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Date: January 7, 2008
Refer To: EP2007-0805

James P. Bearzi, Bureau Chief
Hazardous Waste Bureau
New Mexico Environment Department
2905 Rodeo Park Drive East, Building 1
Santa Fe, NM 87505-6303

Subject: Submittal of Well R-20 Rehabilitation and Conversion Summary Report

Dear Mr. Bearzi:

Enclosed please find two hard copies with electronic files of the "Well R-20 Rehabilitation and Conversion Summary Report" as well as two copies of the video log DVD.

All redevelopment and rehabilitation activities were completed with the exception of the installation of the permanent sampling system, which is expected to arrive from the manufacturer sometime in January. Per discussions with your staff on November 5, we will submit a revision to the report, including an as-built diagram of the well, as soon as the sampling system is installed.

If you have questions, please contact Ardyth Simmons at (505) 665-3935 (asimmons@lanl.gov) or Mat Johansen at (505) 665-5046 (mjohansen@doeal.gov).

Sincerely,

Susan G. Stiger, Associate Director
Environmental Programs
Los Alamos National Laboratory

Sincerely,

David R. Gregory, Project Director
Environmental Operations
Los Alamos Site Office

SS/DG/PH/AS:sm

Enclosures: 1) Two hard copies with electronic files - Well R-20 Rehabilitation and Conversion Summary Report (EP2007-0805)
2) Video log DVDs

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LA-UR-08-0056
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Well R-20 Rehabilitation and Conversion Summary Report

Los Alamos
NATIONAL LABORATORY
EST. 1943

Prepared by the Environmental Programs Directorate

LA-UR-08-0056
EP2007-0805

Well R-20 Rehabilitation and Conversion Summary Report

January 2008

Responsible project leader:

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1.0 INTRODUCTION

This report provides a summary of the work performed and the results of rehabilitating and converting well R-20 to a dual-screen well. Plans for R-20 conversion were presented in the “Work Plan for R-Well Rehabilitation and Replacement, Revision 2” (LANL 2007, 098119) that was approved by the New Mexico Environment Department (NMED) on August 20, 2007 (NMED 2007, 098182). The R-20 borehole was drilled to a total depth of 1365 ft using fluid assisted air-rotary and conventional mud-rotary techniques, and was completed with three screened intervals in the regional aquifer; screen 1 from 904.6 to 912.2 ft; screen 2 from 1147.1 to 1154.7 ft; and screen 3 from 1328.8 to 1336.5 ft. A dedicated Westbay sampling system was installed in the well after completion.

The results of the well screen analysis for R-20 (LANL 2007, 096330) indicated that after the rehabilitation pilot study (LANL 2007, 095889), screen 1 passed 81% of the assessment tests, screen 2 passed 89% of the assessment tests, and screen 3 passed 69% of the assessment tests. Based on these results, screen 3 was abandoned as part of the rehabilitation and conversion program. One conventional submersible pump and one Bennett pump will be installed for long-term sampling of the uppermost screens (screens 1 and 2) at R-20. The lower pump will be a conventional electrical unit and the upper pump will be a dual-action piston fluid pump operated with compressed gas.

2.0 REHABILITATION ACTIVITIES

Well rehabilitation and conversion activities at R-20 included removing and subsequently replacing the inflatable isolation packers, compiling a video log of the upper two screens, redeveloping screens 1 and 2 by means of jetting/pumping and swabbing, isolation of screen 3, hydraulic testing to measure the specific capacity of screens 1 and 2, cleanup pumping from abandonment activities, and collecting water samples for laboratory analysis. These activities are described in the following subsections. Dedicated sampling system installation is pending.

2.1 Isolation Packers

The dedicated sampling system in R-20 was removed during the 2006 pilot study, and the well screens were left in an isolated state with two inflatable packers. The packers were deflated and removed from the well on November 12, 2007. After video logging, redevelopment, abandonment, and testing activities were completed, a single inflatable packer was reinstalled on December 5, 2007, between screens 1 and 2.

2.2 Video Logging

A downhole video camera was run in the R-20 well on November 13, 2007, to document current screen conditions, confirm screen depth locations of the upper two screens, and measure the composite static water level before backfilling and development activities. The Los Alamos National Laboratory’s (the Laboratory’s) geophysical trailer and camera were used to complete video logging. Ground surface was used as the datum for all video depth measurements. The video was run from the surface to a depth of 1160 ft below ground surface (bgs), to just below screen 2. Static water level in the well at the time of logging was recorded at 850 ft 10 in.. bgs. Observed screen depths and static water level are noted in Table 2.2-1. Overall water clarity was good to excellent and provided visibility to adequately assess screen conditions. Approximately 600 gal. of clear potable water was introduced into the well overnight, before the video was run to ensure that visibility was enhanced during video operations. Both screens were observed to be in very good condition. Although fines were present resting on the lower portion of the circular perforations of the pipe-based portion of the screen, no bentonite was observed protruding through the wire-wrapped portion of either screen. Previous redevelopment operations performed on screen 1 noted bentonite on the tools that passed through the top screen (LANL 2007, 095889). A well video log DVD has been included with this report (Appendix C).

2.3 Redevelopment of Screens 1 and 2

Well development of R-20 screens 1 and 2 consisted of three activities: (1) high-velocity jetting with simultaneous pumping, (2) swabbing, and (3) pumping. Jetting and swabbing were performed before screen 3 was isolated, while purging was performed afterwards.

High-velocity jetting was accomplished by operating a 20 gallons per minute (gal./min) submersible pump with a jetting tool attached above the pump discharge within the well screen. The pump and jetting tool were raised and lowered continuously throughout the well screen length while they were rotated back and forth periodically to cover the entire screen surface. The jetting tool nozzles were designed to direct a portion of the pump output through the nozzles and the balance to the surface. In this way, the effectiveness of the jetting was enhanced by ensuring the net removal of water from the screen zone throughout the development process (i.e., simultaneous jetting and pumping).

Screen 2 was developed using a jetting tool with four nozzles, each 5/64-in. in diameter. Approximately 13 gal./min was delivered to the jetting tool, with the balance of about 7 gal./min discharged from the well. Based on the estimated pumping water level, the jetting pressures likely exceeded 400 pounds per square in. (psi). The jetting tool was moved up and down over a length roughly 2.5 times the well screen length to allow much of the sediment stirred up by the jets to be purged from the screen zone while the jetting tool was inside blank casing. This was done to minimize the possible damaging sand-blasting effect on the screen. Jetting continued for about 3 h, so the effective jetting time within the screen was a little over an hour.

Screen 1 was developed using a jetting tool having four nozzles, each 3/32-in. in diameter. This design change from that of screen 2 increased the flow delivered to the jetting tool to about 15 gal./min and decreased that to the surface to around 5 gal./min. This modification was done to avoid completely dewatering screen 1 (just 74 ft below the regional aquifer water level) while jetting. To further reduce the chance of dewatering the screen, jetting was carried out in 20-min intervals, with 10 min of rest in between to allow water levels in the casing above screen 1 to recover between jetting episodes. As with screen 2, active jetting was performed for about 3 h.

Following jetting and simultaneous pumping, both screens were swabbed using a surge block built by sandwiching a 4-in.-outer-diameter (OD) nylon disc between two metal plates. The surge block was connected to a heavy weight so that effective swabbing was accomplished in both the upward and downward directions. Swabbing consisted of running the tool both upward and downward approximately 150 round trips through each screen.

Following isolation of screen 3, the well was purged to remove sediment that was loosened by the development activities as well as residual abandonment materials such as traces of cement and fines from the sand backfill. Purging was performed at two depths: first with the pump between the screens and next with the pump installed in the sump beneath screen 2 to clean that portion of the well.

Initial purging was performed with the pump depth setting limited to 986 ft, about 156 ft below the static water level. The drawdown was limited to this level to avoid hydraulically stressing screen 2 and damaging the permeability of the sediments around the screen. During the pilot rehabilitation project executed in 2006, it was observed that applying extreme drawdown to screens 2 and 3 during routine pumping degraded the specific capacities of these zones significantly (LANL 2007, 095889). This occasionally seen phenomenon can occur in deep, tight, fine-grained sediments when very large drawdown is applied to the well. The enormous resulting hydraulic gradient in the regional aquifer near the well can cause hydraulic compaction of the sediments and concomitant loss of permeability. With the pump set at 986 ft, the pumping rate from screens 1 and 2 was about 3 gal./min and held fairly steady at that level.

After the well had been purged clean, the pump was lowered into the sump beneath screen 2 to remove the turbid water from the bottom of the well. Upon startup, the initial drawdown was limited while the pump evacuated the water stored in the annulus between the well casing and drop pipe. This provided time to adjust the discharge rate to 3 gal./min in an attempt to restrict the drawdown to a level similar to that used in the first purging step. During this pumping step, there was only slight degradation in the pumping capacity.

Following well purging, the pump was pulled and fitted with upper and lower packers to perform sampling and zone testing of screens 1 and 2.

2.4 Abandonment and Conversion

Isolation of screen 3 at R-20 was conducted between November 17 and 18, 2007. Details of backfill materials and placement are presented on Figure 2.4-1. Filter-grade 10/20 silica sand was used as the primary backfill material through the screen interval. The 10/20 sand was installed from the total depth (TD) of the well at 1353.3 to 1317.4 ft bgs. Finer 20/40 filter-grade silica sand was installed above the 10/20 sand from 1313.1 to 1317.4 ft bgs. The finer 20/40 sand serves as a transition interval to keep the cement from flowing into the coarser 10/20 sand. All the backfill sand was installed with a tremie pipe while running a small volume of potable water to carry the sand into place. A Portland-cement seal was installed above the fine transition sand from 1300.4 to 1313.1 ft bgs. Cement was emplaced using a wireline dump bailer. The dump bailer allowed discrete placement of a calculated volume of cement while minimizing impacts to the well screen by fugitive cement. The cement was allowed to cure overnight (approximately 24 h) before proceeding with the next sand interval. A second interval of 10/20 sand was installed as a buffer above the cement from 1185 to 1300.4 ft bgs.

2.5 Specific Capacity Testing

Hydraulic testing of R-20 screens 1 and 2 was performed by installing a shrouded 4-in. submersible pump with inflatable packers above and below the pump to isolate the tested zone. A pressure transducer was installed between the pump and bottom packer to collect water-level data for specific capacity determination.

A corollary benefit of the data collection effort was to obtain data sets that could support hydraulic analysis of the screen zones. A detailed hydraulic analysis of the data was beyond the scope of services for the well rehabilitation project. The current discussion is limited to presenting the specific capacity results. However, the data will be archived and will be available for examination in the future if the Laboratory chooses to pursue a rigorous analysis of well hydraulics.

Several pumping events were performed on screens 1 and 2 in R-20. Tests included pumping screens 1 and 2 simultaneously, as well as individual tests on each zone. Table 2.5-1 summarizes the results of the pumping rate and water level observations made during the tests. An explanation of the tests and test results follows.

Table 2.5-1 shows the final specific capacity results obtained during the pilot rehabilitation project in 2006 (LANL 2007, 095889). During that project, experimental use of the Hydro-Pulse development tool was applied to R-20. This device uses high-pressure, rapidly expanding nitrogen gas to pulse the well water and formation material. Application of the Hydro-Pulse effectively destroyed the yields of screens 1 and 2, cutting the specific capacity of each zone to less than 0.002 gal./min/ft of drawdown.

Subsequently, more gentle development methods were carefully implemented to restore much of the lost yield. Following these procedures, no tests were conducted on screen 2 by itself. However, screen 1 was isolated and tested, and screens 1 and 2 were tested together. Therefore, by subtraction, it was possible to estimate the specific capacity of screen 2. As shown in Table 2.5-1, the measured specific capacity of screen 1 was 0.0105 gal./min/ft. The combined specific capacity of screens 1 and 2 together was 0.0182 gal./ft, making the inferred specific capacity of screen 2 about 0.077 gal./min/ft. The tests on which these data were based were conducted at low pumping rates that prevented the occurrence of extreme drawdown in screens 1 and 2.

After the recent redevelopment and well conversions procedures were concluded, additional specific capacity tests were run on screens 1 and 2. These tests were conducted to document well performance and to evaluate the development methods applied during this effort, primarily simultaneous jetting and pumping. These results are summarized in Table 2.5-1.

On November 29, 2007, a test was conducted in which screens 1 and 2 were pumped simultaneously for 77 min after which the packers were inflated isolating screen 1. The two zones together yielded 2.05 gal./min with a pumping water level 64.9 ft below the screen 1 static water level. As soon as the packers were inflated, the yield (of screen 1 alone) declined to 1.47 gal./min and the drawdown increased to 65.8 ft. Thus, the screen 1 specific capacity was 1.47/65.8 = 0.02 gal./min/ft.

