection well 199-D4-7 (37 μg/L) was injected as part of the treatability test phase in 1997. Hexavalent chromium concentrations in this well have fluctuated greatly (339 μg/L in the first quarter of FY 2002 and 55 μg/L in the fourth quarter of FY 2001), suggesting complex groundwater flow and/or a response to changes in water level.

- Injection wells 199-D4-26, 199-D4-32, and 199-D4-36 were treated in FY 2000. Wells 199-D4-32 and 199-D4-36 exhibited detectable concentrations of hexavalent chromium (6 μg/L and 7/8 μg/L [duplicates], respectively), but are below the RAO of 20 μg/L. Well 199-D-26 (17/45 μg/L) exhibited one sample result exceeding the RAO. All of these wells exceed the SDWS of 250 mg/L for sulfate.

- Wells 199-D4-14, 199-D4-48, and 199-D4-62 were treated in FY 2001. All of these wells exhibited hexavalent chromium concentrations less than the RAO. Wells 199-D4-48 and 199-D4-62 exceed the SDWS of 250 mg/L for sulfate.

- Monitoring wells 199-D4-13 and 199-D4-19 are located within the western half of the treatment zone. Well 199-D4-13 (nondetect) lies between injection wells 199-D4-53 and 199-D4-54, which were treated in the third quarter of FY 2001. Well 199-D4-19 (430 μg/L) is located between injection wells 199-D4-70 and 199-D4-71, which will be treated in the third quarter of FY 2002. Hexavalent chromium concentrations in this well represent baseline conditions prior to Phase III injections for this portion of the treatment zone.

- Injection well 199-D4-68 exhibited a hexavalent chromium concentration of 344 µg/L. This well has not been treated as of the close of the second quarter of FY 2002.

3.2.3 Upgradient/Cross-Gradient Monitoring Wells

During the second quarter of FY 2002, samples were collected from 14 monitoring wells that were either upgradient or cross-gradient from the established treatment zone. The corresponding analytical results provide a basis for assessing the magnitude and extent of the plume in relation to the proposed orientation of the completed treatment zone.

- Monitoring wells 199-D3-2 and 199-D2-6 both exhibited decreasing hexavalent chromium concentrations (17.4 µg/L and nondetect, respectively) over the previous 6 months. Historically low contaminant concentrations suggests they lie on the western boundary of the plume. Continued low concentrations also indicate the plume is not spreading to the west or south.

- Monitoring wells 199-D4-15, 199-D4-20, 199-D4-22, 199-D5-40, and 199-D5-43 all exhibited either stable or decreasing 6-month hexavalent chromium concentrations. These wells are located in the central core of the identified plume, suggesting little change in plume configuration in this area.

- Monitoring wells 199-D5-41 and 199-D5-42 exhibited low, stable hexavalent chromium concentrations over the past 6 months (71 µg/L and 13 µg/L, respectively). These wells are located inland of the eastern extent of the ISRM treatment zone, west of the 100-D Reactor site. Hexavalent chromium in these wells may be part of a separate plume currently being treated by the 100-HR-3 pump-and-treat remediation system.

- Monitoring well 199-D5-39 exhibited a significant decrease in hexavalent chromium concentration (2,020 µg/L) relative to its recent high of 5,510/5,660 µg/L reported the previous quarter. Hexavalent chromium concentrations have been extraordinarily high in this well since the third quarter of FY 2001 (May 2001). The well is located approximately 185 m due west from a former sodium dichromate transfer station. Currently there is no causal explanation for the dramatic rise and fall of hexavalent chromium in this well. Continued monitoring, especially at downgradient wells, may help to explain the occurrence and movement of this hot spot in the plume.

- Monitoring well 199-D5-38 is located just southwest of the 182-D Reservoir downgradient from well 199-D5-39 and exhibited an increasing hexavalent chromium concentration trend over the past 6 months (689/720 µg/L to 1,060 µg/L). Concentrations in this well have fluctuated between 689/720 µg/L (August 2001) and 1,140 µg/L (December 2000) for more than a year. This latest increase may be related to the high concentrations recorded in well 199-D5-39 recently, suggesting plume movement in a northwesterly direction, towards the treatment zone. Additional monitoring results will be required to verify this..

- Monitoring wells 199-D5-36, 199-D5-37, and 199-D5-44 are located northeast of, and on trend with, the axis of the treatment zone. Hexavalent chromium concentrations in wells

199-D5-36 and 199-D5-44 have been at or below detection for more than a year. Well 199-D5-37 (293 µg/L), located farthest from the treatment zone, has exhibited steadily increasing concentrations since March 2001. It has been suggested in the *Fiscal Year 2001 Annual Summary Report for the In Situ Redox Manipulation Operations* (DOE-RL 2002) that the origin of the elevated chromium in this well is the result of northerly movement of the ISRM plume, beneath the 182-D Reservoir between monitoring wells 199-D5-41 and 199-D5-42 to the east and wells 199-D5-36 and 199-D5-44 to the west. The recent decrease in concentration at 199-D5-39 and the recent increase in concentration at 199-D5-38 suggest more monitoring information is needed since the new data could suggest plume movement is towards the river. The chromium increase at 199-D5-39 requires further evaluation.

- The absence of monitoring wells between the 182-D Reservoir and well 199-D5-37 makes it difficult to interpret the behavior of the plume in this area. Groundwater flow and plume movement to the north carries significant implications for the ultimate success of the ISRM treatment zone. Additional monitoring wells have been purposed to be installed in this area in FY 2003.

3.2.4 Supplemental Operational Sampling of Treatment Zone Wells

Supplemental operational sampling of treatment zone wells began in November 2000 in response to increasing hexavalent chromium concentrations in the treatability test phase wells treated in 1997 and 1998. Sampling is limited to dissolved oxygen, oxidation-reduction potential, and hexavalent chromium. These sampling results are not subjected to the rigorous quality control protocol required for quarterly compliance monitoring sampling and, therefore, are discussed separately. Table 3-4 presents a summary of hexavalent chromium results from this sampling effort for the previous year (February 2001 to January 2002). The results discussed below are organized according to when the wells were injected.

- Treatment zone wells 199-D4-7 and 199-D4-9 through 199-D4-12 were installed and treated as part of the treatability test phase in 1997 and 1998. Monitoring well 199-D4-8 is located in the center of the treatment zone, between wells 199-D4-7 and 199-D4-11. All of these wells exhibit elevated hexavalent chromium concentrations exceeding the RAO, except well 199-D4-10, which reported a concentration of 20 µg/L. Well 199-D4-10 has exceeded the RAO during the previous 3 months. As part of the mitigation plan, the five treatment wells are to be reinjected in late FY 2002 or early FY 2003.

- Treatment zone well 199-D4-21 was treated in 1999, and hexavalent chromium concentrations remain below detection.

- Upgradient monitoring wells 199-D4-2 and 199-D4-3 exhibited elevated hexavalent chromium concentrations and serve to roughly establish the baseline concentration entering the treatability test phase treatment zone. Assuming that the average concentration between these two wells (1,520 µg/L) represents the hexavalent chromium concentration of the groundwater entering this portion of the treatment zone, the reduction in hexavalent chromium at the above-mentioned treatment zone wells ranges between 57% and 99%.

Further reduction likely occurs as the groundwater passes through the downgradient half of the treatment zone.

- Downgradient monitoring wells 199-D4-4 and 199-D4-5 both exhibit increasing hexavalent chromium concentration apparently as a result of the partial breakdown of the treated zone.

- Wells 199-D4-26 through 199-D4-31 were treated in FY 2000 and are located west of the treatability test wells. All of these wells exhibited hexavalent chromium concentrations below the RAO of 20 µg/L. Of these wells, 199-D4-26 is the only well that has previously recorded contaminant levels greater than the RAO.

- Treatment zone wells 199-D4-32 through 199-D4-36 were treated in FY 2000 and are located east of the treatability test wells. Only well 199-D4-35 (1,000 µg/L) exceeds the RAO.

- Treatment zone wells 199-D4-24, 199-D4-25, and 199-D4-37 were treated in FY 2001. All of these wells remain below the RAO for hexavalent chromium.

In summary, of the 45 treatment zone wells that have been treated as of the close of the second quarter (including well 199-D4-64), 7 wells no longer satisfy the RAO criterion of 20 µg/L. Five of the seven wells are the original treatability test zone injection wells (199-D4-7, 199-D4-9 through 199-D4-12). All of these wells will be re-injected with sodium dithionite in FY 2003 to reestablish reducing conditions. At this time the cause for the treatment zone breakdown is uncertain, but is probably related to multiple factors.

Table 3-1. Summary of FY 2002 Second Quarter Water-Level Monitoring Data.

Well	Distance from River (m)	Average Water-Level Elevation (m)	Minimum Water-Level Elevation (m)	Date	Maximum Water-Level Elevation (m)	Date	Maximum Change in Water-Level Elevation (m)
River	0	117.355	116.494	31-Mar-02	118.432	01-Feb-02	1.938
199-D4-84	92	117.816	117.361	31-Mar-02	118.107	14-Feb-02	0.746
199-D4-85	92	117.849	117.460	31-Mar-02	118.100	14-Feb-02	0.640
199-D4-38	95	117.721	117.257	31-Mar-02	118.055	01-Feb-02	0.798
199-D4-13	165	117.848	117.666	02-Jan-02	118.015	17-Feb-02	0.349
199-D5-38	320	118.209	117.982	01-Jan-02	118.355	24-Feb-02	0.373
199-D4-20	370	118.118	117.937	01-Jan-02	118.236	03-Mar-02	0.299
199-D5-43	665	118.174	118.019	01-Jan-02	118.279	11-Mar-02	0.260

Table 3-2. Second Quarter FY 2002 Sampling Summary. (2 Pages)

Well Name	Well ID	Well Type	Well Location	Hexavalent Chromium (µg/L)	Sulfate (mg/L)	Conductivity (µS/cm)	Dissolved Oxygen (mg/L)	Eh (mV)[a]	Manganese (µg/L)
199-D4-23	B5779	C	DG			819	2.1	308	
199-D4-38	B8989	C	DG		148	581	3.14		
199-D4-39	B8990	C	DG		152	686	1.05		
199-D4-83	C3315	C	DG		18	242	7.79		
199-D4-84	C3316	C	DG	558	94	528	7.85		
199-D4-85	C3317	C	DG	337/345	86	547	9.11		
199-D4-86	C3318	C	DG	24		422	6.73		
199-D4-1	B2895	M	DG		156	749	0.79		
199-D4-4	B8060	M	DG	23		944	0.33	270	
199-D4-5	B8061	M	DG			736	1.08	266	
199-D4-6	B8064	M	DG			775	134		
199-D4-13	B8071	I	TZ	5.0 (U)		2553			
199-D4-14	B8072	I	TZ	5.0 (U)	168	1140			
199-D4-26	B8977	I	TZ			2059	0.11		40.5
199-D4-32	B8983	I	TZ	6		975	0.22		
199-D4-36	B8987	I	TZ	7/ 8		1058	0.15		
199-D4-48	C3278	I	TZ	5.0 (U)		1033	0.05		

Table 3-2. Second Quarter FY 2002 Sampling Summary. (2 Pages)

Well Name	Well ID	Well Type	Well Location	Hexavalent Chromium (µg/L)	Sulfate (mg/L)	Conductivity (µS/cm)	Dissolved Oxygen (mg/L)	Eh (mV)[a]	Manganese (µg/L)
199-D4-62	C3292	I	TZ	6		2293	0.11		
199-D4-68	C3298	I	TZ	344					
199-D4-7	B8065	I	TZ			766	0.25	304	
199-D3-2	B8074	M	CG	17.4	62.8	420	5.11		0.81
199-D4-19	B8746	M	CG	431	92	546			
199-D5-36	B8744	M	CG	7	16	226	8.67		
199-D5-37	B8745	M	CG	293	33	333			
199-D5-44	B8754	M	CG	7	11	207			
199-D2-6	A4568	M	UG	5.0 (U)	140	737	7.86		
199-D4-15	B8073	M	UG	1730	132	658	8.5		
199-D4-20	B8750	M	UG	147/149	128/136	663	7.7		
199-D4-22	B8778	M	UG	1570	144	687	6.49	300	
199-D5-38	B8747	M	UG	1060	114	546	7.7		
199-D5-40	B8749	M	UG	293/293	112/120	612			
199-D5-41	B8751	M	UG	71	45	375			
199-D5-42	B8752	M	UG	13	64	435			
199-D5-43	B8753	M	UG	1410/1420	94/98	512	8.6		

NOTE: Shaded values indicate result exceed target limits (i.e., SDWS) or RAO. Shading is applied only to injection and downgradient monitoring wells in relation to the established treatment zone.

[a] Eh value converted from oxidation-reduction potential measurement by adding +200 mV as suggested by the manufacturer.