These data were used to estimate the screen 2 specific capacity. When both screens were producing, the drawdown was 64.9 ft below the screen 1 static water level. Applying this to the screen 1 specific capacity of 0.0223 gal./min/ft meant that the screen 1 contribution to the yield was 0.0223 x 64.9 = 1.45 gal./min. Thus, the inferred contribution of screen 2 was 2.05 – 1.45 = 0.6 gal./min. The static water level of screen 2 was estimated to be about 5 ft lower than that of screen 1. This meant that the drawdown in screen 2 was 64.9 – 5.0 = 59.9 ft. Thus, the estimated/inferred specific capacity of screen 2 was 0.6/59.9 = 0.01 gal./min/ft.

On November 30, 2007, screen 1 was pumped for 420 min. As shown in Table 2.5-1, after 30 min, the pumping rate was 1.55 gal./min, with a drawdown of 74 ft, making the short-term specific capacity 0.0209 gal./min/ft. At the end of the test the pumping rate was 1.43 gal./min with a drawdown of 70.9 ft, making the long-term specific capacity 0.0202 gal./min/ft. This latter specific capacity can be compared with that obtained in 2006 because the pumping times of the two tests were similar (420 versus 368 min). The recent specific capacity of 0.0202 gal./min/ft represents an increase of 92% over that observed before the recent rehabilitation efforts. The documented improvement in yield speaks to the efficacy of the simultaneous pumping and jetting development method used in R-20.

On December 3, 2007, several tests were conducted. In the first test, the pump was set above screen 1, automatically limiting the drawdown that could be applied to the screen zones, particularly screen 2. After 30 min of pumping 1.88 gal./min from both zones, the drawdown from the *composite* static water level was 63.3 ft. It was estimated that the static water level for screen 1 was 1.5 ft above the composite level, and for screen 2 it was about 3.5 ft below the composite level. Thus, the drawdown applied to screen 1 was 64.8 ft and that applied to screen 2 was 59.8 ft. Based on the short-term specific capacity of screen 1 of 0.0209 gal./min/ft, the screen 1 contribution during this test was estimated to be

0.0209 x 64.8 = 1.35 gal./min. This meant that screen 2 contributed 1.88 – 1.35 = 0.53 gal./min. Thus, the inferred short-term specific capacity of screen 2 was 0.53/59.8 = 0.01 gal./min/ft.

A second pumping test was conducted with the pump set deeper. During this test, screens 1 and 2 were pumped at 2.73 gal./min with a drawdown from the composite static water level of 113.0 ft—substantially below screen 1. The maximum effective drawdown applied to screen 1 during this test was the distance from the screen 1 static water level (828.5 ft) to the center of screen 1 (908 ft), or 79.5 ft. Based on the short-term specific capacity of screen 1 of 0.0209 gal./min/ft, the yield contribution from screen 1 was estimated to be 0.0209 x 79.5 = 1.66 gal./min. This meant that screen 2 had contributed 2.73 – 1.66 = 1.07 gal./min. The screen 2 drawdown was 3.5 ft less than the composite drawdown, or 109.5 ft. Thus, the inferred specific capacity of screen 2 was 1.07/109.5 = 0.0098 gal./min/ft.

Thus, the indirect specific capacity values obtained from screen 2 (0.0100, 0.0089 and 0.0098 gal./min/ft), while constraining the magnitude of the drawdown applied to this zone, averaged 0.0096 gal./min/ft. This represented an increase of 25% over the specific capacity of 0.0077 gal./min/ft inferred from testing R-20 in 2006. The actual increase may have been less than indicated because the 2006 specific capacity value was based on long-term pumping results rather than short-term. Nevertheless, even after an adjustment for pumping time, the 2007 specific-capacity values represented a substantial increase over 2006 performance, again reinforcing the use of simultaneous pumping and jetting for well development.

Despite the good pumping performance obtained from screen 2, once the zone was subjected to extreme drawdown, yields declined significantly as shown by pumping results obtained from the third pumping test conducted on December 3, 2007 Once screen 2 was isolated by inflatable packers with the pump set near the depth of the well screen, it was no longer possible to constrain the drawdown as had been done deliberately during the previous tests. Packing off screen 2 and pumping with a deep-set pump simulated the conditions expected to prevail during future sampling using a permanent pump and packer installation.

As shown in the Table 2.5-1, the packer test on screen 2 conducted on December 3, 2007, produced 1.50 gal./min with 314.8 ft of drawdown for a specific capacity of 0.0048 gal./min/ft. As indicated, after 180 min of pumping, the specific capacity had declined to 0.0045 gal./min/ft and to 0.0042 gal./min/ft after 341 min. Previous tests had constrained the drawdown by limiting the pump setting depth or by delaying significant drawdown by relying on casing storage volume to satisfy the pump until the discharge rate could be adjusted to a modest level. With the implementation of inflatable packers and a deep-set pump, however, the drawdown could not be constrained readily and no storage volume was available to the pump. Thus, on startup, the pump rapidly depressurized the screen zone greatly, causing immediate compaction of the near-well sediments. A detailed analysis of the transducer data revealed that the drawdown had reached 275 ft just 2 s after the onset of pumping during this initial packer test.

Additional pumping was performed on December 4, 2007. As shown in Table 2.5-1, the specific capacity continued to decline. After pumping times of 34, 200, and 454 min, the measured specific capacities were 0.0041, 0.0040, and 0.0039, respectively.

In summary, well development procedures provided good increases in hydraulic performance of the salvaged screen zones in R-20. The postdevelopment yields of screens 1 and 2 were 92% and 25% greater, respectively, than those before development, supporting the use of the chosen development methods, primarily simultaneous pumping and high velocity jetting. However, the gains obtained for screen 2 were lost because of hydraulic compaction of the near-well sediments that occurred when a deep-set pump incorporating inflatable packers was operated. The final specific capacity of screen 2 was less than that obtained before redevelopment when the magnitude of the drawdown was carefully constrained.

It is probable that any tight, fine-grained screened interval far beneath the water table is susceptible to yield degradation from sediment compaction when sampled using a deep-set pump and inflatable packers. The exception to this would be instances where the pump capacity is fortuitously low enough to not overstress the regional aquifer (unlikely in most instances because of the limited selection of pumps that can lift water 1000 ft or more). If similar conditions are encountered in the future, it may be beneficial to explore or develop practical methods to automatically constrain the discharge rate and/or drawdown to prevent the deleterious effects of applying extreme drawdown to producing zones. Implementation of inline flow controllers placed in the discharge line, downhole below the water level, is one example of a possible remedy to consider.

2.6 Water Quality

Table 2.6-1 shows the sample collection objectives for R-20 screens 1 and 2 during the hydraulic testing and the constituents measured in the field and laboratory.

2.6.1 Sample Collection, Field Preparation, and Analytical Techniques

A total of 34 groundwater samples were collected during two pumping tests conducted at R-20 screen 1 on November 30, 2007 (15 samples) and screen 2 on December 3 and 4, 2007 (19 samples). Field parameters consisting of pH, turbidity, dissolved oxygen (DO), temperature, specific conductance (SC), and oxidation-reduction potential (ORP) were measured using a flow-through cell (Geotech) during sample collection. Measurements for the different field parameters recorded during the pumping tests at screens 1 and 2 are provided in Table 2.6-2. Field pH and temperature were measured using a Beckman (Model 255) meter and DO was measured using a WTW (Model OXI-330I) instrument. SC and ORP were measured using a HACH Sension-5 meter and a Thermoelectron Corp. (Russell RL 060P model) instrument, respectively. Four equipment rinsate blanks (GW20-08-8880 and GW20-08-8942, filtered and GW20-08-9004 and GW20-08-9072, nonfiltered) and 2 field blanks (GW20-08-8998 and GW20-08-9066) were collected during the pumping tests. Groundwater samples were collected every 5 min during the initial 30 min of the pumping test conducted at screen 1 (Table 2.6-2). The frequency of sample collection at screen 1 decreased to every 10 min from 30 to 60 min during the test, every 30 min from 60 to 180 min, and a final sample was collected at 290 min. The total duration of the pumping test at screen 1 was 290 mi (4.83 h).

Groundwater samples were collected every 5 min during the initial 25 min of the pumping test conducted at screen 2 (Table 2.6-2). The frequency of sample collection at screen 2 decreased to every 10 min from 25 to 55 min during the test and every 30 min from 55 to 175 min on December 3, 2007. The pumping test at screen 2 continued on December 4, 2007, with groundwater samples collected every 60 min for a period of 4 h (240 min). A final sample was collected from screen 2 at 270 min. The total time duration of the pumping test at screen 2 was 445 min (7.42 h).

Groundwater samples were collected using a submersible pump connected to a mild-steel discharge pipe equipped with a standard submersible pump. The discharge rate varied from 1.47 to 1.5 gal./min and from 1.23 to 1.44 gal./min during the pumping tests conducted at screens 1 and 2, respectively.

Thirty-four groundwater samples were filtered before analyses for metals, trace elements, and major cations and anions. Aliquots of samples collected from R-20 screens 1 and 2 were filtered through 0.45-µmeter Geotech disposable filters. Thirty-four nonfiltered groundwater samples were also analyzed for major cations, trace elements, and metals. Samples were acidified with analytical-grade nitric acid to a pH of 2.0 or less for metal and major cation analyses. Nonfiltered samples collected for total sulfide analysis were preserved with a buffer consisting of sodium hydroxide, ethylenediaminetetraacetic acid

(EDTA), and ascorbic acid. Samples collected for TOC analysis were not filtered and were acidified with analytical-grade sulfuric acid.

Chemical analyses of screening-groundwater samples were performed at the Laboratory's Earth and Environmental Sciences Group 6 (EES-6) laboratory. Groundwater samples were analyzed by EES-6 using techniques specified in the U.S. Environmental Protection Agency SW-846 manual. Total carbonate alkalinity was measured using standard titration techniques. Ion chromatography was the analytical method for bromide, chloride, fluoride, nitrate, nitrite, oxalate, chlorate, perchlorate, phosphate, and sulfate. Total sulfide was determined by ion selective electrode (ISE) with a detection limit of 0.010 parts per million (ppm). Inductively coupled (argon) plasma optical emission spectroscopy (ICPOES) was used for analyses of calcium, magnesium, potassium, silica, sodium, and strontium. Aluminum, antimony, arsenic, barium, beryllium, boron, cadmium, cesium, chromium, cobalt, copper, iron, lead, lithium, manganese, mercury, molybdenum, nickel, rubidium, selenium, silver, thallium, thorium, tin, titanium, vanadium, uranium, and zinc were analyzed by inductively coupled (argon) plasma mass spectrometry (ICPMS). The precision limits (analytical error) for major ions and trace elements were generally less than ±10% using ICPOES and ICPMS. Total organic carbon was measured using a total carbon-organic carbon analyzer.

2.6.2 Field Parameters

During the pumping test conducted at R-20 screen 1 on November 30, 2007, field parameters were measured on 15 groundwater samples collected from R-20 screen 1. These results are provided in Tables 2.6-2 and are shown in Figure 2.6-1. Field pH varied from 7.96 to 8.49; temperature varied from 17.4 to 20.9°C. Specific conductance decreased from 132 to 124 microSiemens per centimeter (μS/cm), and DO generally increased from 1.0 to 1.9 mg/L. Turbidity decreased from 132 to 7.06 nephelometric turbidity units (NTUs) (Table 2.6-2, Figure 2.6-1). Noncorrected ORP measurements varied from +128 to +281 millivolts (mV) during the 2007 pumping test at R-20 screen 1.

Dissolved oxygen, ORP, SC, turbidity, and temperature varied during Westbay sampling, conducted at R-20 screen 1 from 2004 through 2006, and the July 2006 and November and December 2007 pumping tests (Figure 2.6-1). The most consistent temperature measurements were recorded during the 2007 pumping tests. Concentrations of DO were higher during the Westbay sampling than during the 2006 and 2007 pumping tests as a result of sample aeration without using a flow-through cell at Westbay-equipped wells.

The most stable field parameter is pH, having slightly lower values during the initial part of the 2006 pumping test. Specific conductance decreased during both Westbay sampling and the 2006 pumping test in response to groundwater with lower solute concentrations entering the well screen (Figure 2.6-1). Specific conductance was most stable during the 2007 pumping test conducted at R-20 screen 1. Turbidity, however, was most stable during Westbay sampling from the lack of purging of groundwater before sampling (Figure 2.6-1). Turbidity consistently decreased during the 2007 pumping test in comparison to the 2006 pumping test, which showed an increase at the end of sampling. The highest SC measurements recorded at R-20 screen 1 were during the initial sampling of the 2007 pumping test (Figure 2.6-1). The most negative, noncorrected ORP measurements were recorded during Westbay sampling at R-20 screen 1, followed by less negative values recorded during the 2006 pumping test. The most positive ORP measurements were taken during the 2007 pumping test; however, this parameter became less positive as fresh, nonstagnant groundwater entered screen 1. DO and ORP measurements indicative of in situ groundwater at R-20 are difficult to obtain because the samples become aerated using sampling jars with Westbay equipment.

Field parameters were measured on 19 groundwater samples collected from R-20 screen 2. These results are provided in Table 2.6-2 and Table A-2 and are shown in Figure 2.6-2. Field pH varied from 7.68 to 8.50; temperature varied from 18.5 to 20.9°C during the 2007 pumping test. Specific conductance decreased from 165 to 141 μS/cm, and DO slightly increased from 0.4 to 0.6 mg/L. Measurements for DO and SC recorded on December 4, 2007, are very inconsistent and are considered not reliable. These two parameters are not included in any interpretation presented in this report. Turbidity decreased from 331 to 4.15 NTUs during pumping (Table 2.6-2, Figure 2.6-2). Noncorrected ORP measurements generally decreased from +293 to +153 mV during the pumping test at R-20 screen 2.

Similar to field parameters measured at R-20 screen 1, DO, ORP, SC, turbidity, and temperature also varied during Westbay sampling and the 2006 and 2007 pumping tests at screen 2 (Figure 2.6-2). The most consistent temperature measurements were recorded on December 3, 2007. Lower and more consistent concentrations of DO were recorded during the 2006 pumping test. No DO measurements were recorded during Westbay sampling conducted at R-20 screen 2. The most stable field parameter is pH, having slightly lower values during both Westbay sampling and the 2006 pumping test. SC decreased the most during Westbay sampling (Figure 2.6-2). Slightly higher SC measurements, however, were recorded during the 2007 pumping test at R-20 screen 2. Turbidity was most stable during Westbay sampling due to the lack of purging before sampling (Figure 2.6-2). The highest turbidity measurements were made during the 2007 pumping test in comparison to Westbay sampling and the 2006 pumping test. The highest SC measurements recorded at R-20 screen 2 were during Westbay sampling (Figure 2.6-2). The least positive, noncorrected ORP measurements were recorded during both Westbay sampling and the 2006 pumping test. The most positive ORP measurements were taken during the 2007 pumping test; however, this parameter became less positive as fresh groundwater entered screen 2 (Figure 2.6-2).

2.6.3 Analytical Results

Analytical results for groundwater samples collected during aquifer performance testing at R-20 screens 1 and 2 are provided in Appendix A Tables A-2 and A-3. Charge balance errors for dissolved cations and anions were generally less than ±6%. Figures 2.6-3 and 2.6-4 show concentration trends of several solutes for screens 1 and 2, respectively, during Westbay sampling and the 2006 and 2007 pumping tests. Calcium and sodium are the dominant cations present in the regional aquifer at R-20 screens 1 and 2. During the 2007 pumping tests, dissolved concentrations of calcium ranged from 11.2 to 12.0 ppm or mg/L and from 12.1 to 14.1 mg/L at screens 1 and 2, respectively (Figures 2.6-3 and 2.6-4). Dissolved concentrations of calcium generally show small variations in groundwater samples collected during pumping tests conducted in 2006 and 2007. The highest concentrations of this solute occurred during Westbay sampling at R-20 screen 2, whereas the lowest concentrations of dissolved calcium were measured during the same time period at screen 1 (Figures 2.6-3 and 2.6-4) (LANL 2007, 096330). Dissolved concentrations of sodium ranged from 12.8 to 13.7 ppm and from 8.6 to 14.3 ppm at screens 1 and 2, respectively, during the 2007 pumping tests (Figures 2.6-3 and 2.6-4, Tables A-2 and A-3). The highest concentrations of dissolved sodium were measured during Westbay sampling at R-20 screens 1 and 2 (Figures 2.6-3 and 2.6-4) (LANL 2007, 096330). Dissolved chloride showed small variations in concentration during the 2007 pumping tests for both screens, with the highest concentrations of this anion measured in R-20 screen 2. A higher degree of variability in dissolved chloride concentrations is observed during both Westbay sampling and the July 2006 pumping test conducted at R-20 screen 1. Smaller variations in dissolved chloride concentrations occurred in groundwater samples collected from R-20 screen 2 during both Westbay sampling and the July 2006 pumping test (Figures 2.6-3 and 2.6-4).

Concentrations of total carbonate alkalinity did not vary significantly during the 2007 pumping tests conducted at R-20 screens 1 and 2. Higher concentrations of total carbonate alkalinity were measured during the previous Westbay sampling at screen 2 and the initial part of the July 2006 pumping test.

Dissolved concentrations of sulfate in samples collected from R-20 screens 1 and 2 decreased during the 2007 pumping tests (Figures 2.6-3 and 2.6-4). Higher dissolved concentrations of sulfate, however, were measured in groundwater samples collected from R-20 screen 2 during the 2007 pumping test (Figure 2.6-4). Dissolved concentrations of sulfate decreased from 10.8 to 7.21 ppm in samples collected from R-20 screen 2 (Figure 2.6-4, Table A-3). The upper tolerance limit (UTL) for dissolved sulfate in the regional aquifer is 7.2 mg/L (LANL 2007, 095817). Concentrations of total sulfide generally were less than analytical detection (0.010 ppm), suggesting that sulfate reduction was not significant during the 2007 pumping tests. Four groundwater samples (GW20-08-9072, -9074, -9075, and -9088) collected from screen 2 contained measurable total sulfide between 0.02 and 0.04 ppm, suggesting that small amounts of residual sulfide associated with drilling effects occur in the regional aquifer at R-20 screen 2 (Table A-3).

Concentrations of TOC varied from 0.89 to 3.29 mgC/L and from 1.46 to 2.28 mgC/L in groundwater samples collected from R-20 screens 1 and 2, respectively, during the 2007 pumping tests (Tables A-2 and A-3). Concentrations of TOC ranged from 8.24 to 17.10 mgC/L and from 35.20 to 49.3 mgC/L in groundwater samples collected from R-20 screens 1 and 2, respectively, during Westbay sampling (LANL 2007, 096330). During the July 2006 pumping tests, average concentrations of TOC were 2.93 and 1.08 mgC/L in groundwater samples collected from R-20 screens 1 and 2, respectively (LANL 2007, 096330). The dominant source of TOC probably includes residual QUIK-FOAM and other organic-based drilling additives consisting of a long-chain hydrocarbon surfactant used during drilling of R-20. Elevated above background concentrations of ammonia and total Kjeldahl nitrogen (TKN) measured in groundwater samples collected from R-20 screens 1 and 2 (LANL 2007, 096330) provide evidence for the presence of residual QU"IK-FOAM. Higher concentrations of ammonia and TKN were measured in groundwater samples collected from R-20 screen 2 from 2004 to 2006 than from R-20 screen 1 (LANL 2007, 096330). Well rehabilitation efforts conducted in 2006 and 2007 at R-20, however, have enhanced additional removal of residual drilling fluid and associated breakdown products supported by decreasing concentrations of TOC, TKN, and ammonia in the regional aquifer.

Dissolved concentrations of nitrate(N) increased from 0.145 to 0.331 ppm during the 2007 pumping test conducted at R-20 screen 1 (Figure 2.6-3, Table A-2). Concentrations of this solute were less than detection (<0.017 mg/L, maximum instrument detection limit [IDL]) during the previous Westbay sampling at R-20 screen 1 (LANL 2007, 096330). The average concentration of dissolved nitrate(N) was 0.15 mg/L at R-20 screen 1 during the July 2006 pumping test, showing higher concentrations during the initial part of the test, then decreasing during the middle, and increasing slightly at the end of testing (Figure 2.6-3). Dissolved concentrations of nitrate(N) increased from 0.160 to 0.316 ppm during the 2007 pumping test conducted at R-20 screen 2 (Figure 2.6-4, Table A-3). Concentrations of this solute were also less than analytical detection (<0.017 mg/L, maximum IDL) during Westbay sampling (LANL 2007, 096330). The average concentration of dissolved nitrate(N) was 0.27 mg/L at R-20 screen 2 during the July 2006 pumping test, mostly showing consistent concentrations during the test (Figure 2.6-4). Background mean, median, and maximum concentrations of dissolved nitrate plus nitrite(N) are 0.33, 0.31, and 1.05 mg/L, respectively, within the regional aquifer (LANL 2007, 095817).

Total dissolved concentrations of iron increased from 0.15 to 1.56 ppm during the 2007 pumping test conducted at R-20 screen 1 (Figure 2.6-5, Table A-2). The ratio of total iron in nonfiltered samples to total dissolved iron in groundwater samples collected from R-20 screen 1 decreased during pumping, suggesting that more reducing conditions were established as the pumping test progressed. Concentrations of this solute ranged from 0.0756 to 0.123 mg/L during Westbay sampling conducted at R-20 screen 1 (LANL 2007, 096330). The average concentration of total dissolved iron was 0.243 mg/L at R-20 screen 1 during the July 2006 pumping test, showing some variation during the test (Figure 2.6-5).

Background mean, median, and maximum concentrations of total dissolved iron are 0.0193, 0.095, and 0.147 mg/L, respectively, within the regional aquifer (LANL 2007, 095817).

Total dissolved concentrations of manganese generally increased from 0.019 to 0.034 ppm during the 2007 pumping test conducted at R-20 screen 1 (Figure 2.6-5, Table A-2). As with iron, the ratio of total manganese in nonfiltered samples to total dissolved manganese in groundwater samples collected from R-20 screen 1 also decreased, providing additional evidence that more reducing conditions were established as the 2007 pumping test progressed. Concentrations of this solute ranged from 0.0143 to 0.0285 mg/L during Westbay sampling at R-20 screen 1 (LANL 2007, 096330). The average concentration of total dissolved manganese was 0.029 mg/L at R-20 screen 1 during the July 2006 pumping test, showing higher concentrations during the initial part of the test, then decreasing during the middle and slightly increasing at the end of testing (Figure 2.6-5). Background mean, median, and maximum concentrations of total dissolved manganese are 0.0076, 0.001, and 0.124 mg/L, respectively, within the regional aquifer (LANL 2007, 095817).

Total dissolved concentrations of iron generally increased from 0.16 to 0.80 ppm during the 2007 pumping test conducted at R-20 screen 2 (Figure 2.6-6, Table A-3). The ratio of total iron in nonfiltered samples to dissolved iron in groundwater samples collected from R-20 screen 2 also decreased during pumping, suggesting that more reducing conditions were established as the pumping test progressed. Concentrations of this solute ranged from 0.141 to 0.423 mg/L during Westbay sampling conducted at R-20 screen 2 (LANL 2007, 096330). The average concentration of total dissolved iron was 0.185 mg/L at R-20 screen 2 during the July 2006 pumping test, showing variation during the test (Figure 2.6-6).

Total dissolved concentrations of manganese varied from 0.021 to 0.039 ppm during the 2007 pumping test conducted at R-20 screen 2 (Figure 2.6-6, Table A-3). Similar to manganese concentrations at screen 1, the ratio of total manganese in nonfiltered samples to total dissolved manganese in groundwater samples collected from screen 2 also decreased during the 2007 pumping test. Concentrations of this solute ranged from 0.332 to 0.368 mg/L during previous Westbay sampling at R-20 screen 2 (LANL 2007, 096330). The average concentration of total dissolved manganese was 0.0371 mg/L at R-20 screen 2 during the July 2006 pumping test, generally decreasing during the test (Figure 2.6-6).