C = compliance well
I = injection well
M = monitoring well
TZ = treatment zone
DG = down-gradient
CG = cross-gradient
(U) = undetected
UG = up-gradient

Table 3-3. Hexavalent Chromium Data Summary and Trend Analysis from February 2001 to March 2002. (2 Pages)

Well Name	Well ID	Well Type	Well Location	3rd Quarter FY 2001		4th Quarter FY 2001		1st Quarter FY 2002		2nd Quarter FY 2002		6-Month Trend
				Hexavalent Chromium (µg/L)	Sample Date	Hexavalent Chromium (µg/L)	Sample Date	Hexavalent Chromium (µg/L)	Sample Date	Hexavalent Chromium (µg/L)	Sample Date	
199-D2-6	A4568	M	UG	22	17-May-01	31 / 27	20-Aug-01	77.8	15-Nov-01	5.0 (U)	30-Jan-02	Decreasing
199-D3-2	B8074	M	CG	41	17-May-01	36	20-Aug-01	N/S	N/S	17.4	30-Jan-02	Decreasing
199-D4-6	B8064	M	DG		18-May-01		23-Aug-01		15-Nov-01		21-Feb-02	Stable
199-D4-14	B8072	I	TZ	n/s	n/s	5.0 (U)	27-Aug-01	5.8(U)/ 5.8(U)	19-Nov-01	5.0 (U)	30-Jan-02	Stable
199-D4-15	B8073	M	UG	1660	17-May-01	1740	20-Aug-01	1530	15-Nov-01	1730	14-Feb-02	Stable
199-D4-19	B8746	M	CG	481/489	21-May-01	430	27-Aug-01	430	20-Nov-01	431	20-Feb-02	Stable
199-D4-20	B8750	M	UG	202	23-May-01	198 / 200	20-Aug-01	151	30-Nov-01	148	14-Feb-02	Decreasing
199-D4-22	B8778	M	UG	1310	17-May-01	1620	20-Aug-01	1340/1410	30-Nov-01	1570	22-Feb-02	Stable
199-D4-23	B5779	C	DG		17-May-01		16-Aug-01		17-Nov-01		22-Feb-02	Stable
199-D4-38	B8989	C	DG		22-May-01		20-Aug-01		15-Nov-01		14-Feb-02	Increasing
199-D4-39	B8990	C	DG		18-May-01		27-Aug-01		15-Nov-01		30-Jan-02	Increasing
199-D5-36	B8744	M	CG	5 (u)	18-May-01	14	23-Aug-01	13.2	19-Nov-01	7	19-Feb-02	Stable
199-D5-37	B8745	M	CG	171	23-May-01	209	27-Aug-01	230	20-Nov-01	293	31-Jan-02	Increasing
199-D5-38	B8747	M	UG	769	18-May-01	689 / 720	23-Aug-01	1050	19-Nov-01	1060	19-Feb-02	Increasing
199-D5-39	B8748	M	UG	3600 / 3640	18-May-01	4750	23-Aug-01	5510/5660	19-Nov-01	2020	28-Mar-02	Decreasing
199-D5-40	B8749	M	UG	382	23-May-01	355	27-Aug-01	352	20-Nov-01	293/293	20-Feb-02	Stable
199-D5-41	B8751	M	UG	112	23-May-01	65	27-Aug-01	48.8	26-Nov-01	71	31-Jan-02	Stable
199-D5-42	B8752	M	UG	14	23-May-01	12	27-Aug-01	13.1	26-Nov-01	13	31-Jan-02	Stable
199-D5-43	B8753	M	UG	1850	22-May-01	1710 / 1740	23-Aug-01	1350	19-Nov-01	1410/1420	20-Feb-02	Stable
199-D5-44	B8754	M	CG	5.0 (u)	22-May-01	5.0 (U)	27-Aug-01	6.3	26-Nov-01	7	31-Jan-02	Stable

Table 3-3. Hexavalent Chromium Data Summary and Trend Analysis from February 2001 to March 2002. (2 Pages)

Well Name	Well ID	Well Type	Well Location	3rd Quarter FY 2001		4th Quarter FY 2001		1st Quarter FY 2002		2nd Quarter FY 2002		6-Month Trend
				Hexavalent Chromium (µg/L)	Sample Date	Hexavalent Chromium (µg/L)	Sample Date	Hexavalent Chromium (µg/L)	Sample Date	Hexavalent Chromium (µg/L)	Sample Date	
199-D4-1	B2895	M	DG		18-May-01		20-Aug-01		15-Nov-01		30-Jan-02	Decreasing
199-D4-4	B8060	M	DG	8	22-May-01	5.0 (U)	23-Aug-01	5.8(U)	29-Nov-01	23	25-Feb-02	Increasing
199-D4-5	B8061	M	DG		21-May-01		23-Aug-01		28-Nov-01		25-Feb-02	Increasing
199-D4-7	B8065	I	TZ		21-May-01		23-Aug-01		26-Nov-01		21-Feb-02	Fluctuating
199-D4-83	C3315	C	DG			87	29-Aug-01	115	19-Nov-01		20-Feb-02	Decreasing
199-D4-84	C3316	C	DG			614/617	28-Aug-01	593	19-Nov-01	558	20-Feb-02	Stable
199-D4-85	C3317	C	DG			287	28-Aug-01	256	19-Nov-01	337/345	20-Feb-02	Stable
199-D4-86	C3317	C	DG				28-Aug-01	27	19-Nov-01	24	20-Feb-02	Stable

NOTES: Shaded values indicate reported concentrations exceed the RAO for the most recent sampling event. Shading is applied only to injection and downgradient monitoring wells in relation to the established treatment zone.
The latter value in a pair represents a duplicate sample.
A blank space indicates no data were available (e.g. well not constructed).
[a] Value reported is total chromium from filtered inductively coupled plasma (ICP) analysis. Chromium from filtered ICP samples is assumed to be entirely hexavalent chromium (soluble form).
[b] Well 199-D4-14 was converted to a treatment well during the third quarter of FY 2001.
[c] Trend is defined as a change in concentration greater than ± 20% relative to the third quarter FY 2001 sampling event.
UG = upgradient
CG = cross-gradient
DG = downgradient
M = monitoring well
I = injection well
C = compliance well
N/A = insufficient data to calculate trend
N/S = not sampled during the identified time period.
TZ = treatment zone well
(U) = The analyte was not detected in the sample. The associated numerical value is the laboratory reporting limit.

Table 3-4. ISRM Operational Hexavalent Chromium Sampling Results (μg/L), February 2001 to January 2002.

Well Name	Injected	Feb 01	Mar 01	Apr 01	May 01	Jun 01	Sep 01	Oct 01	Dec 01	Jan 02
199-D4-24	2001		740	430[a]				NS	NS	NS
199-D4-25	2001		630	670[a]		820[a]		(U)	NS	0
199-D4-26	2000		50	130 / 340		520		(U)	NS	0
199-D4-27	2000		10	2		10		(U)	NS	0
199-D4-28	2000		0	0		0		(U)	NS	0
199-D4-29	2000		0	0		0		(U)	NS	10
199-D4-30	2000		10	0		0		(U)	NS	10
199-D4-31	2000		10	0	0	10		70	NS	NS
199-D4-10	1998	10		10	70	0	220	220	70	20
199-D4-9	1998	880		900	640	390	1,160	1,160	700	
199-D4-7	1997	310		500	640	500		160	530	NS
199-D4-8	Not treated	110		100	0	160	0	(U)	140	
199-D4-3	Not treated	1,360		1,470	680	1,180		1080	NS	1,320
199-D4-2	Not treated	1,400		1,590	1,650	1,590	1,350	1,350	NS	1,720
199-D4-11	1998	160		320	350	30	540	540	310	
199-D4-5	Not treated	60		420	640	210	10	10	NS	
199-D4-4	Not treated	10		0	10	300	0	(U)	NS	
199-D4-12	1998	0		40	60	110	10	10	NS	
199-D4-21	1999	0		0	0	0		(U)	NS	0
199-D4-32	2000		0	0		10		(U)	NS	NS
199-D4-33	2000	0		0		10		(U)	NS	0
199-D4-34	2000		0	0		0		(U)	NS	10
199-D4-35	2000		20	0		40 / 230		140	NS	
199-D4-36	2000		0	0		0		(U)	NS	N,S
199-D4-37	2001		720[a]	20		0		(U)	NS	0

NOTE: Shaded values exceed the RAO for the last sampling event. Shading only applied to wells located within treatment zone or downgradient from treatment zone.
[a]Indicates pre-injection values.
NS = not sampled
(U) = The analyte was not detected in the sample. The associated numerical value is the laboratory reporting limit.

4.0 QUALITY ASSURANCE

Offsite laboratory duplicates and splits were used to assess and evaluate the precision of reported analytical results. The quality assurance sampling results for the second quarter of FY 2002 are summarized in Table 4-1.

Analysis of the quality assurance duplicates consisted of calculating the relative percent difference (RPD) between sample pairs. The RPD values less than 20% are considered acceptable for this type of analysis. The RPD is calculated as follows:

$$\text{RPD} = \frac{(C_1 - C_2)}{(C_1 + C_2)/2} \times 100\%$$

where C_1 is the larger of the reported concentrations and C_2 is the smaller of the reported concentrations.

For this reporting period, field duplicates from five wells were analyzed for hexavalent chromium, field duplicates from four wells were analyzed for sulfate, and one field/laboratory split was analyzed for hexavalent chromium. All calculated RPD values are less than 20%.

Table 4-1. Quality Assurance Sampling Results for the Second Quarter of FY 2002.

Well Name	Sample Date	Constituent	Reported Value #1 (µg/L) or (mg/L)[a]	Sample Number	Reported Value #2 (µg/L) or (mg/L)[a]	Sample Number	RPD (%)	Method	Filtered
Field Duplicates									
199-D4-20	14-Feb-02	Hexavalent chromium	0.149	B13XL0	0.147	B13XL2	1.4	COLOR_TK_FLD	Yes
199-D4-20	14-Feb-02	Sulfate	128	B13XL1	136	B13XL3	6.1	COLOR_TK_FLD	No
199-D4-23	22-Feb-02	Hexavalent chromium	0.16	B13XD5	0.159	B13XD7	0.6	COLOR_TK_FLD	Yes
199-D4-23	22-Feb-02	Sulfate	288	B13XD6	280	B13XD8	2.8	COLOR_TK_FLD	No
199-D4-36	19-Feb-02	Hexavalent chromium	0.008	B13XM2	0.007	B13XM4	13.3	COLOR_TK_FLD	Yes
199-D5-40	20-Feb-02	Hexavalent chromium	0.293	B13XH0	0.293	B13XH2	0.0	COLOR_TK_FLD	Yes
199-D5-40	20-Feb-02	Sulfate	120	B13XH1	112	B13XH3	6.9	COLOR_TK_FLD	No
199-D5-43	20-Feb-02	Hexavalent chromium	1.41	B13XT1	1.42	B13XT3	0.7	COLOR_TK_FLD	Yes
199-D5-43	20-Feb-02	Sulfate	94	B13XT2	98	B13XT4	4.2	COLOR_TK_FLD	No
Field/Laboratory Splits									
199-D4-85	20-Feb-02	Hexavalent chromium	0.345	B13XR0	0.337	B13XR2	2.3	COLOR_TK_FLD/ 7196_cr6(lab)	Yes

[a] Hexavalent chromium concentrations are reported in µg/L, and sulfate concentrations are reported in mg/L.

5.0 CONCLUSIONS

Although the ISRM treatment zone is only partially constructed, data that have been collected allow preliminary evaluation of its performance in relation to the RAOs (EPA et al. 1996) and key elements identified in the ROD Amendment (EPA et al. 1999).

5.1 REMEDIAL ACTION OBJECTIVES (RAOs)

- **Protect aquatic receptors in the river substrate from contamination in groundwater entering the Columbia River.**

  Status: The treatment zone has been extended to a total length of 448 m (1,470 ft) by the close of the second quarter of FY 2002. The treatment zone continues to intercept the contaminant plume in general. Hexavalent chromium concentrations are being reduced as groundwater passes through the treatment zone but have not reached the RAO of 20 µg/L at the compliance wells.

  Issue: Treatment zone and monitoring wells constructed during the treatability test phase continue to show increasing hexavalent chromium concentrations. Three characterization wells were drilled in the treatability test area during the second quarter. Sediment core samples collected from the aquifer will be used to evaluate the in situ oxidation state of the treatment zone in that area.

- **Protect human health by preventing exposure to contaminants in the groundwater.**

  Status: Institutional controls were maintained to prevent public access to the groundwater.

- **Provide information that will lead to the final remedy.**

  Status: Operational and monitoring data continue to be collected to support the development and implementation of a final remedy.

5.2 ISRM KEY ELEMENTS

The ROD Amendment (EPA et al. 1999) identified the overall elements of the ISRM remedial action. The following is a summary of select key design elements identified and a current assessment of ISRM performance to date.

- **The treatment zone shall treat the chromium plume to 20 µg/L or less at each compliance well to achieve 10 µg/L at the river. Compliance monitoring wells will monitor chromium and dissolved oxygen concentrations between the barrier treatment wells and the Columbia River to determine the effectiveness of the treatment zone.**

Status: Compliance monitoring wells are sampled quarterly. All seven of the established compliance monitoring wells exhibited hexavalent chromium concentrations exceeding the RAO of 20 µg/L during the second quarter of FY 2002. Wells 199-D4-84, 199-D4-85, and 199-D4-86 are located downgradient from untreated portions of the treatment zone and therefore expected to exhibit elevated concentrations. Compliance monitoring well 199-D4-83, installed in FY 2001, exhibited a marked decrease in hexavalent chromium concentration during the second quarter. This decrease is believed to be due to treatment activities conducted upgradient from the well in FY 2001.

- **Performance monitoring wells will measure other field parameters including sulfate, dissolved oxygen, pH, temperature, and specific conductance.**

  Status: Monitoring wells are sampled on a quarterly basis. Results of second quarter FY 2002 sampling are summarized in Section 3.0 and presented in Appendix C.

- **The siting, design, and sampling of the compliance monitoring wells shall be adequate to define the boundaries of the plume and the effectiveness of the treatment zone, and shall be capable of assessing if barrier "breakthrough" occurs. This requires wells located between both the treatment barrier and the Columbia River, and wells beyond the end of the treatment barrier, to ensure compliance with the RAOs.**

  Status: Designated compliance monitoring wells are located approximately midway between the treatment zone and the Columbia River. The wells are oriented parallel to the treatment zone and span its entire length. Should there be migration of the plume beyond the ends of the treatment zone, existing monitoring wells are positioned to detect this movement.

  Issue: Additional monitoring wells may be needed to improve resolution of possible plume migration in the vicinity of the 182-D Reservoir.

- **If barrier breakthrough is identified, the Washington State Department of Ecology and U.S. Environmental Protection Agency will determine alternative action to be taken.**

  Status: Treatment zone breakthrough has been identified in the vicinity of the original treatability phase (1997-1999) treatment zone wells and some Phase I and Phase II treatment wells. The appropriate regulatory agencies have been notified. Five treatment zone wells are scheduled for reinjection in late 2002 or early 2003.