Two rinsate blanks collected from the discharge pipe consisting of mild steel used during the 2007 pumping tests conducted at R-20 screens 1 and 2 have concentrations of total manganese and iron of 0.013 and 0.073 ppm and 1.64 and 6.75 ppm, respectively, in nonfiltered samples (Tables A-2 and A-3). Concentrations of total dissolved manganese and iron in associated filtered rinsate blanks were 0.003 and 0.003 and 0.01 and 0.030 ppm, respectively. Dissolved concentrations of iron and manganese leached from the corroded discharge pipe do not significantly contribute additional iron and manganese to the groundwater samples analyzed as part of this study. Other metals and trace elements detected in the rinsate blanks include aluminum, barium, boron, chromium, copper, lead, nickel, strontium, titanium, vanadium, and zinc (Tables A-2 and A-3). Total concentrations of copper, lead, nickel, and vanadium in the nonfiltered rinsate samples were less than 0.010 ppm. Total concentrations of several metals/trace elements exceeded 0.010 ppm: aluminum (0.042 and 0.613 ppm), barium (0.018 and 0.081 ppm), boron (0.028 and 0.032 ppm), copper (0.014 ppm), strontium (0.063 ppm), titanium (0.041 ppm), and zinc (0.062 and 0.524 ppm) (Tables A-2 and A-3). Higher concentrations of metals in nonfiltered samples occurred in the two initial equipment rinsate blanks collected before pumping of R-20 screen 1.

Figure 2.6-7 shows total and dissolved concentrations of uranium, vanadium, and zinc measured at R-20 screen 1 from 2004 to 2007. Dissolved concentrations of uranium ranged from 0.0007 to 0.0014 ppm at R-20 screen 1 during the 2007 pumping test (Table A-2). Total concentrations of uranium were the same or slightly higher ranging from 0.0007 to 0.0026 ppm during this pumping test. Similar concentrations of total and dissolved uranium were also measured during the July 2006 pumping test conducted at R-20 screen 1 (Figure 2.6-7). Dissolved uranium(VI) complexes from the major phase at R-20 screen 1, based on similar concentrations of uranium in sample pairs for filtered and nonfiltered aliquots analyzed during the 2007 pumping test. Uranium(VI) complexes including $UO_2(CO_3)_2^{2-}$ and $UO_2(CO_3)_3^{4-}$ are mobile in oxidizing groundwater under basic pH conditions (Langmuir 1997, 056037), suggested by positive noncorrected ORP and DO measurements and sulfate and nitrate concentrations, characteristic of R-20 screen 1. Lower concentrations of dissolved and total uranium, ranging from 0.000095 to 0.00021 ppm, were measured during earlier Westbay sampling conducted at R-20 screen 1 (LANL 2007, 096330) (Figure 2.6-7). It is likely that uranium(IV) complexes were stable during Westbay sampling in which reducing conditions were enhanced by residual organic-rich drilling fluid. Precipitation of uranium(IV) solids including UO_2 and $USiO_4$ is enhanced under reducing conditions in the absence of DO and in the presence of dissolved sulfide. Dissolved and total concentrations of vanadium were very consistent, only ranging from 0.003 to 0.006 ppm at R-20 screen 1 during the 2007 pumping test (Figure 2.6-7, Table A-2). Similar concentrations of total and dissolved vanadium were measured during both Westbay sampling and the July 2006 pumping test conducted at R-20 screen 1 (Figure 2.6-7). Dissolved concentrations of zinc varied from 0.005 to 0.027 ppm during the 2007 pumping test. Dissolved concentrations of zinc at R-20 screen 1 are within background distributions for the regional aquifer (0.0004 to 0.032 mg/L) (LANL 2007, 095817). Following the same pattern for iron, the ratio of total zinc in nonfiltered samples to total dissolved zinc in groundwater samples collected from R-20 screen 1 decreased during pumping, suggesting that zinc is associated with suspended iron either through adsorption and/or coprecipitation processes. Total concentrations of zinc associated with suspended particles decreased as the pumping test progressed, possibly due to reducing conditions characterized by increasing concentrations of dissolved iron (see Figure 2.6-5). One hypothesis includes reductive dissolution of hydrous ferric oxide (HFO), supported by increasing concentrations of dissolved iron, resulting in desorption of zinc(II) surface complexes. An alternate hypothesis includes oxidation of iron-zinc sulfide minerals as fresh, less reducing regional aquifer groundwater enters the well screen during continued pumping. Dissolved concentrations of zinc ranged from 0.0021 to 0.160 mg/L during Westbay sampling conducted at R-20 screen 1 from 2004 to 2006 (LANL 2007, 096330). The highest concentrations of total and dissolved zinc were measured during the July 2006 pumping test, with an average dissolved concentration of 0.326 ppm (LANL 2007, 096330).

Figure 2.6-8 shows total and dissolved concentrations of uranium, vanadium, and zinc measured at R-20 screen 2 from 2004 through 2007. Dissolved concentrations of uranium ranged from 0.0008 to 0.0011 ppm at R-20 screen 2 during the 2007 pumping test (Table A-3). Total concentrations of uranium were the same or slightly higher, decreasing from 0.0021 to 0.0008 ppm during this pumping test. The average concentration of dissolved uranium was 0.0012 mg/L (LANL 2007, 096330) measured during the July 2006 pumping test conducted at R-20 screen 2 (Figure 2.6-8). Lower concentrations of dissolved uranium, ranging from 0.000058 to 0.00011 ppm, were measured during the previous Westbay sampling conducted at R-20 screen 2 (LANL 2007, 096330) (Figure 2.7-8). Dissolved concentrations of vanadium increased from 0.002 to 0.005 ppm, whereas total vanadium decreased from 0.007 to 0.004 ppm at R-20 screen 2 during the 2007 pumping test (Figure 2.6-8, Table A-3). Similar concentrations of total and dissolved vanadium generally were measured during the July 2006 pumping test conducted at R-20 screen 2 (Figure 2.7-8). Dissolved concentrations of zinc generally decreased from 0.056 to 0.008 ppm during the 2007 pumping test conducted at R-20 screen 2. Four of the 19 dissolved concentrations of zinc at R-20 screen 2 (four samples) are not within background distributions for the regional aquifer (0.0004 to 0.032 mg/L) (LANL 2007, 095817). Following the same pattern for zinc at screen 1, the ratio of total zinc in nonfiltered samples to total dissolved zinc in groundwater samples collected from screen 2 decreased during the 2007 pumping test. Hypotheses for zinc and iron presented above are also applicable to screen 2 during the 2007 pumping test. Measurable dissolved concentrations of zinc ranged from 0.0054 to 0.0092 mg/L during Westbay sampling conducted at R-20 screen 2 (LANL 2007, 096330). The average dissolved concentration of zinc was 0.313 ppm measured during the July 2006 pumping test (LANL 2007, 096330).

2.6.4 Well Screen Analysis

Previous Results

Analytical results obtained from sampling of well R-20 screens 1 and 2 were evaluated for representativeness and reliability, following geochemical protocols established by the Laboratory (LANL 2007, 096330) and approved by the New Mexico Environment Department (NMED 2007, 098182). Groundwater samples were collected from this Westbay-equipped well from 2004 to 2006 during 6 and 5 sampling events conducted at screens 1 and 2, respectively, and results of the Laboratory well screen analysis were previously provided (LANL 2007, 096330). Groundwater samples previously collected from R-20 screen 1 have scores increasing from 51% to 72% with an average score of 60% (LANL 2007, 096330). Groundwater samples collected from R-20 screen 1 during well rehabilitation conducted in July 2006 contributed to a test score of 72% (Appendix B, Table B-1) (LANL 2007, 096330). Groundwater samples collected from R-20 screen 1 during October 2006 contributed to a test score of 81% (Table B-1) (LANL 2007, 096330). The test scores for the 2004 to 2006 samples collected from R-20 screen 1 improved over time with 4 to 18 analytes or general indicators per sampling event failing the geochemical criteria, consisting of 26 to 36 individual tests. Analytes that did not meet the well screen criteria during one or more sampling rounds conducted at R-20 screen 1 included pH, ORP, turbidity, magnesium, total carbonate alkalinity, acetone, sulfate, phosphate, TKN, iron, chromium, TOC, ammonia, perchlorate, nitrate(N), strontium, uranium, molybdenum, manganese, calcium, and/or sodium (Table B-1) (LANL 2007, 096330).

Groundwater samples previously collected from R-20 screen 2 have scores ranging from 37% to 44% with an average score of 40% (LANL 2007, 096330). Groundwater samples collected from R-20 screen 2 during well rehabilitation conducted in July 2006 contributed to a test score of 89% (Table B-1) (LANL 2007, 096330). The test scores for the 2004 to 2006 samples collected from R-20 screen 2 varied over time with 3 to 23 analytes or general indicators per sampling event failing the geochemical criteria, consisting of 32 to 35 individual tests. Analytes that did not meet the well screen criteria during one or more sampling rounds conducted at R-20 screen 2 included pH, ORP, turbidity, barium, magnesium, total carbonate alkalinity, acetone, sulfate, sulfide, phosphate, TKN, iron, chromium, TOC, ammonia, perchlorate, nitrate(N), strontium, uranium, molybdenum, manganese, calcium, and/or sodium (Table B-2) (LANL 2007, 096330).

Updated Well Screen Analysis

Results of the Laboratory well screen analysis using analytical results obtained during the 2007 pumping tests are provided in Tables B-1 and B-2. Groundwater samples analyzed from well R-20 screen 1 during the 2007 pumping test have scores ranging from 85% to 91% consisting of 34 criteria (Table B-1) for 16 samples. This screen is near the regional water table and is most important for detecting potential contaminants released to Pajarito Canyon near Technical Area 18. Therefore, all 16 samples were selected for the well screen analysis presented in this section. Test scores generally improved during pumping of R-20 screen 1. The average well screen test score for the 2007 pumping test is 89%, which is an improvement over the previous score achieved during the July 2006 pumping test (72%). Elevated above background concentrations of dissolved barium (9 samples), boron (2 samples), iron (16 samples) and zinc (1 sample); turbidity values greater than 5 NTUs (16 measurements); and DO concentrations less than 2 mg/L (16 measurements) contributed to samples failing several criteria of the well screen analysis (Table B-1).

Groundwater samples analyzed from well R-20 screen 2 during the 2007 pumping test have scores ranging from 85% to 91% consisting of 34 criteria (Table B-2) for three samples. The samples selected for this well screen analysis were collected at the beginning (GW20-08-9118 and -8959), middle (GW20-08-9081 and -8951), and end (GW20-08-9088 and -8958) of the 2007 pumping test. Test scores generally improved during pumping of R-20 screen 2. The average well screen test score for the 2007 pumping test is 88%, which is the same as the previous score achieved during the July 2006 pumping test (89%). Elevated above background concentrations of dissolved barium (19 samples), boron (1 sample), iron (19 samples), sulfate (19 samples), and zinc (4 samples); turbidity values greater than 5 NTsU (18 measurements), and DO concentrations less than 2 mg/L (13 reliable measurements) contributed to samples failing several criteria of the well screen analysis (Table B-1).

Well screen tests for four criteria were not applicable in the updated analysis for R-20 screens 1 and 2 because:

- groundwater samples were not analyzed for acetone, TKN, and ammonia, and
- analytical detection limitation for perchlorate. Perchlorate was analyzed by using the ion chromatography method, which has a method detection limit (MDL) greater than 0.005 ppm.

2.6.5 Geochemical Comparison of Westbay and Pumping Test Samples

A geochemical comparison of selected analytes and pH was performed on the R-20 screens 1 and 2 samples to evaluate sampling methodologies using Westbay equipment and a submersible pump. This comparison included analytical results for seven and five previous sampling events for R-20 screens 1 and 2, respectively. The sampling events were conducted from September 20, 2004, to October 2, 2006 (R-20 screen 1) and from September 3, 2004, to June 7, 2006 (R-20 screen 2) using Westbay equipment, and four pumping tests were conducted on July 6 and 8, 2006, November 30, 2007, and December 3 and 4, 2007. Concentrations of dissolved calcium, chloride, sulfate, nitrate(N), iron, manganese, uranium, vanadium, and zinc were generally lower in samples using Westbay equipment in comparison to those collected during the four pumping tests conducted in 2006 and 2007 (Table B-1). Concentrations of total carbonate alkalinity, TOC, and dissolved sodium, however, were generally higher in samples using Westbay equipment in comparison to those collected during the four pumping tests (Table B-1). Energetic purging or pumping of R-20 screens 1 and 2 allowed groundwater outside of the filter pack to be sampled, providing more reducing groundwater samples potentially impacted by residual drilling effects based on elevated concentrations of dissolved iron. Dissolved concentrations of iron could result from partial reductive dissolution of HFO present in the regional aquifer at R-20 screens 1 and 2, based on elevated concentrations of dissolved iron measured during the 2006 and 2007 pumping tests. It is clear that excess TOC concentrations measured from 2004 to 2006 are most likely derived from residual QUIK-FOAM and other drilling additives associated with drilling of R-20. Concentrations of TOC measured during the 2007 pumping tests conducted at R-20 screens 1 and 2 are lower than previous values as more residual organic-based drilling fluid breaks down and oxidizes to inorganic carbon in the form of total carbonate alkalinity. Turbidity significantly decreased during the 2007 pumping tests conducted at R-20 screens 1 and 2 (Tables 2.7-2 and 2.7-3).

3.0 MINERALOGY

Solids from a turbid groundwater sample collected immediately after pumping commenced at screen 1 at well R-20 on November 16, 2007 were analyzed by x-ray diffraction (XRD). The bulk of the solids settled out overnight and the remaining suspended solids were removed by centrifugation. Those solids collected by centrifugation represent the <1.5-µm-size fraction; the collected mass of this fine fraction was <1% of the total but does not account for similar material that may be bound in uncrushed coarser particles.

Figure 3.0-1 shows the XRD pattern for the coarser bulk sample, mixed with corundum as an internal standard. The dominant mineral present is quartz; among the other minerals present are smectite, mica, feldspar, and talc. This same mineralogy was observed in the particulates from screen 1 when R-20 was pumped in July 2006 (LANL 2007, 095889). Talc is used as a coating on PelPlug and is a characteristic tracer for that annular fill material. The high quartz content is also significant, since quartz is rare (<1%) in the local host rock (trachyandesite scoria) at screen 1. The high quartz abundance in this sample is of uncertain origin; it may be mobilized fines from the filter pack or transition sands at screen 1, or it may have been introduced from another horizon when the interval from 765 to 933 ft was reamed after cement was set to the 785 ft depth. The steady and abundant occurrence of fine quartz drawn through this screen suggests that a sizeable source may be involved.

Analysis of the fine fraction (Figure 3.0-2) provides some detail for the most mobile constituents (the finest fraction). Smectite predominates, and talc is still prominent; notably, quartz is also present, indicating that some the quartz observed is extremely fine-grained.

4.0 CONCLUSIONS

The following bullets summarize the results of redevelopment at R-20.

- Well development procedures provided good increases in hydraulic performance of the salvaged screen zones in R-20. The postdevelopment yields of screens 1 and 2 were 92% and 25% greater, respectively, than those before development, supporting the use of the chosen development methods, primarily simultaneous pumping and high velocity jetting. However, the hydraulic gains obtained for screen 2 were lost because of hydraulic compaction of the near-well sediments that occurred when operating a deep-set pump incorporating inflatable packers. The final specific capacity of screen 2 was less than that obtained before redevelopment when the magnitude of the drawdown was carefully constrained. If similar conditions are encountered in the future, it may be beneficial to explore or develop practical methods to automatically constrain the discharge rate and/or drawdown to prevent the deleterious effects of applying extreme drawdown to producing zones.
- Solids from a sample of turbid groundwater collected from screen 1 at well R-20 on November 16, 2007, were analyzed by XRD. The dominant mineral present is quartz; the other minerals present are smectite, mica, feldspar, and talc. This same mineralogy was observed in the particulates from screen 1 when R-20 was pumped in July 2006. Talc is used as a coating on PelPlug and is a characteristic tracer for that annular-fill material. This finding indirectly, but strongly, suggests that there is annular seal bentonite opposite some portion of the screen.
- Most turbidity values were higher than 5 NTUs but decreased steadily during purging. The elevated turbidity likely was attributable to a combination of the corroded steel drop pipe used for pumping, the compromised annular seal of screen 1, the fine-grained formation, and normal, expected cleanup following aggressive well development.
- Sulfate concentrations in R-20 screen 2 exceed background values established for regional aquifer groundwater; this may be attributed to oxidation metal sulfide solids or to a residual bentonite effect.
- Increasing concentrations of dissolved iron measured during the 2007 pumping tests conducted at R-20 screens 1 and 2 (Figures 2.6-5 and 2.6-6) suggest that reductive dissolution of HFO

and/or oxidation of iron sulfide has taken place or that groundwater from reducing zones in the aquifer is being drawn into the well bore. This solute exceeds the upper background value for iron (0.147 mg/L) (LANL 2007, 095817). Iron concentrations in nonfiltered samples are greater than those in filtered samples collected from R-20 screen 1 and 2 (Tables A-2 and A-3), resulting from pipe corrosion and/or presence of HFO and iron sulfide within the regional aquifer.

- Taken together, the concentrations of TOC, TKN, and ammonia measured from 2004 to 2006 suggest the lingering presence of QUIK-FOAM and additional drilling products during well drilling.
- Groundwater samples analyzed from well R-20 screen 1 during the 2007 pumping test have an average well screen score of 89%, ranging from 85% to 91%. The well screen score for the July 2006 pumping test was 72%. Turbidity values greater than 5 NTUs (15 measurements), DO concentrations less than 2 mg/L (15 measurements), and excessive concentrations of dissolved iron (15 samples), barium (9 samples), boron (2 samples) and zinc (1 sample) exceeding Laboratory background levels contributed to samples failing several criteria of the 2007 well screen analysis.
- Groundwater samples analyzed from well R-20 screen 2 during the 2007 pumping test have an average well screen score of 88% ranging from 85% to 91%. The well screen score for the July 2006 pumping test was 89%. Turbidity values greater than 5 NTUs (18 measurements), DO concentrations less than 2 mg/L (13 measurements), and excessive concentrations of TOC (19 samples), boron (1 sample), dissolved iron (19 samples), barium (19 samples), sulfate (19 samples), and zinc (4 samples) exceeding Laboratory background levels contributed to samples failing several criteria of the 2007 well screen analysis.
- A geochemical comparison of selected analytes and pH was performed on the R-20 screens 1 and 2 samples to evaluate sampling methodologies used Westbay equipment and a submersible pump. Concentrations of dissolved calcium, chloride, sulfate, nitrate(N), iron, manganese, uranium, vanadium, and zinc were generally lower in samples using Westbay equipment in comparison to those collected during the four pumping tests conducted in 2006 and 2007. Concentrations of total carbonate alkalinity, TOC, and dissolved sodium, however, were generally higher in samples using Westbay equipment in comparison to those collected during the four pumping tests. Energetic purging or pumping of R 20 screens 1 and 2 allowed groundwater outside of the filter pack to be sampled, providing more reducing groundwater samples potentially impacted by residual drilling effects based on elevated above background concentrations of dissolved iron. Excess TOC concentrations measured from 2004 to 2006 are most likely derived from residual QUIK-FOAM and additional organic drilling fluids associated with drilling R-20. Concentrations of TOC measured during the 2007 pumping tests conducted at R-20 screens 1 and 2 are lower than previous values as more residual organic-based drilling fluid breaks down and oxidizes to inorganic carbon in the form of total carbonate alkalinity.
- The overall conclusion is that redevelopment activities significantly improved the specific capacity at R-20 screen 1 and (temporarily) at screen 2. Water quality also improved somewhat at screen 1 and remained about the same at screen 2 compared with October 2006 results of the well screen analysis.
- All planned activities were completed successfully with the exception of installation of the pumps and sampling system. These activities will take place when the materials arrive.

5.0 REFERENCES

The following list includes all documents cited in this appendix. Parenthetical information following each reference provides the author(s), publication date, and ER ID number. This information is also included in text citations. ER ID numbers are assigned by the Environmental Programs Directorate's Records Processing Facility (RPF) and are used to locate the document at the RPF and, where applicable, in the master reference set.

Copies of the master reference set are maintained at the NMED Hazardous Waste Bureau; the U.S. Department of Energy–Los Alamos Site Office; the U.S. Environmental Protection Agency, Region 6; and the Directorate. The set was developed to ensure that the administrative authority has all material needed to review this document, and it is updated with every document submitted to the administrative authority. Documents previously submitted to the administrative authority are not included.

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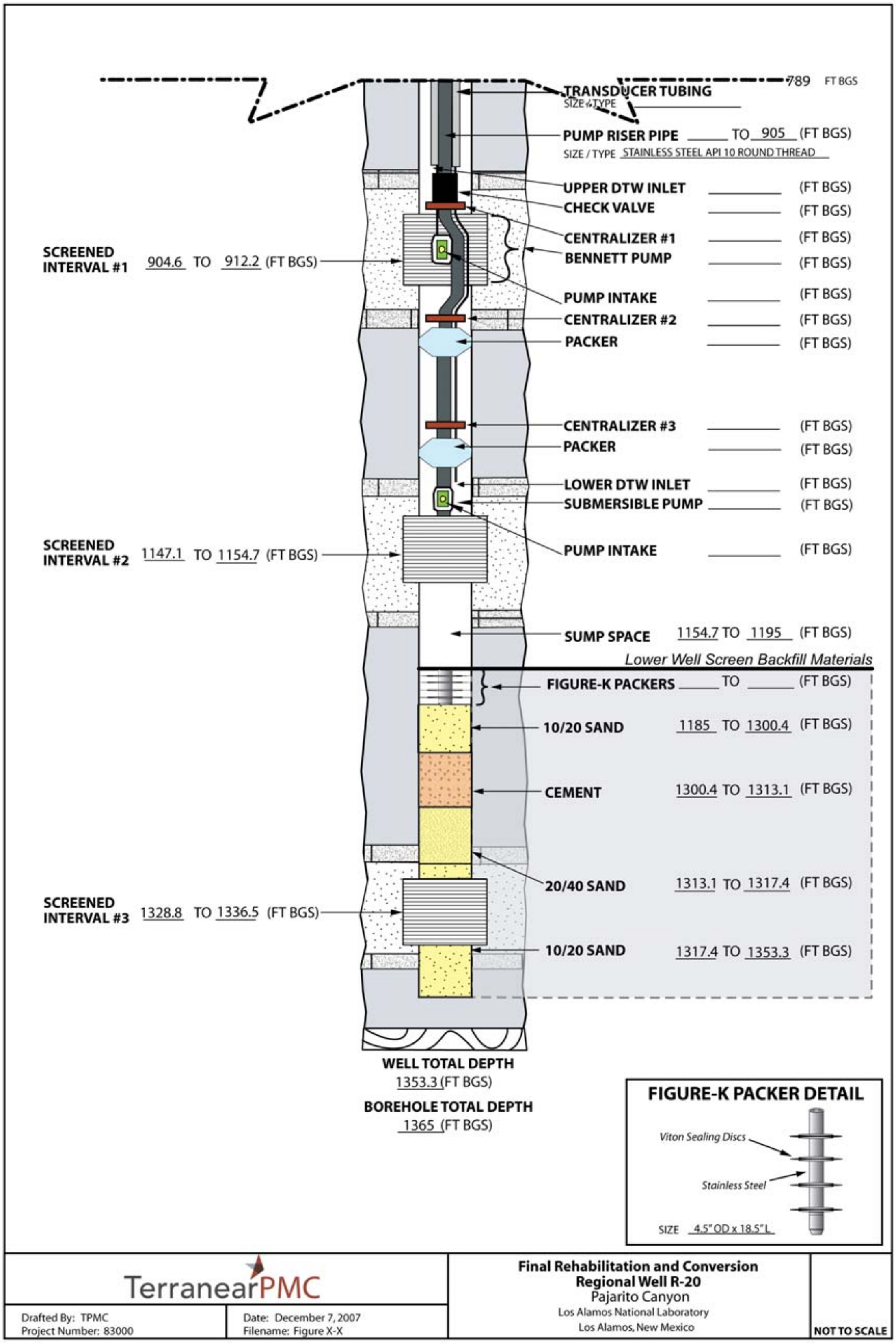