- **Post-treatment extraction purgewater shall be collected and disposed to an evaporation pond constructed at the ISRM site. High-concentrated purgewater generated during post-treatment extraction shall be disposed at the evaporation pond with the option of sending a portion of the concentrated purgewater to the Purgewater Storage and Treatment Facility (*Resource Conservation and Recovery Act of 1976* [RCRA] interim status unit) and/or to the Effluent Treatment Facility (RCRA final status unit), both of which are in the 200 Areas. Subsequent low-concentrated purgewater volumes will continue to be disposed to the evaporation pond or to the ground surface through a localized drip field constructed at the ISRM site. The withdrawn water that is to be**

discharged to the ground will be analyzed to confirm that the sulfate SDWS of 250 mg/L will not be exceeded in the underlying groundwater.

Status: No extraction purgewater was generated during the quarter. No extraction purgewater was removed from the evaporation pond during the quarter, except losses due to evaporation.

6.0 ITEMS FOR CONSIDERATION

Based on observations made through the second quarter of FY 2002, the following items for consideration were identified:

- Continue to investigate the need for additional monitoring wells in the vicinity of the 182-D Reservoir. Recent groundwater sample results suggest that northly plume movement into this area and potential historic river water leakage from the 182-D Reservoir may be important factors controlling plume distribution. Additional geologic, groundwater, and chemical data from this area would enhance the conceptual model of plume configuration and movement.

- Continue to investigate groundwater flow direction and gradient at multiple points upgradient and along the treatment zone. The objective is to characterize seasonal shifts in flow direction and evaluate the significance in terms of treatment zone capture and plume movement.

- Additional monthly sampling of downgradient compliance monitoring wells. Sampling should be limited to field parameters and hexavalent chromium and performed in a manner similar to the additional operational sampling of the established treatment zone. Information gathered may help refine groundwater velocity estimates by recording when the treatment front reaches the compliance wells downgradient from recently established portions of the treatment zone. Additionally, more frequent sampling may reveal a connection between small scale concentration trends and changes in water level, especially in compliance wells located downgradient from the area of breakthrough (e.g. in wells 199-D4-23, 199-D4-38, and 199-D4-39).

7.0 RECOMMENDATIONS

Based on observations made through the second quarter of FY 2002, the following recommendations were made and are being implemented:

- Two well networks, one in the treatability test area and another in the Phase III well area, to be instrumented and monitored intensively during treatment events at selected wells to support additional analysis of aquifer hydraulic characteristics.

- Sampling frequency increased at upgradiant monitoring wells 199-D5-39, 199-D5-38, 199-D4-15, and 199-D5-43 to aid in assessing the movements of the high concentration (> 1000 μg/L) upgradient core of the plume.

8.0 REFERENCES

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APPENDIX A

SECOND QUARTER FISCAL YEAR 2002

INJECTION DATA FOR WELL 199-D4-64

Table A-1. ISRM Data from March 27, 2002 Injection (D4-64 Data). (4 pages)

The following is data from well D4-64. This well was the main injection/extraction well. Adjacent wells are D4-63 and D4-65.

Injection start: approximately 10:30 on March 27, 2002.
Reaction stage start: approximately 05:40 on March 30, 2002.
Withdrawal stage start: approximately 07:10 on March 30, 2002.
Withdrawal stage end: N/A

Injection Flowrate (gpm): 17.6
Extraction Flowrate (gpm): N/A
Dithionite Conversion: 0.792

Date Time	Stage	Volume Processed (gal)	Field Parameters										
			pH (unitless)	Sample Temp. (°C)	Eh (mV)	DO[1] (mg/L)	DO[2] (mg/L)	DO[3] (mg/L)	Conductivity (mS/cm)	Hexavalent Chromium (mg/L)	Dithionite[4] Concentration (moles/L)	Dithionite[5] Concentration (moles/L)	Well Level[6] (ft)
3/26/02 18:30	Baseline	0	8.06	16.00	N/A	N/A	7.28	N/A	0.22	0.17	N/A	N/A	18.57
3/27/02 10:30	Start Injection	0	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
3/27/02 12:15	Injection	1848	11.43	13.00	-424.00	N/A	0.00	N/A	45.40	N/A	0.1179	0.0934	86.26
3/27/02 13:30	Injection	3168	11.38	9.00	-396.00	N/A	0.00	N/A	37.80	N/A	0.0817	0.0647	80.50
3/27/02 15:20	Injection	5104	11.34	9.00	-401.00	N/A	0.01	N/A	46.00	N/A	0.1039	0.0823	88.69
3/27/02 16:45	Injection	6600	11.37	9.00	-425.00	N/A	0.02	N/A	44.40	N/A	0.1054	0.0835	85.22
3/27/02 17:40	Injection	7568	11.34	9.00	-419.00	N/A	0.02	N/A	45.10	N/A	0.1124	0.0890	88.23
3/27/02 18:30	Injection	8448	11.38	9.00	-416.00	N/A	0.02	N/A	46.40	N/A	0.1061	0.0840	80.51
3/27/02 19:30	Injection	9504	11.38	9.00	-426.00	N/A	0.01	N/A	45.30	N/A	0.1122	0.0889	84.72
3/27/02 20:30	Injection	10560	11.35	10.00	-473.00	N/A	0.01	N/A	46.50	N/A	0.1045	0.0828	84.71
3/27/02 21:30	Injection	11616	11.46	9.00	-453.00	N/A	0.02	N/A	45.60	N/A	0.1184	0.0938	81.59
3/27/02 22:30	Injection	12672	11.31	11.00	-438.00	N/A	0.01	N/A	45.10	N/A	0.1085	0.0859	85.55
3/27/02 23:45	Injection	13992	11.39	9.00	-443.00	N/A	0.01	N/A	53.10	N/A	0.1214	0.0961	83.23
3/28/02 0:45	Injection	15048	11.36	9.00	-415.00	N/A	0.01	N/A	47.00	N/A	0.1025	0.0812	83.70
3/28/02 1:30	Injection	15840	11.27	9.00	-405.00	N/A	0.01	N/A	48.70	N/A	0.1157	0.0916	89.72
3/28/02 2:40	Injection	17072	11.44	9.00	-450.00	N/A	0.01	N/A	49.20	N/A	0.1216	0.0963	84.66
3/28/02 3:25	Injection	17864	11.28	9.00	-438.00	N/A	0.02	N/A	48.40	N/A	0.1025	0.0812	85.55
3/28/02 4:25	Injection	18920	11.33	9.00	-427.00	N/A	0.02	N/A	44.30	N/A	0.0983	0.0779	86.33

Table A-1. ISRM Data from March 27, 2002 Injection (D4-64 Data). (4 pages)

Date Time	Stage	Volume Processed (gal)	Field Parameters										
			pH (unitless)	Sample Temp. (°C)	Eh (mV)	DO[1] (mg/L)	DO[2] (mg/L)	DO[3] (mg/L)	Conductivity (mS/cm)	Hexavalent Chromium (mg/L)	Dithionite[4] Concentration (moles/L)	Dithionite[5] Concentration (moles/L)	Well Level[6] (ft)
3/28/02 5:25	Injection	19976	11.35	9.00	-460.00	N/A	0.01	N/A	52.00	N/A	0.1129	0.0894	87.14
3/28/02 6:25	Injection	21032	11.32	10.00	-429.00	N/A	0.01	N/A	46.40	N/A	0.1177	0.0932	91.77
3/28/02 7:25	Injection	22088	11.40	9.00	-469.00	N/A	0.03	N/A	48.00	N/A	0.1073	0.0850	81.15
3/28/02 8:25	Injection	23144	11.39	10.00	-467.00	N/A	0.02	N/A	50.10	N/A	0.1117	0.0885	84.80
3/28/02 9:20	Injection	24112	11.40	10.00	-472.00	N/A	0.02	N/A	50.70	N/A	0.1160	0.0919	81.28
3/28/02 10:20	Injection	25168	11.39	10.00	-471.00	N/A	0.02	N/A	52.30	N/A	0.1110	0.0879	83.97
3/28/02 11:30	Injection	26400	11.35	10.00	-472.00	N/A	0.03	N/A	48.70	N/A	0.1081	0.0856	85.39
3/28/02 15:45	Injection	30888	11.48	10.00	-564.00	N/A	0.02	N/A	48.70	N/A	0.1217	0.0964	75.62
3/28/02 16:30	Injection	30888	11.13	10.00	-562.00	N/A	0.03	N/A	43.60	N/A	0.1172	0.0928	74.02
3/28/02 17:55	Injection	30888	11.36	11.80	-547.00	N/A	0.08	N/A	48.70	N/A	0.1222	0.0968	77.76
3/28/02 18:45	Injection	30888	11.36	9.00	-535.00	N/A	0.03	N/A	49.30	N/A	0.1086	0.0860	76.93
3/28/02 19:45	Injection	30888	11.03	9.00	-536.00	N/A	0.02	N/A	50.90	N/A	0.1434	0.1136	71.78
3/28/02 20:45	Injection	30888	11.35	9.00	-556.00	N/A	0.02	N/A	46.90	N/A	0.1236	0.0979	74.84
3/28/02 21:30	Injection	30888	11.26	11.00	-553.00	N/A	0.02	N/A	44.90	N/A	0.1125	0.0891	86.54
3/28/02 22:45	Injection	30888	11.38	9.00	-549.00	N/A	0.03	N/A	48.50	N/A	0.1220	0.0966	78.80
3/28/02 23:45	Injection	30888	11.31	10.00	-549.00	N/A	0.02	N/A	47.60	N/A	0.1183	0.0937	86.73
3/29/02 0:45	Injection	30888	11.36	10.00	-551.00	N/A	0.02	N/A	48.20	N/A	0.1297	0.1027	82.30
3/29/02 1:45	Injection	30888	11.24	9.00	-547.00	N/A	0.01	N/A	45.10	N/A	0.1092	0.0865	80.23
3/29/02 2:30	Injection	30888	10.71	9.00	-549.00	N/A	0.03	N/A	48.90	N/A	0.1215	0.0962	78.78
3/29/02 3:30	Injection	30888	11.38	9.00	-568.00	N/A	0.02	N/A	46.90	N/A	0.1007	0.0798	84.00
3/29/02 4:30	Injection	30888	11.16	10.00	-532.00	N/A	0.02	N/A	44.20	N/A	0.1032	0.0817	84.09

Table A-1. ISRM Data from March 27, 2002 Injection (D4-64 Data). (4 pages)

Date Time	Stage	Volume Processed (gal)	Field Parameters										
			pH (unitless)	Sample Temp. (°C)	Eh (mV)	DO[1] (mg/L)	DO[2] (mg/L)	DO[3] (mg/L)	Conductivity (mS/cm)	Hexavalent Chromium (mg/L)	Dithionite[4] Concentration (moles/L)	Dithionite[5] Concentration (moles/L)	Well Level[6] (ft)
3/29/02 5:20	Injection	30888	11.35	9.00	-519.00	N/A	0.02	N/A	46.50	N/A	0.1136	0.0900	85.01
3/29/02 6:25	Injection	30888	11.27	10.00	-501.00	N/A	0.02	N/A	46.00	N/A	0.1106	0.0876	82.02
3/29/02 7:25	Injection	30888	11.27	11.00	-515.00	N/A	0.01	N/A	50.80	N/A	0.1251	0.0991	85.44
3/29/02 8:25	Injection	30888	11.35	11.00	-515.00	N/A	0.01	N/A	45.10	N/A	0.1148	0.0909	85.67
3/29/02 9:25	Injection	30888	11.30	11.00	-443.00	N/A	0.01	N/A	49.60	N/A	0.1189	0.0942	82.65
3/29/02 10:30	Injection	30888	11.27	13.00	-501.00	N/A	0.02	N/A	45.10	N/A	0.0905	0.0717	86.36
3/29/02 12:00	Injection	30888	11.31	10.00	-516.00	N/A	0.02	N/A	49.40	N/A	0.1139	0.0902	87.00
3/29/02 12:46	Injection	30888	11.21	18.00	-517.00	N/A	0.04	N/A	47.30	N/A	0.1136	0.0900	86.00
3/29/02 13:50	Injection	30888	11.28	10.00	-527.00	N/A	0.02	N/A	48.80	N/A	0.1188	0.0941	82.30
3/29/02 14:45	Injection	30888	11.10	10.00	-524.00	N/A	0.04	N/A	43.70	N/A	0.1236	0.0979	76.57
3/29/02 15:40	Injection	30888	11.35	10.00	-542.00	N/A	0.03	N/A	45.00	N/A	0.1157	0.0916	86.96
3/29/02 16:45	Injection	30888	11.30	11.00	-522.00	N/A	0.03	N/A	48.10	N/A	0.1140	0.0903	84.69
3/29/02 17:30	Injection	30888	11.21	10.00	-556.00	N/A	0.02	N/A	48.90	N/A	0.1146	0.0908	82.57
3/29/02 18:40	Injection	30888	11.39	10.00	-556.00	N/A	0.03	N/A	52.00	N/A	0.1130	0.0895	80.36
3/29/02 19:40	Injection	30888	11.34	10.00	-524.00	N/A	0.03	N/A	48.00	N/A	0.1140	0.0903	81.10
3/29/02 20:40	Injection	30888	11.32	10.00	-529.00	N/A	0.02	N/A	42.20	N/A	0.1127	0.0893	83.33
3/29/02 21:30	Injection	30888	11.25	10.00	-543.00	N/A	0.03	N/A	49.80	N/A	0.0000	0.0000	83.67
3/29/02 22:30	Injection	30888	10.97	10.00	-569.00	N/A	0.02	N/A	46.60	N/A	0.0000	0.0000	83.35
3/29/02 23:40	Injection	30888	11.22	10.00	-538.00	N/A	0.02	N/A	45.00	N/A	0.0000	0.0000	81.49
3/30/02 0:35	Injection	30888	11.16	10.00	-545.00	N/A	0.01	N/A	49.80	N/A	N/A	N/A	86.18
3/30/02 1:50	Injection	30888	11.10	11.00	-501.00	N/A	0.01	N/A	44.00	N/A	N/A	N/A	89.04

Table A-1. ISRM Data from March 27, 2002 Injection (D4-64 Data). (4 pages)

Date Time	Stage	Volume Processed (gal)	Field Parameters										
			pH (unitless)	Sample Temp. (°C)	Eh (mV)	DO[1] (mg/L)	DO[2] (mg/L)	DO[3] (mg/L)	Conductivity (mS/cm)	Hexavalent Chromium (mg/L)	Dithionite[4] Concentration (moles/L)	Dithionite[5] Concentration (moles/L)	Well Level[6] (ft)
	Start Withdrawal	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Averages (Injection):	N/A	N/A	11.30	10.00	-496.38	N/A	0.02		47.25	N/A	0.1071	N/A	83.26

Note:
[1] Cole Palmer DO meter used.
[2] Honeywell DO meter used.
[3] Orion DO meter used.
[4] Raw Data from computer
[5] The conversion factor listed in the computer is set for a different UV detector. Therefore, a conversion factor is used to produce actual dithionite concentration.
[6] Reported as feet above transducer. Transducer set 106.5 ft below top of protective casing (approximately 103.5 ft bgs).
N/A = Not applicable

Table A-2. ISRM Data from March 27, 2002 Injection (D4-63 Data). (2 pages)

The following is data from well D4-63. This well is adjacent to well D4-64.

Injection start: approximately 10:30 on March 27, 2002.
Reaction stage start: approximately 05:40 on March 30, 2002.
Withdrawal stage start: approximately 07:10 on March 30, 2002.
Withdrawal stage end: N/A

Injection Flowrate (gpm): 17.6
Extraction Flowrate (gpm): N/A
Dithionite Conversion: 0.792

Date Time	Stage	Volume Processed (gal)	Field Parameters										
			pH (unitless)	Sample Temp. (°C)	Eh (mV)	DO[1] (mg/L)	DO[2] (mg/L)	DO[3] (mg/L)	Conductivity (mS/cm)	Hexavalent Chromium (mg/L)	Dithionite[4] Concentration (moles/L)	Dithionite[5] Concentration (moles/L)	Well Level[6] (ft)
3/26/02 16:55	Baseline	0	8.01	17.00	964.00	N/A	1.65	N/A	0.64	0.09	N/A	N/A	N/A
3/27/02 10:30	Start Injection	0	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
3/27/02 13:11	Injection	2834	8.43	18.00	382.00	N/A	0.01	N/A	0.82	N/A	0.0000	0.0000	N/A
3/27/02 16:25	Injection	6248	7.73	17.00	439.00	N/A	2.37	N/A	0.67	N/A	0.0030	0.0000	25.00
3/27/02 18:20	Injection	8272	8.25	15.00	377.00	N/A	2.04	N/A	0.63	N/A	0.0000	0.0000	21.98
3/27/02 22:20	Injection	12496	8.24	15.00	354.00	N/A	2.36	N/A	0.57	N/A	0.0001	0.0000	22.79
3/27/02 0:30	Injection	-10560	8.27	15.00	378.00	N/A	3.79	N/A	0.57	N/A	0.0003	0.0000	22.84
3/28/02 2:30	Injection	16896	7.91	15.00	508.00	N/A	4.89	N/A	0.58	N/A	0.0003	0.0000	26.23
3/28/02 4:35	Injection	19096	8.65	15.00	325.00	N/A	2.29	N/A	0.55	N/A	0.0002	0.0000	24.81
3/28/02 8:40	Injection	23408	8.53	18.00	342.00	N/A	3.05	N/A	0.55	N/A	0.0002	0.0000	25.97
3/28/02 10:40	Injection	25520	8.62	20.00	324.00	N/A	1.63	N/A	0.61	N/A	0.0001	0.0000	24.71
3/28/02 18:30	Injection	33792	8.46	16.00	283.00	N/A	5.34	N/A	0.42	N/A	0.0001	0.0000	22.62
3/28/02 20:30	Injection	35904	8.27	16.00	300.00	N/A	3.50	N/A	0.44	N/A	0.0000	0.0000	39.98
3/28/02 22:30	Injection	38016	8.08	16.00	287.00	N/A	4.34	N/A	0.42	N/A	0.0000	0.0000	22.53
3/29/02 0:30	Injection	40128	8.46	16.00	288.00	N/A	4.06	N/A	0.44	N/A	0.0001	0.0000	21.82
3/29/02 4:30	Injection	44352	8.62	15.00	-185.00	N/A	1.73	N/A	0.52	N/A	0.0002	0.0000	20.74
3/29/02 6:35	Injection	46552	8.82	15.00	-262.00	N/A	0.82	N/A	0.54	N/A	0.0002	0.0000	21.54
3/29/02 8:30	Injection	48576	8.80	16.00	-201.00	N/A	1.00	N/A	0.58	N/A	0.0000	0.0000	21.10

Table A-2. ISRM Data from March 27, 2002 Injection (D4-63 Data). (2 pages)

Date Time	Stage	Volume Processed (gal)	Field Parameters										
			pH (unitless)	Sample Temp. (°C)	Eh (mV)	DO[1] (mg/L)	DO[2] (mg/L)	DO[3] (mg/L)	Conductivity (mS/cm)	Hexavalent Chromium (mg/L)	Dithionite[4] Concentration (moles/L)	Dithionite[5] Concentration (moles/L)	Well Level[6] (ft)
3/29/02 10:40	Injection	50864	8.79	19.00	-351.00	N/A	0.28	N/A	0.63	N/A	0.0000	0.0000	22.39
3/29/02 14:30	Injection	54912	7.94	19.00	355.00	N/A	2.98	N/A	0.59	N/A	0.0000	0.0000	20.94
3/29/02 16:30	Injection	57024	7.91	17.00	185.00	N/A	2.39	N/A	0.59	N/A	0.0000	0.0000	22.04
3/29/02 18:30	Injection	59136	7.67	16.00	-34.00	N/A	2.60	N/A	0.63	N/A	0.0000	0.0000	21.86
3/29/02 20:30	Injection	61248	7.93	16.00	-147.00	N/A	0.69	N/A	0.71	N/A	0.0002	0.0000	21.30
3/30/02 0:30	Injection	65472	8.01	16.00	-588.00	N/A	0.01	N/A	0.76	N/A	N/A	N/A	21.50

Note:
[1] Cole Palmer DO meter used.
[2] Honeywell DO meter used.
[3] Orion DO meter used.
[4] Raw Data from computer
[5] The conversion factor listed in the computer is set for a different UV detector. Therefore, a conversion factor is used to produce actual dithionite concentration.
[6] Reported as feet above transducer. Transducer set 106.5 ft below top of protective casing (approximately 103.5 ft bgs).
N/A = Not applicable

Table A-3. ISRM Data from March 27, 2002 Injection (D4-65 Data). (2 pages)

The following is data from well D4-63. This well is adjacent to well D4-64.

Injection start: approximately 10:30 on March 27, 2002.
Reaction stage start: approximately 05:40 on March 30, 2002.
Withdrawal stage start: approximately 07:10 on March 30, 2002.
Withdrawal stage end: N/A

Injection Flowrate (gpm): 17.6
Extraction Flowrate (gpm): N/A
Dithionite Conversion: 0.792

Date Time	Stage	Volume Processed (gal)	Field Parameters										
			pH (unitless)	Sample Temp. (°C)	Eh (mV)	DO[1] (mg/L)	DO[2] (mg/L)	DO[3] (mg/L)	Conductivity (mS/cm)	Hexavalent Chromium (mg/L)	Dithionite[4] Concentration (moles/L)	Dithionite[5] Concentration (moles/L)	Well Level[6] (ft)
3/26/02 17:20	Baseline	0	8.30	17.00	1365.00	N/A	7.62	N/A	0.41	0.52	N/A	N/A	N/A
3/27/02 10:30	Start Injection	0	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
3/27/02 12:00	Injection	1584	8.18	18.00	853.00	N/A	7.47	N/A	0.40	N/A	0.0000	0.0000	19.99
3/27/02 14:10	Injection	3872	8.73	18.00	301.00	N/A	2.57	N/A	0.54	N/A	0.0000	0.0000	19.67
3/27/02 17:25	Injection	7304	8.48	16.00	473.00	N/A	5.61	N/A	0.40	N/A	0.0000	0.0000	19.63
3/27/02 19:30	Injection	9504	8.44	15.00	988.00	N/A	6.60	N/A	0.39	N/A	0.0001	0.0000	19.71
3/27/02 21:30	Injection	11616	8.08	15.00	1045.00	N/A	7.08	N/A	0.36	N/A	0.0002	0.0000	19.81
3/27/02 23:25	Injection	13640	9.02	10.00	343.00	N/A	0.01	N/A	0.55	N/A	0.0002	0.0000	20.26
3/28/02 3:50	Injection	18304	8.90	13.00	325.00	N/A	1.95	N/A	0.48	N/A	0.0000	0.0000	20.06
3/28/02 5:40	Injection	20240	9.03	13.00	307.00	N/A	0.01	N/A	0.54	N/A	0.0002	0.0000	20.26
3/28/02 7:40	Injection	22352	8.64	16.00	342.00	N/A	4.35	N/A	0.42	N/A	0.0108	0.0000	19.88
3/28/02 9:40	Injection	24464	8.98	18.00	303.00	N/A	0.59	N/A	0.61	N/A	0.0004	0.0000	19.79
3/28/02 15:30	Injection	30624	8.30	19.00	937.00	N/A	7.19	N/A	0.40	N/A	0.0004	0.0000	20.03
3/28/02 17:30	Injection	32736	8.00	17.00	390.00	N/A	6.94	N/A	0.38	N/A	0.0000	0.0000	20.08
3/28/02 19:30	Injection	34848	8.70	15.00	316.00	N/A	4.37	N/A	0.42	N/A	0.0000	0.0000	19.74
3/28/02 23:30	Injection	39072	8.76	15.00	-239.00	N/A	3.07	N/A	0.41	N/A	0.0002	0.0000	19.66
3/29/02 1:30	Injection	41184	8.62	15.00	305.00	N/A	5.57	N/A	0.40	N/A	0.0002	0.0000	19.59
3/29/02 3:40	Injection	43472	8.72	15.00	-104.00	N/A	1.54	N/A	0.45	N/A	0.0002	0.0000	19.67

Table A-3. ISRM Data from March 27, 2002 Injection (D4-65 Data). (2 pages)

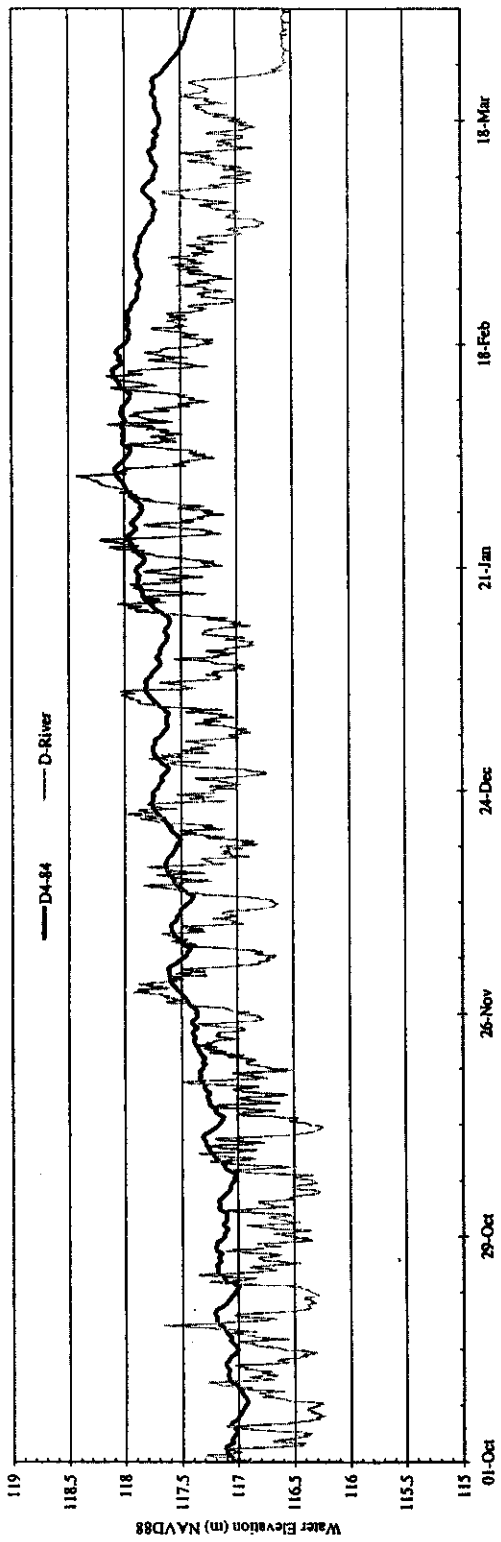
Date Time	Stage	Volume Processed (gal)	Field Parameters										
			pH (unitless)	Sample Temp. (°C)	Eh (mV)	DO[1] (mg/L)	DO[2] (mg/L)	DO[3] (mg/L)	Conductivity (mS/cm)	Hexavalent Chromium (mg/L)	Dithionite[4] Concentration (moles/L)	Dithionite[5] Concentration (moles/L)	Well Level[6] (ft)
3/29/02 5:35	Injection	45496	8.73	15.00	15.00	N/A	2.90	N/A	0.45	N/A	0.0003	0.0000	19.70
3/29/02 9:35	Injection	49720	8.89	18.00	290.00	N/A	3.00	N/A	0.50	N/A	0.0002	0.0000	19.60
3/29/02 12:20	Injection	52624	8.49	19.00	139.00	N/A	4.56	N/A	0.60	N/A	0.0000	0.0000	19.22
3/29/02 13:50	Injection	54208	8.06	20.00	33.00	N/A	4.17	N/A	0.67	N/A	0.0000	0.0000	19.61
3/29/02 15:25	Injection	55880	7.45	18.00	40.00	N/A	4.54	N/A	0.65	N/A	0.0000	0.0000	19.52
3/29/02 19:30	Injection	60192	7.38	18.00	-93.00	N/A	1.68	N/A	0.88	N/A	0.0002	0.0000	20.02
3/29/02 21:25	Injection	62216	7.15	15.00	-252.00	N/A	1.18	N/A	1.03	N/A	0.0000	0.0000	19.74
3/29/02 23:25	Injection	64328	6.99	16.00	-45.00	N/A	2.63	N/A	1.06	N/A	0.0000	0.0000	19.70
3/30/02 1:45	Injection	66792	7.07	15.00	-379.00	N/A	0.01	N/A	1.17	N/A	N/A	N/A	19.51