Figure 2.4-1 Well R-20 final rehabilitation and conversion configuration

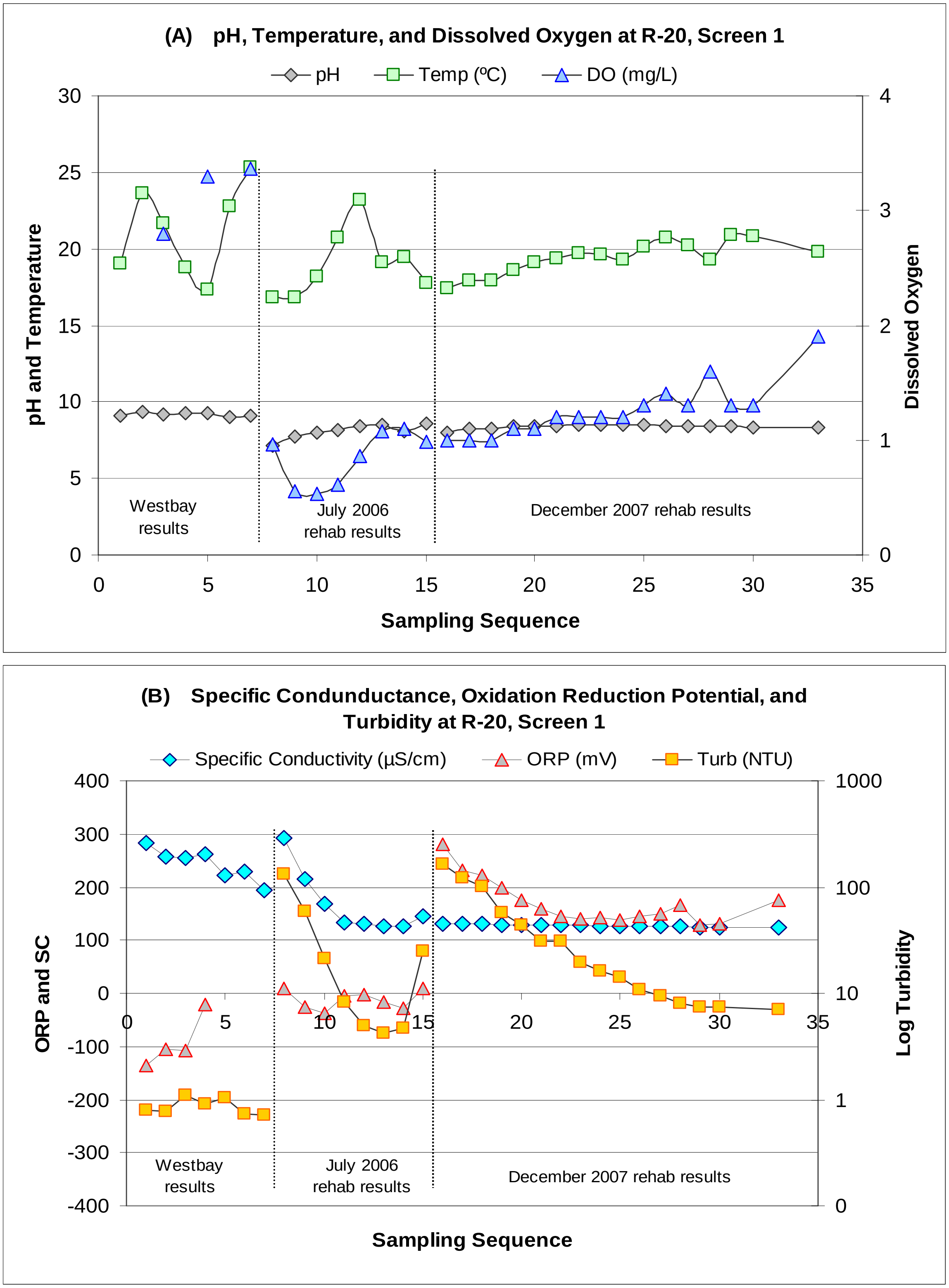

Figure 2.6-1 Field parameters measured at R-20 screen 1 from 2004 through 2007: (A) pH, temperature, and dissolved oxygen and (B) Specific conductance, oxidation reduction potential and turbidity

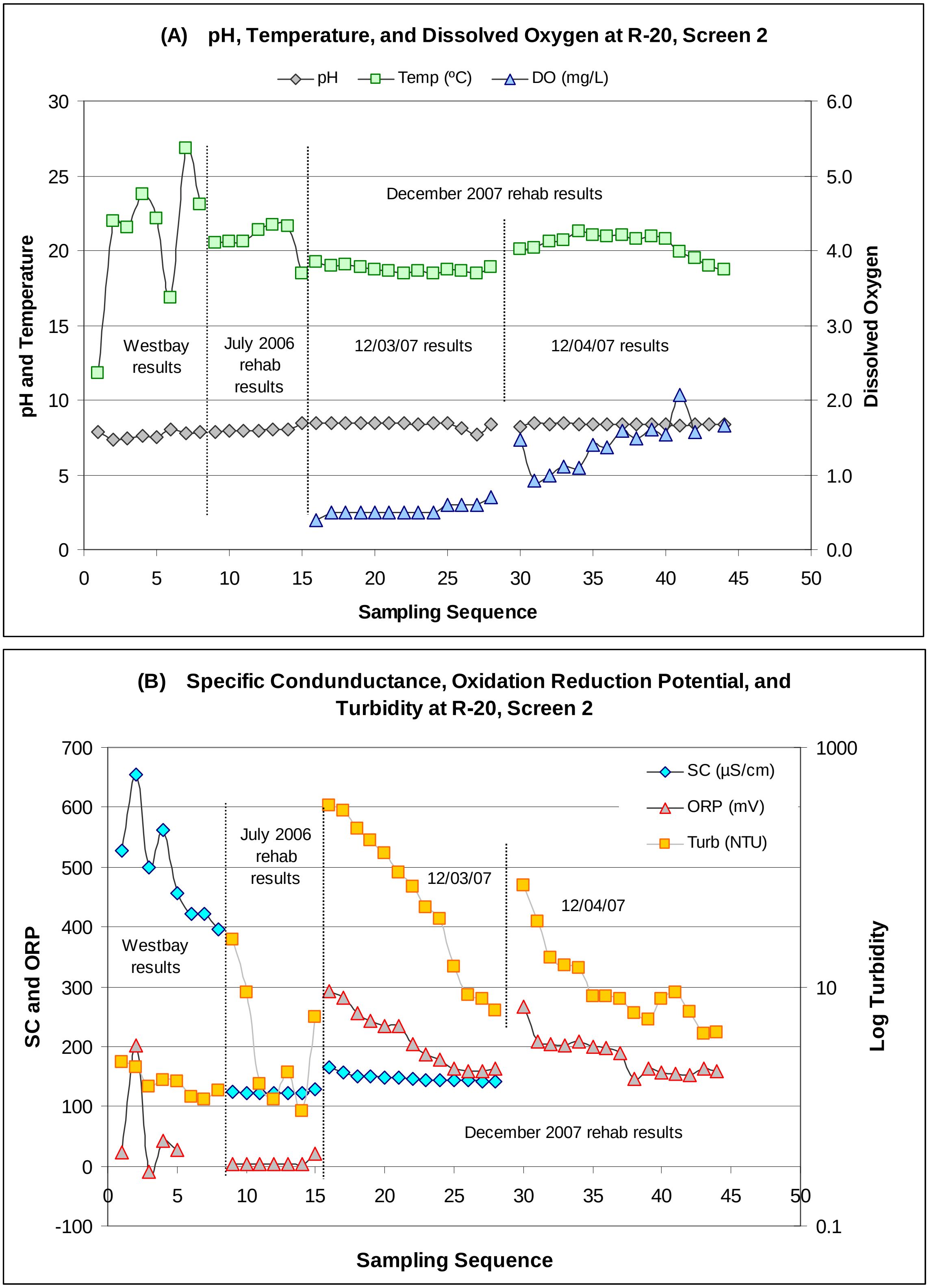

Figure 2.6-2 Field parameters measured at R-20 screen 2 from 2004 through 2007: (A) pH, temperature, and dissolved oxygen and (B) Specific conductance, oxidation reduction potential, and turbidity

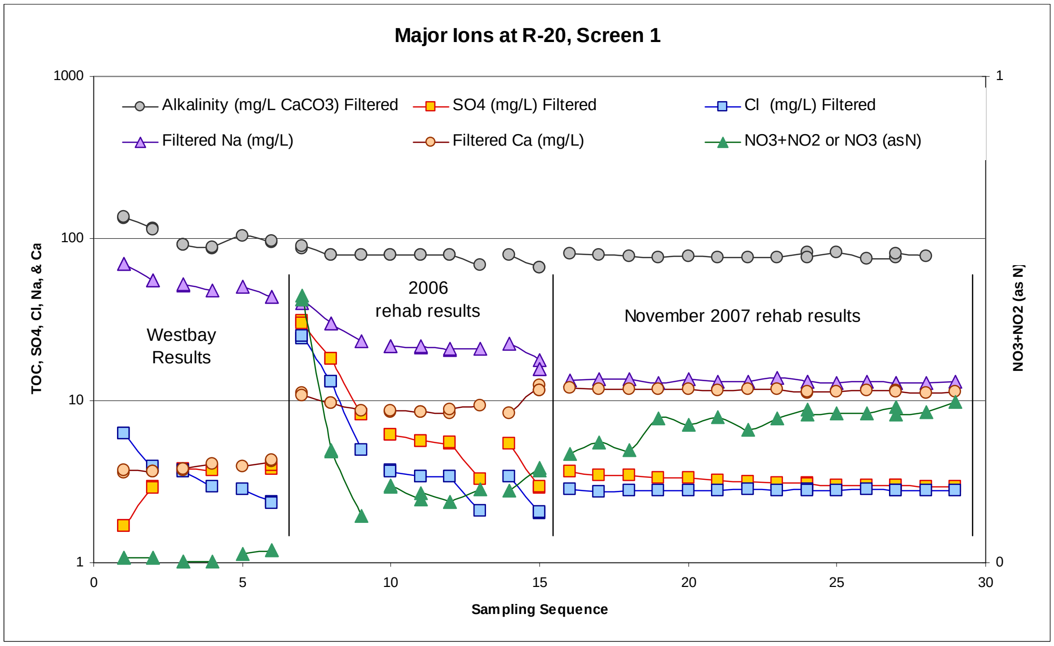

Figure 2.6-3 **Sample sequence versus dissolved concentrations of total carbonate alkalinity, sodium (Na), calcium (Ca), chloride (Cl), sulfate (SO_4), nitrate plus nitrite(N) (NO_2+NO_3-N), and nitrate(N) (NO_3-N) during characterization sampling using Westbay equipment and pumping tests conducted in July 2006 and December 2007 at R-20 screen 1**

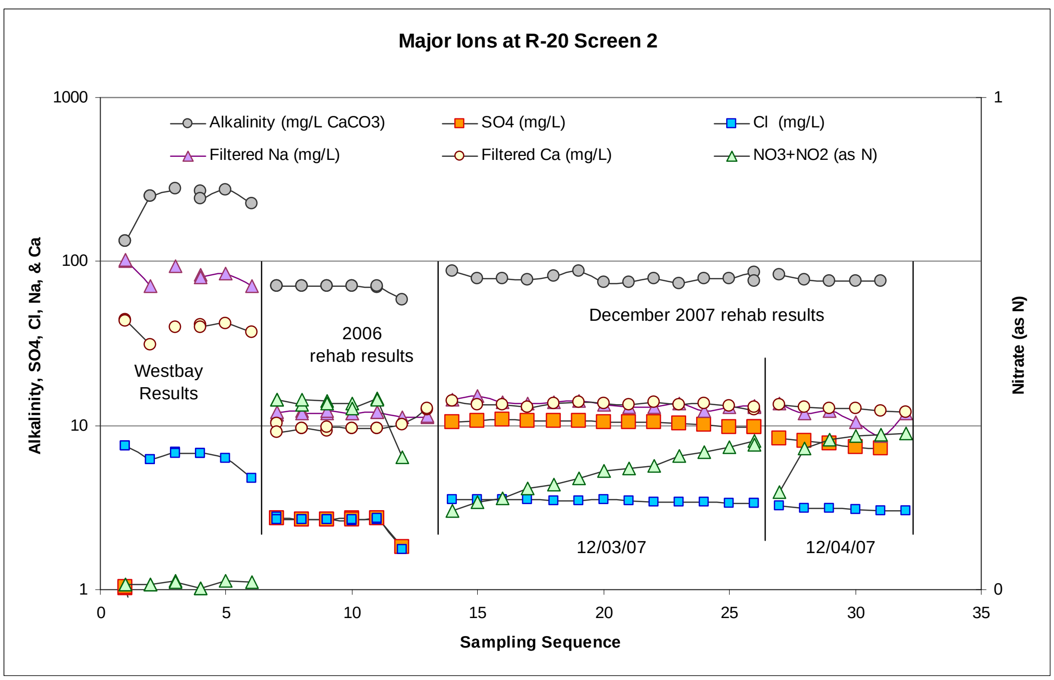

Figure 2.6-4 **Sample sequence versus dissolved concentrations of total carbonate alkalinity, sodium (Na), calcium (Ca), chloride (Cl), sulfate (SO_4), nitrate plus nitrite(N) (NO_2+NO_3-N), and nitrate(N) (NO_3-N) during characterization sampling using Westbay equipment and pumping tests conducted in July 2006 and December 2007 at R-20 screen 2**