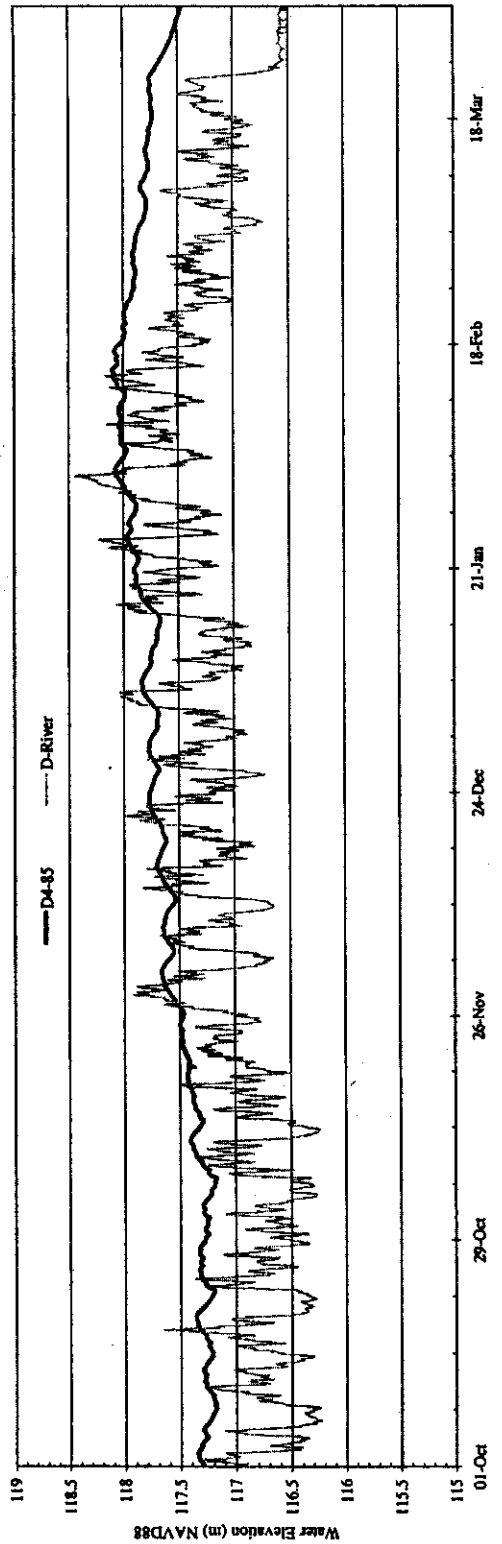
Note:
[1] Cole Palmer DO meter used.
[2] Honeywell DO meter used.
[3] Orion DO meter used.
[4] Raw Data from computer
[5] The conversion factor listed in the computer is set for a different UV detector. Therefore, a conversion factor is used to produce actual dithionite concentration.
[6] Reported as feet above transducer. Transducer set 106.5 ft below top of protective casing (approximately 103.5 ft bgs).
N/A = Not applicable