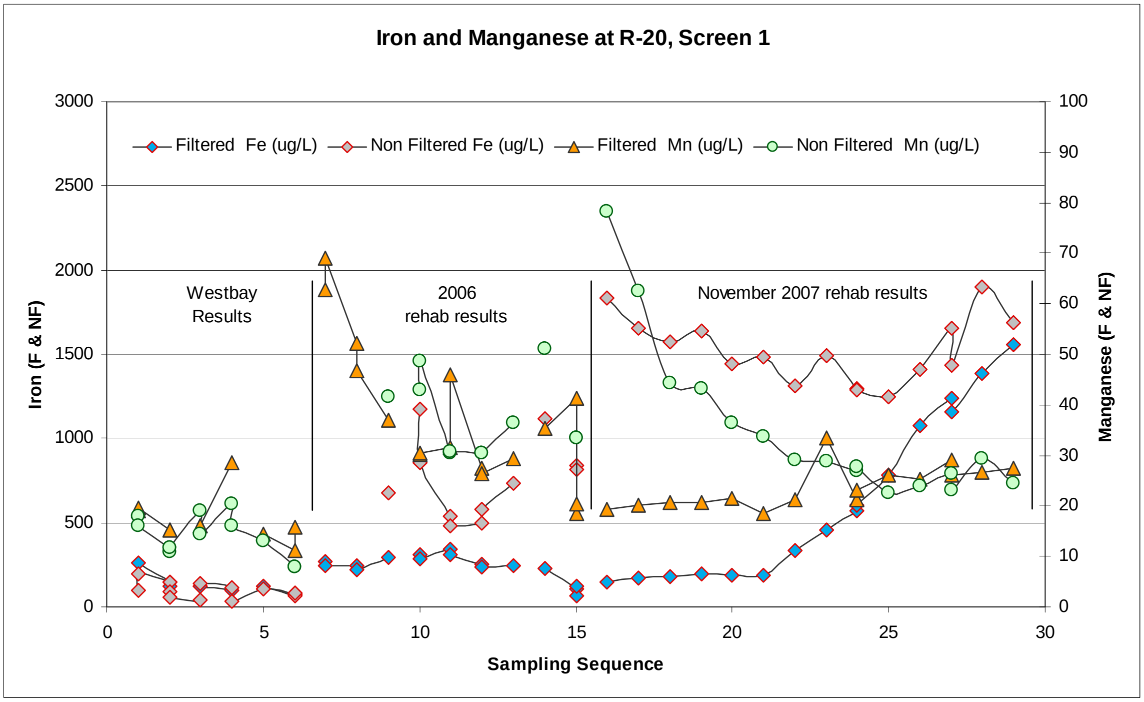

Figure 2.6-5 **Sample sequence versus dissolved and total concentrations of iron (Fe) and manganese (Mn) during characterization sampling using Westbay equipment and pumping tests conducted in July 2006 and November 2007 at R-20 screen 1**

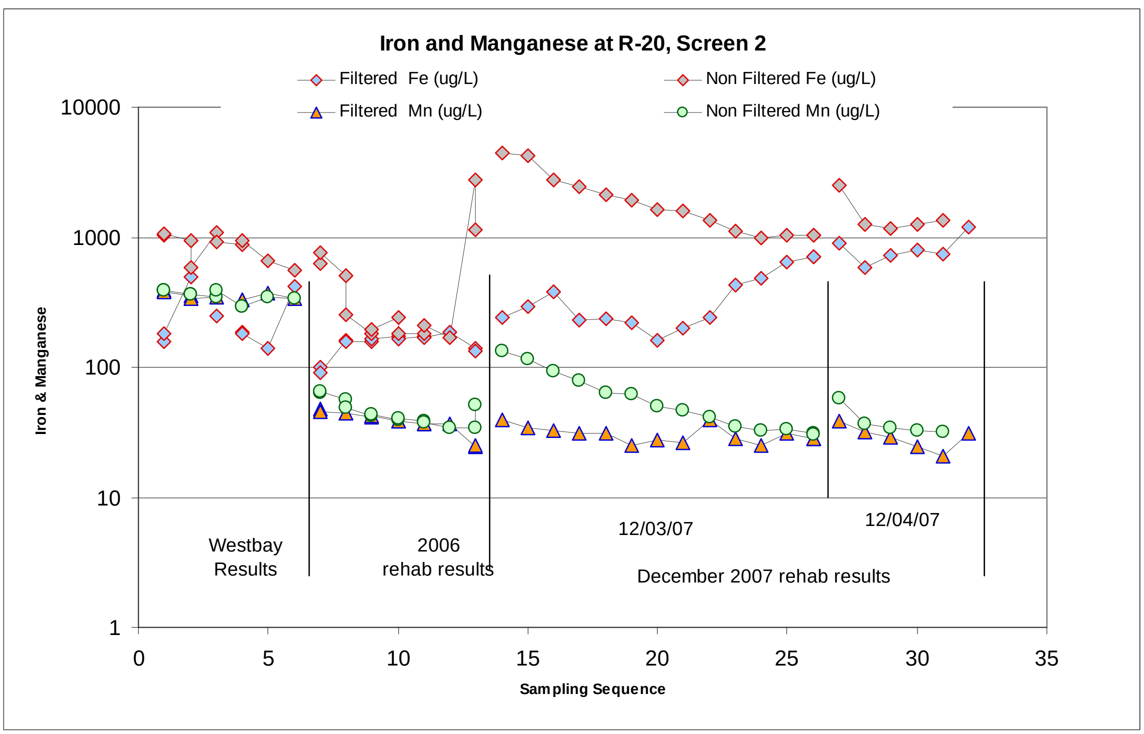

Figure 2.6-6 **Sample sequence versus dissolved and total concentrations of iron (Fe) and manganese (Mn) during characterization sampling using Westbay equipment and pumping tests conducted in July 2006 and December 2007 at R-20 screen 2**

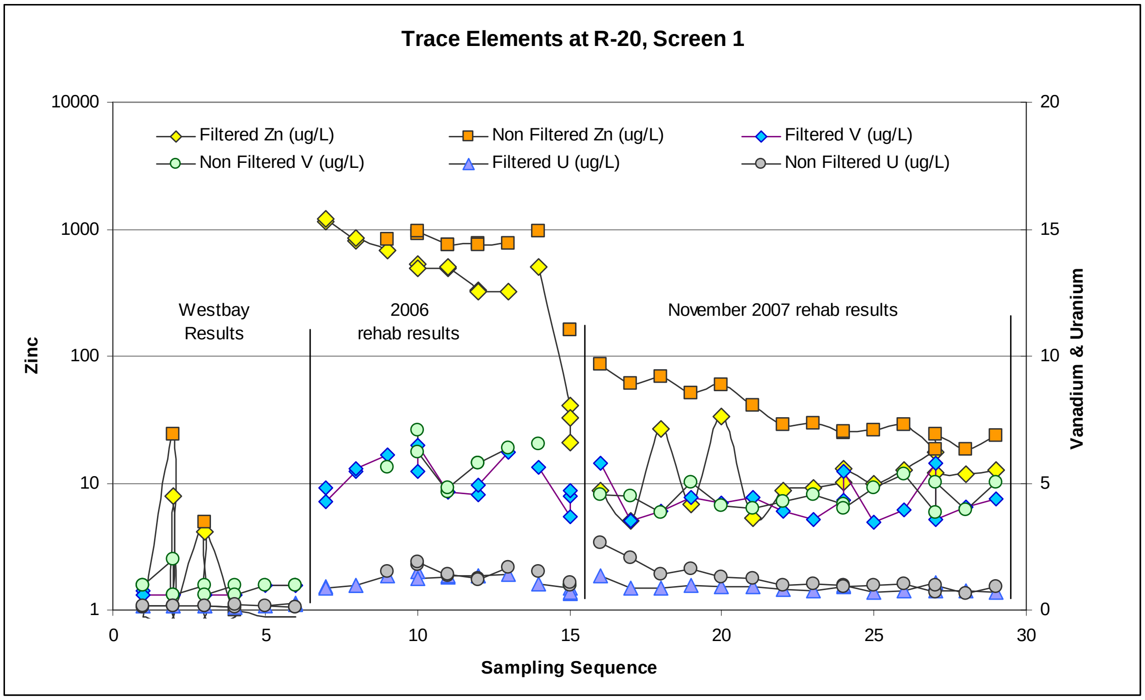

Figure 2.6-7 Sample sequence versus dissolved and total concentrations of zinc (Zn), vanadium (V), and uranium (U) during characterization sampling using Westbay equipment and pumping tests conducted in July 2006 and November 2007 at R-20 screen 1

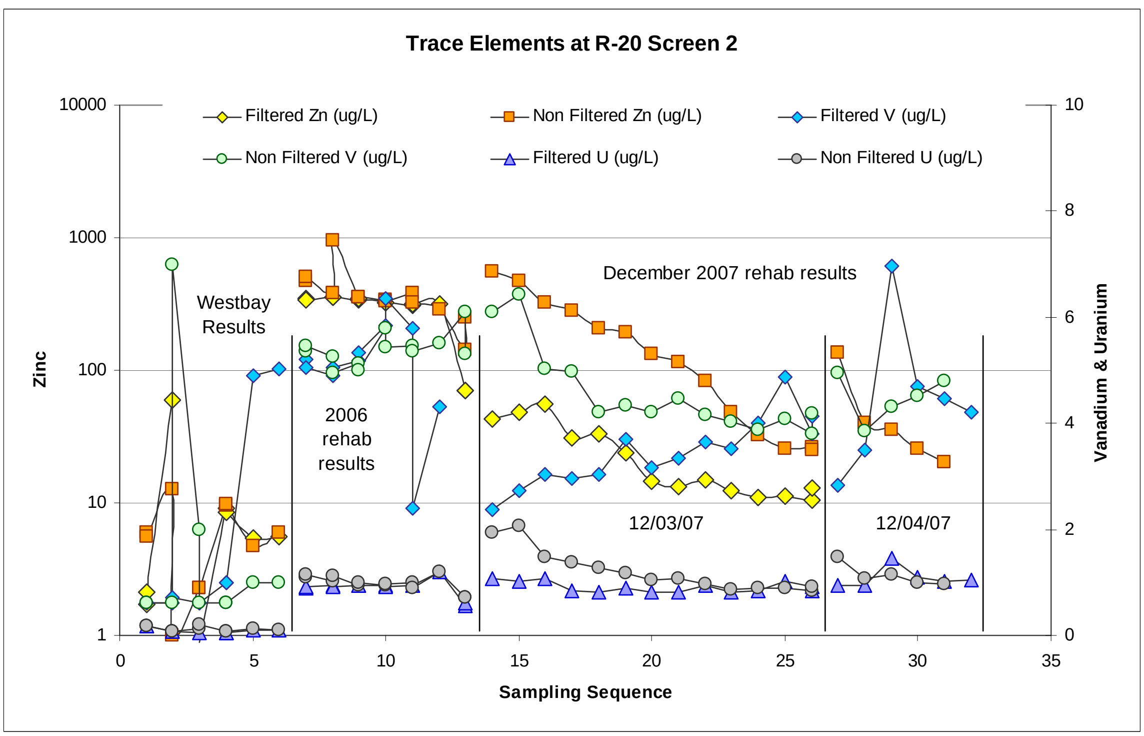

Figure 2.6-8 Sample sequence versus dissolved and total concentrations of zinc (Zn), vanadium (V), and uranium (U) during characterization sampling using Westbay equipment and pumping tests conducted in July 2006 and December 2007 at R-20 screen 2