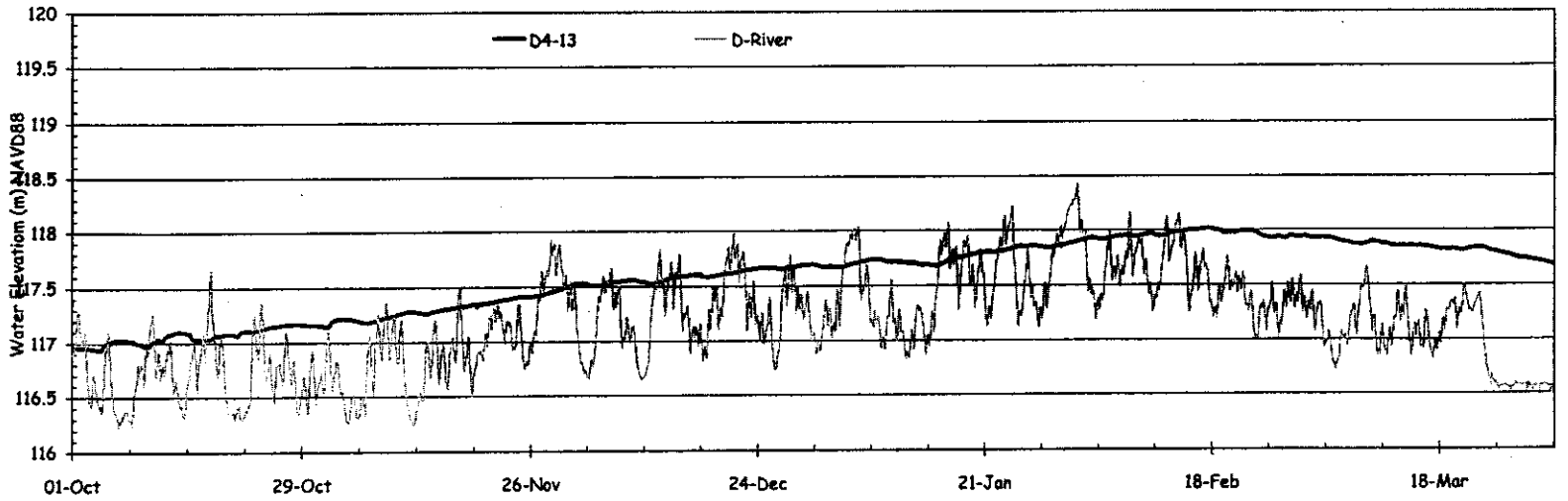
APPENDIX B

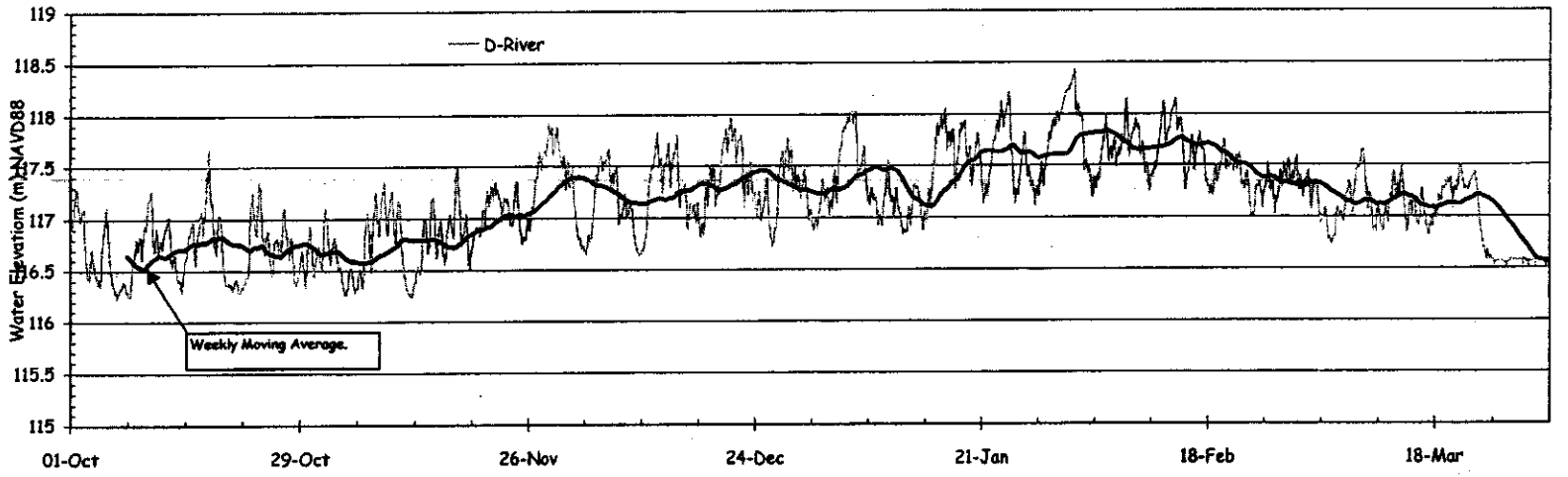
HYDROGRAPHS

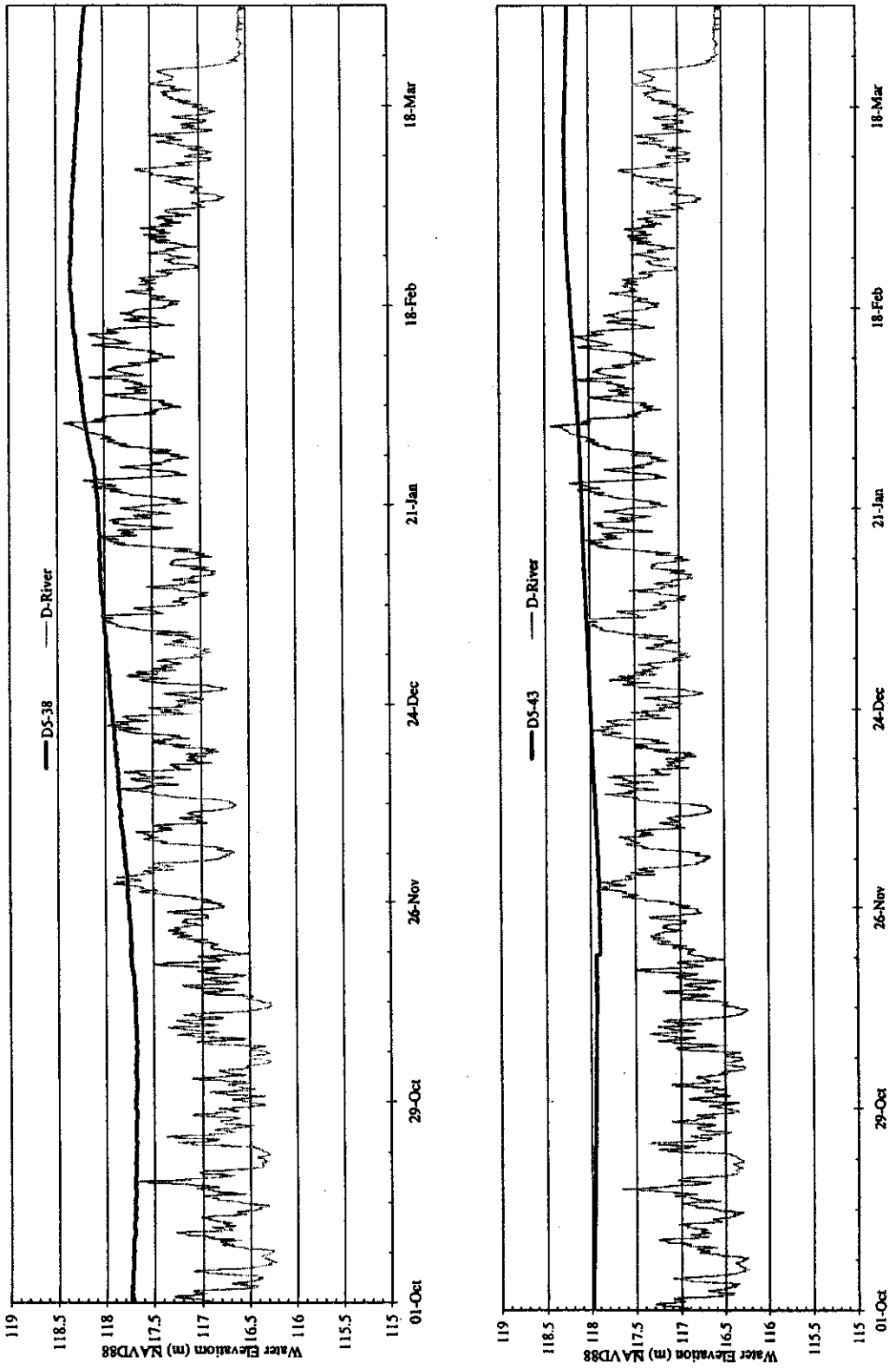
ISRM FIRST QUARTER FY 2002

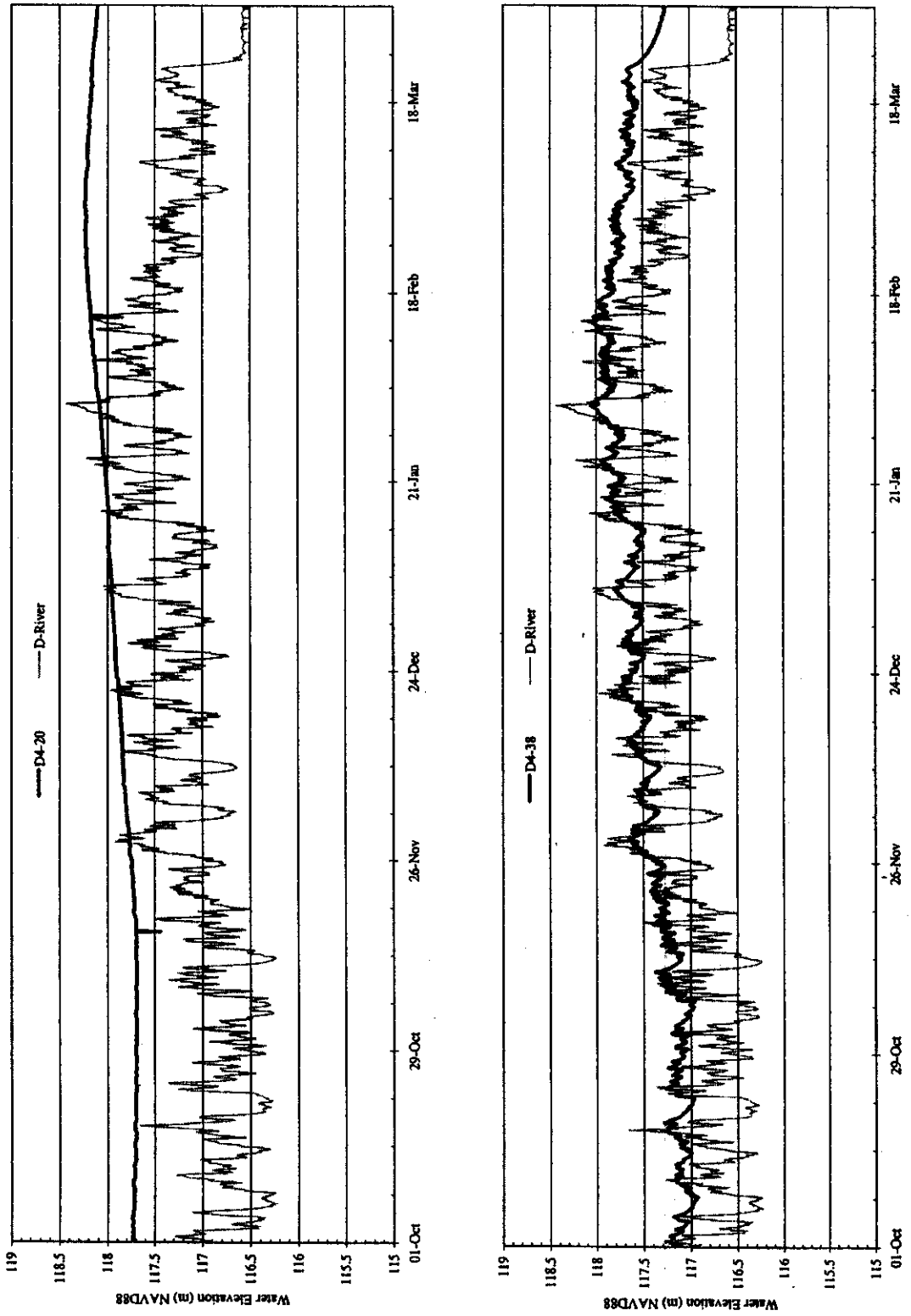

D4-84
D-River
Water Elevation (m) NAVD88
119
118.5
118
117.5
117
116.5
116
115.5
115
01-Oct
29-Oct
26-Nov
24-Dec
21-Jan
18-Feb
18-Mar


D4-85
D-River
Water Elevation (m) NAVD88
119
118.5
118
117.5
117
116.5
116
115.5
115
01-Oct
29-Oct
26-Nov
24-Dec
21-Jan
18-Feb
18-Mar


D4-13
D-River
Water Elevation (m) NAVD88
120
119.5
119
118.5
118
117.5
117
116.5
116
01-Oct
29-Oct
26-Nov
24-Dec
21-Jan
18-Feb
18-Mar


D-River
Water Elevation (m) NAVD88
119
118.5
118
117.5
117
116.5
116
115.5
115
Weekly Moving Average.
01-Oct
29-Oct
26-Nov
24-Dec
21-Jan
18-Feb
18-Mar


D5-38
D-River
Water Elevation (m) NAVD88
119
118.5
118
117.5
117
116.5
116
115.5
115
01-Oct
29-Oct
26-Nov
24-Dec
21-Jan
18-Feb
18-Mar
D5-43
D-River
Water Elevation (m) NAVD88
119
118.5
118
117.5
117
116.5
116
115.5
115
01-Oct
29-Oct
26-Nov
24-Dec
21-Jan
18-Feb
18-Mar


D4-20
D-River
D4-38
D-River
Water Elevation (m) NAVD88
119
118.5
118
117.5
117
116.5
116
115.5
115
01-Oct
29-Oct
26-Nov
24-Dec
21-Jan
18-Feb
18-Mar

APPENDIX C

SECOND QUARTER FISCAL YEAR 2002

TABULATED SAMPLE RESULTS

Table C-1. Second Quarter FY 2002 Tabulated Sample Results. (8 Pages)

Well Name	Sample Date	Constituent	Reported Value	Units	Lab Qualifier	Sample Number	Analytical Method	Filtered Flag
199-D2-6	30-Jan-02	Dissolved Oxygen	7.86	mg/L		B13XK5	360.1_OXYGEN_FLD	N
199-D2-6	30-Jan-02	Hexavalent Chromium	0.005	mg/L	U	B13XK4	COLOR_TK_FLD	Y
199-D2-6	30-Jan-02	pH Measurement	7.73	pH		B13XK5	PH_ELECT_FLD	N
199-D2-6	30-Jan-02	Specific Conductance	737	µS/cm		B13XK5	CONDUCT_FLD	N
199-D2-6	30-Jan-02	Sulfate	140	mg/L		B13XK5	COLOR_TK_FLD	N
199-D2-6	30-Jan-02	Temperature	16.2	Deg C		B13XK5	TEMP_FLD	N
199-D2-6	30-Jan-02	Turbidity	4.32	NTU		B13XK5	TURBIDITY_FLD	N
199-D3-2	30-Jan-02	Alkalinity	102	mg/L		B13CT8	310.1_ALKALINITY	N
199-D3-2	30-Jan-02	Aluminum	27.2	µg/L		B13Y38	6010_METALS_ICP	Y
199-D3-2	30-Jan-02	Antimony	1.9	µg/L	U	B13Y38	6010_METALS_ICP	Y
199-D3-2	30-Jan-02	Barium	40.6	µg/L		B13Y38	6010_METALS_ICP	Y
199-D3-2	30-Jan-02	Beryllium	0.23	µg/L		B13Y38	6010_METALS_ICP	Y
199-D3-2	30-Jan-02	Bromide	0.25	mg/L	U	B13Y37	300.0_ANIONS_IC	N
199-D3-2	30-Jan-02	Cadmium	0.3	µg/L	U	B13Y38	6010_METALS_ICP	Y
199-D3-2	30-Jan-02	Calcium	50300	µg/L		B13Y38	6010_METALS_ICP	Y
199-D3-2	30-Jan-02	Chloride	11.6	mg/L		B13Y37	300.0_ANIONS_IC	N
199-D3-2	30-Jan-02	Chromium	17.4	µg/L		B13Y38	6010_METALS_ICP	Y
199-D3-2	30-Jan-02	Cobalt	0.6	µg/L	U	B13Y38	6010_METALS_ICP	Y
199-D3-2	30-Jan-02	Copper	0.7	µg/L	U	B13Y38	6010_METALS_ICP	Y
199-D3-2	30-Jan-02	Dissolved Oxygen	5.11	mg/L		B13CT8	360.1_OXYGEN_FLD	N
199-D3-2	30-Jan-02	Fluoride	0.25	mg/L	U	B13Y37	300.0_ANIONS_IC	N
199-D3-2	30-Jan-02	Gross alpha	0.531	pCi/L	U	B13Y37	900.0_ALPHABETA_GPC	N
199-D3-2	30-Jan-02	Gross beta	3.88	pCi/L	J	B13Y37	900.0_ALPHABETA_GPC	N
199-D3-2	30-Jan-02	Iron	37.5	µg/L		B13Y38	6010_METALS_ICP	Y
199-D3-2	30-Jan-02	Magnesium	11500	µg/L		B13Y38	6010_METALS_ICP	Y
199-D3-2	30-Jan-02	Manganese	0.81	µg/L		B13Y38	6010_METALS_ICP	Y
199-D3-2	30-Jan-02	Nickel	1.2	µg/L	U	B13Y38	6010_METALS_ICP	Y
199-D3-2	30-Jan-02	Nitrate	21.4	mg/L		B13Y37	300.0_ANIONS_IC	N
199-D3-2	30-Jan-02	Nitrite	1.25	mg/L	U	B13Y37	300.0_ANIONS_IC	N
199-D3-2	30-Jan-02	Oxidation Reduction Potential	118.3	mV		B13CT8	REDOX_PROBE_FLD	N
199-D3-2	30-Jan-02	pH Measurement	7.9	pH		B13CT8	9040_PH	N
199-D3-2	30-Jan-02	Phosphate	0.25	mg/L	U	B13Y37	300.0_ANIONS_IC	N
199-D3-2	30-Jan-02	Potassium	3810	µg/L		B13Y38	6010_METALS_ICP	Y
199-D3-2	30-Jan-02	Silver	0.7	µg/L	U	B13Y38	6010_METALS_ICP	Y
199-D3-2	30-Jan-02	Sodium	12200	µg/L		B13Y38	6010_METALS_ICP	Y

Table C-1. Second Quarter FY 2002 Tabulated Sample Results. (8 Pages)

Well Name	Sample Date	Constituent	Reported Value	Units	Lab Qualifier	Sample Number	Analytical Method	Filtered Flag
199-D3-2	30-Jan-02	Specific Conductance	420	µS/cm		B13CT8	9050_CONDUCT	N
199-D3-2	30-Jan-02	Strontium	271	µg/L		B13Y38	6010_METALS_ICP	Y
199-D3-2	30-Jan-02	Sulfate	62.8	mg/L		B13Y37	300.0_ANIONS_IC	N
199-D3-2	30-Jan-02	Temperature	16.4	Deg C		B13CT8	TEMP_FLD	N
199-D3-2	30-Jan-02	Tritium	7720	pCi/L		B13Y37	906.0_H3_LSC	N
199-D3-2	30-Jan-02	Turbidity	6.89	NTU		B13CT8	214A_TURBIDITY	N
199-D3-2	30-Jan-02	Uranium	2.12	µg/L		B13Y37	UTOT_KPA	N
199-D3-2	30-Jan-02	Vanadium	8.5	µg/L		B13Y38	6010_METALS_ICP	Y
199-D3-2	30-Jan-02	Zinc	666	µg/L		B13Y38	6010_METALS_ICP	Y
199-D4-1	30-Jan-02	Hexavalent Chromium	0.282	mg/L		B13XK6	COLOR_TK_FLD	Y
199-D4-1	30-Jan-02	Sulfate	156	mg/L		B13XK7	COLOR_TK_FLD	N
199-D4-1	30-Jan-02	Specific Conductance	749	µS/cm		B13XK7	CONDUCT_FLD	N
199-D4-1	30-Jan-02	Dissolved Oxygen	0.79	mg/L		B13XK7	360.1_OXYGEN_FLD	N
199-D4-1	30-Jan-02	pH Measurement	8.34	pH		B13XK7	PH_ELECT_FLD	N
199-D4-1	30-Jan-02	Temperature	15.7	Deg C		B13XK7	TEMP_FLD	N
199-D4-1	30-Jan-02	Turbidity	4.77	NTU		B13XK7	TURBIDITY_FLD	N
199-D4-13	19-Feb-02	Hexavalent Chromium	0.005	mg/L		B13XC9	COLOR_TK_FLD	Y
199-D4-13	19-Feb-02	pH Measurement	8.63	pH		B13XD0	PH_ELECT_FLD	N
199-D4-13	19-Feb-02	Specific Conductance	2553	µS/cm		B13XD0	CONDUCT_FLD	N
199-D4-13	19-Feb-02	Sulfate	700	mg/L	JEX	B13XD0	COLOR_TK_FLD	N
199-D4-13	19-Feb-02	Temperature	17.1	Deg C		B13XD0	TEMP_FLD	N
199-D4-13	19-Feb-02	Turbidity	1.03	NTU		B13XD0	TURBIDITY_FLD	N
199-D4-14	30-Jan-02	Hexavalent Chromium	0.005	mg/L	U	B13XD1	COLOR_TK_FLD	Y
199-D4-14	30-Jan-02	pH Measurement	9.76	pH		B13XD2	PH_ELECT_FLD	N
199-D4-14	30-Jan-02	Specific Conductance	1140	µS/cm		B13XD2	CONDUCT_FLD	N
199-D4-14	30-Jan-02	Sulfate	168	mg/L		B13XD2	COLOR_TK_FLD	N
199-D4-14	30-Jan-02	Temperature	16.1	Deg C		B13XD2	TEMP_FLD	N
199-D4-14	30-Jan-02	Turbidity	2.32	NTU		B13XD2	TURBIDITY_FLD	N
199-D4-15	14-Feb-02	Dissolved Oxygen	8.5	mg/L		B13XK9	360.1_OXYGEN_FLD	N
199-D4-15	14-Feb-02	Hexavalent Chromium	1.73	mg/L		B13XK8	COLOR_TK_FLD	Y
199-D4-15	27-Mar-02	Hexavalent Chromium	1.63	mg/L		B146T5	COLOR_TK_FLD	Y
199-D4-15	14-Feb-02	pH Measurement	7.83	pH		B13XK9	PH_ELECT_FLD	N
199-D4-15	14-Feb-02	Specific Conductance	658	µS/cm		B13XK9	CONDUCT_FLD	N
199-D4-15	14-Feb-02	Sulfate	132	mg/L		B13XK9	COLOR_TK_FLD	N
199-D4-15	27-Mar-02	Sulfate	124	mg/L		B146T6	COLOR_TK_FLD	N
199-D4-15	14-Feb-02	Temperature	16.4	Deg C		B13XK9	TEMP_FLD	N
199-D4-15	14-Feb-02	Turbidity	0.71	NTU		B13XK9	TURBIDITY_FLD	N
199-D4-19	20-Feb-02	Hexavalent Chromium	0.431	mg/L		B13XD3	COLOR_TK_FLD	Y

Table C-1. Second Quarter FY 2002 Tabulated Sample Results. (8 Pages)

Well Name	Sample Date	Constituent	Reported Value	Units	Lab Qualifier	Sample Number	Analytical Method	Filtered Flag
199-D4-19	20-Feb-02	pH Measurement	7.98	pH		B13XD4	PH_ELECT_FLD	N
199-D4-19	20-Feb-02	Specific Conductance	546	µS/cm		B13XD4	CONDUCT_FLD	N
199-D4-19	20-Feb-02	Sulfate	92	mg/L		B13XD4	COLOR_TK_FLD	N
199-D4-19	20-Feb-02	Temperature	16.5	Deg C		B13XD4	TEMP_FLD	N
199-D4-19	20-Feb-02	Turbidity	0.34	NTU		B13XD4	TURBIDITY_FLD	N
199-D4-20	14-Feb-02	Dissolved Oxygen	7.7	mg/L		B13XL1	360.1_OXYGEN_FLD	N
199-D4-20	14-Feb-02	Hexavalent Chromium	0.149	mg/L		B13XL0	COLOR_TK_FLD	Y
199-D4-20	14-Feb-02	Hexavalent Chromium	0.147	mg/L		B13XL2	COLOR_TK_FLD	Y
199-D4-20	14-Feb-02	pH Measurement	7.97	pH		B13XL1	PH_ELECT_FLD	N
199-D4-20	14-Feb-02	Specific Conductance	663	µS/cm		B13XL1	CONDUCT_FLD	N
199-D4-20	14-Feb-02	Sulfate	138	mg/L		B14XH8	COLOR_TK_FLD	N
199-D4-20	14-Feb-02	Sulfate	136	mg/L		B13XL3	COLOR_TK_FLD	N
199-D4-20	14-Feb-02	Temperature	16.9	Deg C		B13XL1	TEMP_FLD	N
199-D4-20	14-Feb-02	Turbidity	0.44	NTU		B13XL1	TURBIDITY_FLD	N
199-D4-22	22-Feb-02	Dissolved Oxygen	6.49	mg/L		B140C2	360.1_OXYGEN_FLD	N
199-D4-22	22-Feb-02	Hexavalent Chromium	1.57	mg/L		B13XL4	COLOR_TK_FLD	Y
199-D4-22	22-Feb-02	Oxidation Reduction Potential	100	mV		B140C2	REDOX_PROBE_FLD	N
199-D4-22	22-Feb-02	pH Measurement	7.76	pH		B140C2	9040_PH	N
199-D4-22	22-Feb-02	Specific Conductance	687	µS/cm		B140C2	9050_CONDUCT	N
199-D4-22	22-Feb-02	Sulfate	144	mg/L		B13XL5	COLOR_TK_FLD	N
199-D4-22	22-Feb-02	Temperature	17.6	Deg C		B140C2	TEMP_FLD	N
199-D4-22	22-Feb-02	Turbidity	4.35	NTU		B140C2	214A_TURBIDITY	N
199-D4-23	22-Feb-02	Dissolved Oxygen	2.1	mg/L		B140C3	360.1_OXYGEN_FLD	N
199-D4-23	22-Feb-02	Hexavalent Chromium	0.150	mg/L		B13XD7	COLOR_TK_FLD	Y
199-D4-23	22-Feb-02	Oxidation Reduction Potential	108	mV		B140C3	REDOX_PROBE_FLD	N
199-D4-23	22-Feb-02	pH Measurement	7.65	pH		B140C3	9040_PH	N
199-D4-23	22-Feb-02	Specific Conductance	819	µS/cm		B140C3	9050_CONDUCT	N
199-D4-23	22-Feb-02	Sulfate	256	mg/L		B13XD8	COLOR_TK_FLD	N
199-D4-23	22-Feb-02	Sulfate	256	mg/L		B13XD9	COLOR_TK_FLD	N
199-D4-23	22-Feb-02	Temperature	17.2	Deg C		B140C3	TEMP_FLD	N
199-D4-23	22-Feb-02	Turbidity	3.88	NTU		B140C3	214A_TURBIDITY	N
199-D4-26	25-Feb-02	Aluminum	25.2	µg/L	U	B141D7	6010_METALS_ICP	Y
199-D4-26	25-Feb-02	Antimony	24.8	µg/L	U	B141D7	6010_METALS_ICP	Y
199-D4-26	25-Feb-02	Barium	106	µg/L		B141D7	6010_METALS_ICP	Y
199-D4-26	25-Feb-02	Beryllium	0.5	µg/L	U	B141D7	6010_METALS_ICP	Y
199-D4-26	25-Feb-02	Bromide	1.2	mg/L	U	B141D8	300.0_ANIONS_IC	N

Table C-1. Second Quarter FY 2002 Tabulated Sample Results. (8 Pages)

Well Name	Sample Date	Constituent	Reported Value	Units	Lab Qualifier	Sample Number	Analytical Method	Filtered Flag
199-D4-26	25-Feb-02	Cadmium	6.8	µg/L	U	B141D7	6010_METALS_ICP	Y
199-D4-26	25-Feb-02	Calcium	35100	µg/L		B141D7	6010_METALS_ICP	Y
199-D4-26	25-Feb-02	Chloride	28.8	mg/L		B141D8	300.0_ANIONS_IC	N
199-D4-26	25-Feb-02	Chromium	45	µg/L		B141D7	6010_METALS_ICP	Y
199-D4-26	25-Feb-02	Cobalt	12.5	µg/L		B141D7	6010_METALS_ICP	Y
199-D4-26	25-Feb-02	Copper	11.4	µg/L		B141D7	6010_METALS_ICP	Y
199-D4-26	26-Feb-02	Dissolved Oxygen	0.11	mg/L		B13XL7	360.1_OXYGEN_FLD	N
199-D4-26	25-Feb-02	Fluoride	1.2	mg/L	U	B141D8	300.0_ANIONS_IC	N
199-D4-26	26-Feb-02	Hexavalent Chromium	0.017	mg/L		B13XL6	COLOR_TK_FLD	Y
199-D4-26	25-Feb-02	Iron	62.9	µg/L		B141D7	6010_METALS_ICP	Y
199-D4-26	25-Feb-02	Magnesium	17200	µg/L		B141D7	6010_METALS_ICP	Y
199-D4-26	25-Feb-02	Manganese	40.5	µg/L		B141D7	6010_METALS_ICP	Y
199-D4-26	25-Feb-02	Nickel	45.7	µg/L		B141D7	6010_METALS_ICP	Y
199-D4-26	25-Feb-02	Nitrate	11.5	mg/L		B141D8	300.0_ANIONS_IC	N
199-D4-26	25-Feb-02	Nitrite	2.26	mg/L		B141D8	300.0_ANIONS_IC	N
199-D4-26	26-Feb-02	pH Measurement	8.7	pH		B13XL7	PH_ELECT_FLD	N
199-D4-26	25-Feb-02	Phosphate	1.2	mg/L	U	B141D8	300.0_ANIONS_IC	N
199-D4-26	25-Feb-02	Potassium	382000	µg/L		B141D7	6010_METALS_ICP	Y
199-D4-26	25-Feb-02	Silver	2.8	µg/L	U	B141D7	6010_METALS_ICP	Y
199-D4-26	25-Feb-02	Sodium	91600	µg/L		B141D7	6010_METALS_ICP	Y
199-D4-26	26-Feb-02	Specific Conductance	2059	µS/cm		B13XL7	CONDUCT_FLD	N
199-D4-26	25-Feb-02	Strontium	380	µg/L		B141D7	6010_METALS_ICP	Y
199-D4-26	26-Feb-02	Sulfate	690	mg/L		B13XL7	COLOR_TK_FLD	N
199-D4-26	25-Feb-02	Sulfate	630	mg/L		B141D8	300.0_ANIONS_IC	N
199-D4-26	26-Feb-02	Temperature	17	Deg C		B13XL7	TEMP_FLD	N
199-D4-26	26-Feb-02	Turbidity	1.21	NTU		B13XL7	TURBIDITY_FLD	N
199-D4-26	25-Feb-02	Vanadium	5.5	µg/L		B141D7	6010_METALS_ICP	Y
199-D4-26	25-Feb-02	Zinc	3.3	µg/L	U	B141D7	6010_METALS_ICP	Y
199-D4-32	19-Feb-02	Dissolved Oxygen	0.22	mg/L		B13XM1	360.1_OXYGEN_FLD	N
199-D4-32	19-Feb-02	Hexavalent Chromium	0.006	mg/L		B13XM0	COLOR_TK_FLD	Y
199-D4-32	19-Feb-02	pH Measurement	8.29	pH		B13XM1	PH_ELECT_FLD	N
199-D4-32	19-Feb-02	Specific Conductance	975	µS/cm		B13XM1	CONDUCT_FLD	N
199-D4-32	19-Feb-02	Sulfate	276	mg/L		B13XM1	COLOR_TK_FLD	N
199-D4-32	19-Feb-02	Temperature	17.7	Deg C		B13XM1	TEMP_FLD	N
199-D4-32	19-Feb-02	Turbidity	1.86	NTU		B13XM1	TURBIDITY_FLD	N
199-D4-36	19-Feb-02	Dissolved Oxygen	0.15	mg/L		B13XM3	360.1_OXYGEN_FLD	N
199-D4-36	19-Feb-02	Hexavalent Chromium	0.008	mg/L		B13XM4	COLOR_TK_FLD	Y
199-D4-36	19-Feb-02	Hexavalent Chromium	0.007	mg/L		B13XM4	COLOR_TK_FLD	Y

Table C-1. Second Quarter FY 2002 Tabulated Sample Results. (8 Pages)

Well Name	Sample Date	Constituent	Reported Value	Units	Lab Qualifier	Sample Number	Analytical Method	Filtered Flag
199-D4-36	19-Feb-02	pH Measurement	8.41	pH		B13XM3	PH_ELECT_FLD	N
199-D4-36	19-Feb-02	Specific Conductance	1058	µS/cm		B13XM3	CONDUCT_FLD	N
199-D4-36	19-Feb-02	Sulfate	330	mg/L		B13XM3	COLOR_TK_FLD	N
199-D4-36	19-Feb-02	Temperature	17.7	Deg C		B13XM3	TEMP_FLD	N
199-D4-36	19-Feb-02	Turbidity	0.44	NTU		B13XM3	TURBIDITY_FLD	N
199-D4-38	14-Feb-02	Dissolved Oxygen	3.14	mg/L		B13XM7	360.1_OXYGEN_FLD	N
199-D4-38	14-Feb-02	Hexavalent Chromium	0.21	mg/L		B13XM6	COLOR_TK_FLD	Y
199-D4-38	14-Feb-02	pH Measurement	7.89	pH		B13XM7	PH_ELECT_FLD	N
199-D4-38	14-Feb-02	Specific Conductance	581	µS/cm		B13XM7	CONDUCT_FLD	N
199-D4-38	14-Feb-02	Sulfate	148	mg/L		B13XM7	COLOR_TK_FLD	N
199-D4-38	14-Feb-02	Temperature	16.4	Deg C		B13XM7	TEMP_FLD	N
199-D4-38	14-Feb-02	Turbidity	1.74	NTU		B13XM7	TURBIDITY_FLD	N
199-D4-39	30-Jan-02	Dissolved Oxygen	1.05	mg/L		B13XM9	360.1_OXYGEN_FLD	N
199-D4-39	30-Jan-02	Hexavalent Chromium	1.17	mg/L		B13XM8	COLOR_TK_FLD	Y
199-D4-39	30-Jan-02	pH Measurement	7.99	pH		B13XM9	PH_ELECT_FLD	N
199-D4-39	30-Jan-02	Specific Conductance	686	µS/cm		B13XM9	CONDUCT_FLD	N
199-D4-39	30-Jan-02	Sulfate	152	mg/L		B13XM9	COLOR_TK_FLD	N
199-D4-39	30-Jan-02	Temperature	16.1	Deg C		B13XM9	TEMP_FLD	N
199-D4-39	30-Jan-02	Turbidity	4.34	NTU		B13XM9	TURBIDITY_FLD	N
199-D4-4	25-Feb-02	Dissolved Oxygen	0.33	mg/L		B140C4	360.1_OXYGEN_FLD	N
199-D4-4	25-Feb-02	Hexavalent Chromium	0.023	mg/L		B140C4	CR6_HACH_M	N
199-D4-4	25-Feb-02	Oxidation Reduction Potential	70.2	mV		B140C4	REDOX_PROBE_FLD	N
199-D4-4	25-Feb-02	pH Measurement	7.68	pH		B140C4	9040_PH	N
199-D4-4	25-Feb-02	Specific Conductance	944	µS/cm		B140C4	9050_CONDUCT	N
199-D4-4	25-Feb-02	Temperature	17.1	Deg C		B140C4	TEMP_FLD	N
199-D4-4	25-Feb-02	Turbidity	1.41	NTU		B140C4	214A_TURBIDITY	N
199-D4-48	19-Feb-02	Dissolved Oxygen	0.05	mg/L		B13XN3	360.1_OXYGEN_FLD	N
199-D4-48	19-Feb-02	Hexavalent Chromium	0.005	mg/L	U	B13XN2	COLOR_TK_FLD	Y
199-D4-48	19-Feb-02	pH Measurement	9.13	pH		B13XN3	PH_ELECT_FLD	N
199-D4-48	19-Feb-02	Specific Conductance	1033	µS/cm		B13XN3	CONDUCT_FLD	N
199-D4-48	19-Feb-02	Sulfate	250	mg/L		B13XN3	COLOR_TK_FLD	N
199-D4-48	19-Feb-02	Temperature	15.9	Deg C		B13XN3	TEMP_FLD	N
199-D4-48	19-Feb-02	Turbidity	1.65	NTU		B13XN3	TURBIDITY_FLD	N
199-D4-5	25-Feb-02	Dissolved Oxygen	1.08	mg/L		B140C5	360.1_OXYGEN_FLD	N
199-D4-5	25-Feb-02	Hexavalent Chromium	0.397	mg/L		B140C5	CR6_HACH_M	N
199-D4-5	25-Feb-02	Oxidation Reduction Potential	65.7	mV		B140C5	REDOX_PROBE_FLD	N
199-D4-5	25-Feb-02	pH Measurement	7.86	pH		B140C5	9040_PH	N

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Well Name	Sample Date	Constituent	Reported Value	Units	Lab Qualifier	Sample Number	Analytical Method	Filtered Flag
199-D4-5	25-Feb-02	Specific Conductance	736	µS/cm		B140C5	9050_CONDUCT	N
199-D4-5	25-Feb-02	Temperature	16.9	Deg C		B140C5	TEMP_FLD	N
199-D4-5	25-Feb-02	Turbidity	0.99	NTU		B140C5	214A_TURBIDITY	N
199-D4-6	21-Feb-02	Dissolved Oxygen	134	mg/L		B140C6	360.1_OXYGEN_FLD	N
199-D4-6	21-Feb-02	Hexavalent Chromium	0.025	mg/L		B140C6	CR6_HACH_M	N
199-D4-6	21-Feb-02	pH Measurement	7.88	pH		B140C6	9040_PH	N
199-D4-6	21-Feb-02	Specific Conductance	775	µS/cm		B140C6	9050_CONDUCT	N
199-D4-6	21-Feb-02	Temperature	16.1	Deg C		B140C6	TEMP_FLD	N
199-D4-6	21-Feb-02	Turbidity	0.74	NTU		B140C6	214A_TURBIDITY	N
199-D4-62	20-Feb-02	Dissolved Oxygen	0.11	mg/L		B13XP1	360.1_OXYGEN_FLD	N
199-D4-62	20-Feb-02	Hexavalent Chromium	0.006	mg/L		B13XP0	COLOR_TK_FLD	Y
199-D4-62	20-Feb-02	pH Measurement	8.33	pH		B13XP1	PH_ELECT_FLD	N
199-D4-62	20-Feb-02	Specific Conductance	2293	µS/cm		B13XP1	CONDUCT_FLD	N
199-D4-62	20-Feb-02	Sulfate	650	mg/L		B13XP1	COLOR_TK_FLD	N
199-D4-62	20-Feb-02	Temperature	17.6	Deg C		B13XP1	TEMP_FLD	N
199-D4-62	20-Feb-02	Turbidity	4.34	NTU		B13XP1	TURBIDITY_FLD	N
199-D4-68	4-Feb-02	Hexavalent Chromium	0.344	mg/L		B141J6	COLOR_TK_FLD	N
199-D4-7	21-Feb-02	Dissolved Oxygen	0.25	mg/L		B140C7	360.1_OXYGEN_FLD	N
199-D4-7	21-Feb-02	Hexavalent Chromium	0.037	mg/L		B140C7	CR6_HACH_M	N
199-D4-7	21-Feb-02	Oxidation Reduction Potential	104	mV		B140C7	REDOX_PROBE_FLD	N
199-D4-7	21-Feb-02	pH Measurement	8.41	pH		B140C7	9040_PH	N
199-D4-7	21-Feb-02	Specific Conductance	766	µS/cm		B140C7	9050_CONDUCT	N
199-D4-7	21-Feb-02	Temperature	17.1	Deg C		B140C7	TEMP_FLD	N
199-D4-7	21-Feb-02	Turbidity	0.31	NTU		B140C7	214A_TURBIDITY	N
199-D4-83	20-Feb-02	Dissolved Oxygen	7.79	mg/L		B13XP7	360.1_OXYGEN_FLD	N
199-D4-83	20-Feb-02	Hexavalent Chromium	0.025	mg/L		B13XP6	COLOR_TK_FLD	Y
199-D4-83	20-Feb-02	pH Measurement	8.02	pH		B13XP7	PH_ELECT_FLD	N
199-D4-83	20-Feb-02	Specific Conductance	242	µS/cm		B13XP7	CONDUCT_FLD	N
199-D4-83	20-Feb-02	Sulfate	18	mg/L		B13XP7	COLOR_TK_FLD	N
199-D4-83	20-Feb-02	Temperature	14.9	Deg C		B13XP7	TEMP_FLD	N
199-D4-83	20-Feb-02	Turbidity	4.42	NTU		B13XP7	TURBIDITY_FLD	N
199-D4-84	20-Feb-02	Dissolved Oxygen	7.85	mg/L		B13XP9	360.1_OXYGEN_FLD	N
199-D4-84	20-Feb-02	Hexavalent Chromium	0.558	mg/L		B13XP8	COLOR_TK_FLD	Y
199-D4-84	20-Feb-02	pH Measurement	7.87	pH		B13XP9	PH_ELECT_FLD	N
199-D4-84	20-Feb-02	Specific Conductance	528	µS/cm		B13XP9	CONDUCT_FLD	N
199-D4-84	20-Feb-02	Sulfate	94	mg/L		B13XP9	COLOR_TK_FLD	N
199-D4-84	20-Feb-02	Temperature	16.4	Deg C		B13XP9	TEMP_FLD	N
199-D4-84	20-Feb-02	Turbidity	1.38	NTU		B13XP9	TURBIDITY_FLD	N

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Well Name	Sample Date	Constituent	Reported Value	Units	Lab Qualifier	Sample Number	Analytical Method	Filtered Flag
199-D4-85	20-Feb-02	Dissolved Oxygen	9.11	mg/L		B13XR1	360.1_OXYGEN_FLD	N
199-D4-85	20-Feb-02	Hexavalent Chromium	0.345	mg/L		B13XR0	COLOR_TK_FLD	Y
199-D4-85	20-Feb-02	Hexavalent Chromium	0.337	mg/L		B13XR2	7196_CR6	Y
199-D4-85	20-Feb-02	pH Measurement	7.94	pH		B13XR1	PH_ELECT_FLD	N
199-D4-85	20-Feb-02	Specific Conductance	547	µS/cm		B13XR1	CONDUCT_FLD	N
199-D4-85	20-Feb-02	Sulfate	86	mg/L		B13XR1	COLOR_TK_FLD	N
199-D4-85	20-Feb-02	Temperature	16.6	Deg C		B13XR1	TEMP_FLD	N
199-D4-85	20-Feb-02	Turbidity	1.64	NTU		B13XR1	TURBIDITY_FLD	N
199-D4-86	20-Feb-02	Dissolved Oxygen	6.73	mg/L		B141D9	360.1_OXYGEN_FLD	N
199-D4-86	20-Feb-02	Hexavalent Chromium	0.024	mg/L		B13XR4	COLOR_TK_FLD	Y
199-D4-86	20-Feb-02	pH Measurement	8	pH		B141D9	PH_ELECT_FLD	N
199-D4-86	20-Feb-02	Specific Conductance	422	µS/cm		B141D9	CONDUCT_FLD	N
199-D4-86	20-Feb-02	Temperature	15.6	Deg C		B141D9	TEMP_FLD	N
199-D4-86	20-Feb-02	Turbidity	0.96	NTU		B141D9	TURBIDITY_FLD	N
199-D5-36	19-Feb-02	Dissolved Oxygen	8.67	mg/L		B13XR6	360.1_OXYGEN_FLD	N
199-D5-36	19-Feb-02	Hexavalent Chromium	0.007	mg/L		B13XR5	COLOR_TK_FLD	Y
199-D5-36	19-Feb-02	pH Measurement	8.15	pH		B13XR6	PH_ELECT_FLD	N
199-D5-36	19-Feb-02	Specific Conductance	226	µS/cm		B13XR6	CONDUCT_FLD	N
199-D5-36	19-Feb-02	Sulfate	16	mg/L		B13XR6	COLOR_TK_FLD	N
199-D5-36	19-Feb-02	Temperature	14.8	Deg C		B13XR6	TEMP_FLD	N
199-D5-36	19-Feb-02	Turbidity	0.46	NTU		B13XR6	TURBIDITY_FLD	N
199-D5-37	31-Jan-02	Hexavalent Chromium	0.293	mg/L		B13XF6	COLOR_TK_FLD	Y
199-D5-37	31-Jan-02	pH Measurement	7.86	pH		B13XF7	PH_ELECT_FLD	N
199-D5-37	31-Jan-02	Specific Conductance	333	µS/cm		B13XF7	CONDUCT_FLD	N
199-D5-37	31-Jan-02	Sulfate	33	mg/L		B13XF7	COLOR_TK_FLD	N
199-D5-37	31-Jan-02	Temperature	16	Deg C		B13XF7	TEMP_FLD	N
199-D5-37	31-Jan-02	Turbidity	4.97	NTU		B13XF7	TURBIDITY_FLD	N
199-D5-38	19-Feb-02	Dissolved Oxygen	7.7	mg/L		B13XR8	360.1_OXYGEN_FLD	N
199-D5-38	19-Feb-02	Hexavalent Chromium	1.06	mg/L		B13XR7	COLOR_TK_FLD	Y
199-D5-38	27-Mar-02	Hexavalent Chromium	0.859	mg/L		B146T7	COLOR_TK_FLD	Y
199-D5-38	19-Feb-02	pH Measurement	8.18	pH		B13XR8	PH_ELECT_FLD	N
199-D5-38	19-Feb-02	Specific Conductance	546	µS/cm		B13XR8	CONDUCT_FLD	N
199-D5-38	19-Feb-02	Sulfate	114	mg/L		B13XR8	COLOR_TK_FLD	N
199-D5-38	19-Feb-02	Temperature	15.5	Deg C		B13XR8	TEMP_FLD	N
199-D5-38	19-Feb-02	Turbidity	0.96	NTU		B13XR8	TURBIDITY_FLD	N
199-D5-39	28-Mar-02	Hexavalent Chromium	2.02	mg/L		B146T9	COLOR_TK_FLD	Y
199-D5-39	27-Mar-02	Sulfate	140	mg/L		B146V0	COLOR_TK_FLD	N
199-D5-40	20-Feb-02	Hexavalent Chromium	0.293	mg/L		B13XH0	COLOR_TK_FLD	Y

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Well Name	Sample Date	Constituent	Reported Value	Units	Lab Qualifier	Sample Number	Analytical Method	Filtered Flag
199-D5-40	20-Feb-02	Hexavalent Chromium	0.293	mg/L		B13XH2	COLOR_TK_FLD	Y
199-D5-40	20-Feb-02	pH Measurement	7.88	pH		B13XH1	PH_ELECT_FLD	N
199-D5-40	20-Feb-02	Specific Conductance	612	µS/cm		B13XH1	CONDUCT_FLD	N
199-D5-40	20-Feb-02	Sulfate	120	mg/L		B13XH2	COLOR_TK_FLD	Y
199-D5-40	20-Feb-02	Sulfate	112	mg/L		B13XH3	COLOR_TK_FLD	N
199-D5-40	20-Feb-02	Temperature	16.6	Deg C		B13XH1	TEMP_FLD	N
199-D5-40	20-Feb-02	Turbidity	1.08	NTU		B13XH1	TURBIDITY_FLD	N
199-D5-41	31-Jan-02	Hexavalent Chromium	0.071	mg/L		B13XH4	COLOR_TK_FLD	Y
199-D5-41	31-Jan-02	pH Measurement	8.15	pH		B13XH5	PH_ELECT_FLD	N
199-D5-41	31-Jan-02	Specific Conductance	375	µS/cm		B13XH5	CONDUCT_FLD	N
199-D5-41	31-Jan-02	Sulfate	45	mg/L		B13XH5	COLOR_TK_FLD	N
199-D5-41	31-Jan-02	Temperature	15.9	Deg C		B13XH5	TEMP_FLD	N
199-D5-41	31-Jan-02	Turbidity	1.37	NTU		B13XH5	TURBIDITY_FLD	N
199-D5-42	31-Jan-02	Hexavalent Chromium	0.013	mg/L		B13XH6	COLOR_TK_FLD	Y
199-D5-42	31-Jan-02	pH Measurement	7.94	pH		B13XH7	PH_ELECT_FLD	N
199-D5-42	31-Jan-02	Specific Conductance	435	µS/cm		B13XH7	CONDUCT_FLD	N
199-D5-42	31-Jan-02	Sulfate	64	mg/L		B13XH7	COLOR_TK_FLD	N
199-D5-42	31-Jan-02	Temperature	17.2	Deg C		B13XH7	TEMP_FLD	N
199-D5-42	31-Jan-02	Turbidity	2.33	NTU		B13XH7	TURBIDITY_FLD	N
199-D5-43	20-Feb-02	Dissolved Oxygen	8.6	mg/L		B13XT2	360.1_OXYGEN_FLD	N
199-D5-43	20-Feb-02	Hexavalent Chromium	1.40	mg/L		B13XT3	COLOR_TK_FLD	Y
199-D5-43	27-Mar-02	Hexavalent Chromium	1.37	mg/L		B146V1	COLOR_TK_FLD	Y
199-D5-43	20-Feb-02	pH Measurement	8	pH		B13XT2	PH_ELECT_FLD	N
199-D5-43	20-Feb-02	Specific Conductance	512	µS/cm		B13XT2	CONDUCT_FLD	N
199-D5-43	20-Feb-02	Sulfate	98	mg/L		B13XT3	COLOR_TK_FLD	Y
199-D5-43	27-Mar-02	Sulfate	104	mg/L		B146V2	COLOR_TK_FLD	N
199-D5-43	20-Feb-02	Temperature	16.4	Deg C		B13XT2	TEMP_FLD	N
199-D5-43	20-Feb-02	Turbidity	0.91	NTU		B13XT2	TURBIDITY_FLD	N
199-D5-44	31-Jan-02	Hexavalent Chromium	0.007	mg/L		B13XH8	COLOR_TK_FLD	Y
199-D5-44	31-Jan-02	pH Measurement	8.19	pH		B13XH9	PH_ELECT_FLD	N
199-D5-44	31-Jan-02	Specific Conductance	207	µS/cm		B13XH9	CONDUCT_FLD	N
199-D5-44	31-Jan-02	Sulfate	11	mg/L		B13XH9	COLOR_TK_FLD	N
199-D5-44	31-Jan-02	Temperature	15.3	Deg C		B13XH9	TEMP_FLD	N
199-D5-44	31-Jan-02	Turbidity	3.71	NTU		B13XH9	TURBIDITY_FLD	N

Note: Shaded results indicate quality control duplicate analyses.