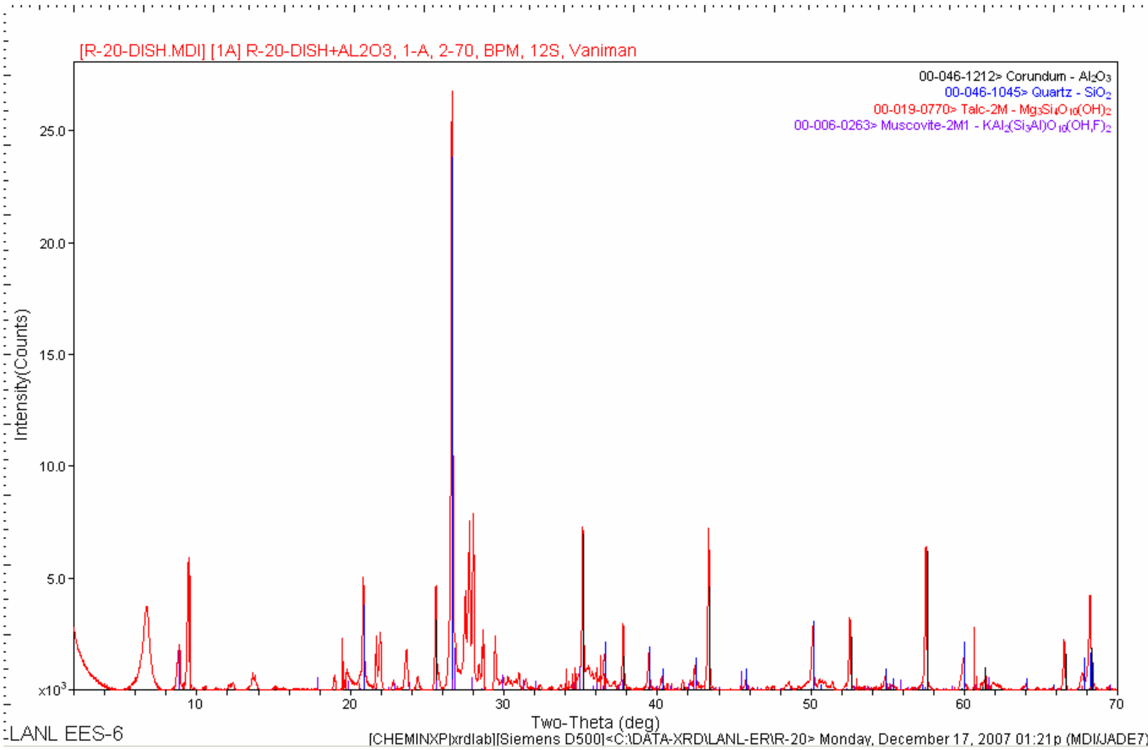

Figure 3.0-1 X-ray diffraction pattern of coarse fraction of solids collected at R-20 screen 1

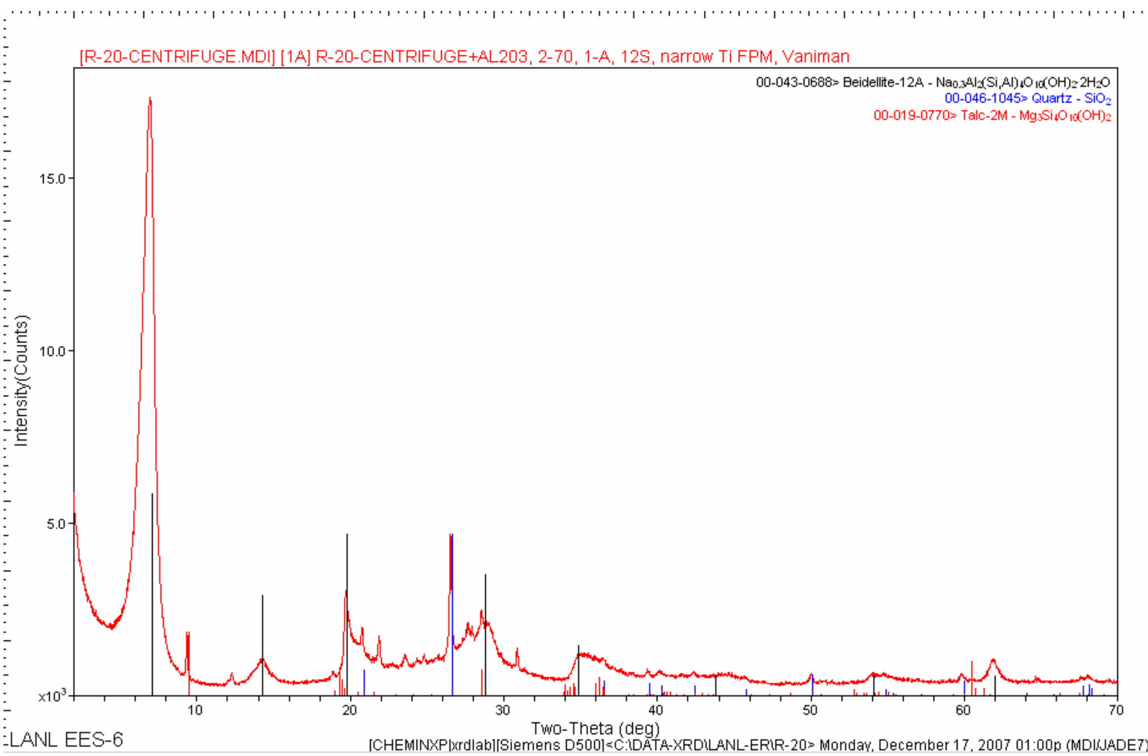

Figure 3.0-2 X-ray diffraction pattern of fine fraction of solids collected at R-20 screen 1

Table 2.2-1
Well R-20 Video Log Information

	Depth to :		
	Top	Bottom	Remarks
SWL	850 ft 10 in.	N/A	Composite static water level
Screen #1	905 ft 9 in.	912 ft 11 in.	Pipe-based; visibility excellent; screen interval appears clean; fines resting on lower lip of hole perforations.
Screen #2	1148 ft 1 in.	1155 ft 1 in.	Pipe-based; visibility very good to good; screen interval appears clean; fines resting on lower lip of hole perforations.

Table 2.5-1
R-20 Screen 1 and 2 Pumping Results

Date	Zone	Pumping Rate (gal./min)	Drawdown (ft)	Pumping Time (min)	Specific Capacity (gal./min/ft)
Baseline Data from 2006					
8/27/2006	Screens 1 and 2	1.35	74.2	531	0.0182
10/17/2006	Screen 1	0.65	62.2	368	0.0105
	Screen 2				0.0077
Postdevelopment Data from 2007					
11/29/2007	Screen 1	1.47	65.8	77	0.0223
	Screen 2	0.60[a]	59.9[b]	77	0.0100
11/30/2007	Screen 1	1.55	74.0	30	0.0209
	Screen 1	1.43	70.9	420	0.0202
12/3/2007	Screen 2	0.53[a]	59.8[b]	30	0.0089
	Screen 2	1.07[a]	109.5[b]	35	0.0098
	Screen 2	1.50	314.8	30	0.0048
	Screen 2	1.43	315.5	180	0.0045
	Screen 2	1.32	311.7	341	0.0042
12/4/2007	Screen 2	1.20	290.8	34	0.0041
	Screen 2	1.23	307.1	200	0.0040
	Screen 2	1.22	315.4	454	0.0039

[a] Inferred.

[b] Estimated.

Table 2.6-1
Data Quality Objectives: Process and
Sampling for the R-20 Well Rehabilitation and Conversion Project

Process/Step	Purpose	Sample Collection	Field Parameters	Frequency/ Number of Samples
Remove packer isolation string	Prepare well for rehabilitation	None	None	None
Run camera survey	Evaluate screen #1 and 2 conditions	DVD/VHS tape	None	0 ft to 1155 ft
Jet screen #1 & #2	Redevelop screen #1 & #2	None	None	None
Swab screen #1 & #2	Redevelopment	None	None	None
Abandon screen #3	To isolate and abandon screen #3	None	None	None
Pump screen #1 and screen #2 to evaluate chemistry	Measure specific capacity and assess water quality during sustained pumping	Performance suite (see definitions below)	pH, ORP, transmissivity (T), SC, dissolved oxygen (DO), turbidity	Every 5 min for first 30 min; 10 min for next 30 min; 30 min for minimum 3 h; each hour until end of specific capacity test [25 samples total per screen]
Install Baski dual pump sample system	Long-term sampling	None	None	None
Performance measurement, *post* submersible pump installment	Test effects of rehabilitation	Sample 1 month after installation; full suite analysis. Followed by semiannual, per “2007 Interim Facility-Wide Groundwater Monitoring Plan” requirements and schedule	pH, ORP, T, EC, DO, turbidity	One filtered/nonfiltered pair
Performance measurement *after* submersible pump installment	Test effects of rehabilitation	Semiannual per watershed requirements and schedule	pH, ORP, T, EC, DO, turbidity	One filtered/nonfiltered pair.

Notes: Performance suite: sulfate, TOC, metals, alkalinity, anions (including perchlorate) and cations, from the EES-6 laboratory.
Full analytical suite: volatile organic compound, semivolatile organic compound, general inorganics (including alkalinity), metals, stable isotopes of hydrogen, oxygen, and nitrogen (only during initial and final sampling of each screen).

Table 2.6-2
Field Parameters Measured at R-20 Screens 1 and 2

Date	Time	pH	Temp (ºC)	Specific Conductivity (µS/cm)	DO (mg/L)	Turb (NTU)	ORP (mV)	Q (gal./min)
A. Field Parameters R-20 Screen 1								
Characterization and Monitoring Results								
03/15/04	10:58	9.09	19.0	282	na[a]	0.8	-135	na
05/10/04	12:55	9.32	23.6	257	na	0.8	-104	na
05/11/04	8:35	9.19	21.7	254	2.80	1.1	-108	na
09/20/04	11:07	9.26	18.8	263	na	0.9	-21	na
11/04/04	11:56	9.29	17.3	223	3.30	1.1	na	na
07/20/05	9:00	9.01	22.8	230	na	0.7	na	na
06/06/06	10:18	9.07	25.3	195	3.37	0.7	na	na
First Rehabilitation Results								
07/06/06	13:33	7.18	16.8	293	0.96	133.0	10	0.8
07/06/06	13:44	7.76	16.8	215	0.56	58.9	-26	0.8
07/06/06	13:54	8.02	18.2	168	0.53	21.4	-37	0.8
07/06/06	14:42	8.16	20.7	133	0.61	8.2	-5	0.8
07/06/06	15:17	8.39	23.2	132	0.86	5.0	-3	0.8
07/06/06	15:47	8.49	19.1	127	1.08	4.2	-17	0.8
07/06/06	16:05	8.08	19.5	127	1.10	4.7	-28	0.8
01/22/07	14:55	8.60	17.8	145	0.99	25.0	9	0.8
Second Rehabilitation Results								
11/30/07	9:55	7.96	17.4	132	1	164.0	281	1.5
11/30/07	10:00	8.21	17.9	131	1	123.0	231	1.5
11/30/07	10:05	8.27	17.9	131	1	101.0	222	1.5
11/30/07	10:10	8.40	18.6	129	1.1	58.0	199	1.5
11/30/07	10:15	8.41	19.1	129	1.1	43.5	175	1.5
11/30/07	10:20	8.44	19.4	129	1.2	31.0	160	1.5
11/30/07	10:25	8.46	19.7	128	1.2	31.0	146	1.5
11/30/07	10:35	8.48	19.6	128	1.2	19.5	140	1.5
11/30/07	10:45	8.49	19.3	127	1.2	16.2	142	1.5
11/30/07	10:55	8.47	20.1	127	1.3	14.1	139	1.47
11/30/07	11:25	8.45	20.7	126	1.4	10.7	144	1.47
11/30/07	11:55	8.43	20.2	125	1.3	9.5	149	1.47
11/30/07	12:25	8.42	19.3	126	1.6	8.0	166	1.47
11/30/07	12:55	8.39	20.9	124	1.3	7.5	128	1.47
11/30/07	13:55	8.37	20.8	124	1.3	7.4	132	1.47
11/30/07	14:45	8.35	19.8	124	1.9	7.1	175	1.47

Table 2.6-2 (continued)

Date	Time	pH	Temp (ºC)	Specific Conductivity (µS/cm)	DO (mg/L)	Turb (NTU)	ORP (mV)	Q (gal./min)
B. Field Parameters R-20 Screen 2								
Characterization and Monitoring Results								
03/10/04	12:12	7.86	11.8	528	na	2.3	23	na
05/04/04	11:10	7.31	22.0	655	na	2.1	201	na
05/05/04	12:25	7.45	21.5	500	na	1.5	-11	na
09/03/04	10:30	7.64	23.8	562	na	1.6	43	na
09/07/04	9:30	7.53	22.1	456	na	1.6	27	na
11/08/04	10:50	8.05	16.8	421	na	1.2	na	na
07/19/05	10:06	7.77	26.8	421	na	1.1	na	na
06/07/06	12:54	7.84	23.1	397	na	1.4	na	na
First Rehabilitation Results								
07/08/06	10:20	7.89	20.5	123	na	24.9	3	na
07/08/06	10:30	7.94	20.6	122	na	9.0	3	na
07/08/06	10:40	7.95	20.6	123	na	1.5	3	na
07/08/06	11:10	7.99	21.4	122	na	1.1	3	na
07/08/06	11:40	8.02	21.7	122	na	1.9	4	na
07/08/06	11:50	8.01	21.6	122	na	0.9	4	na
01/22/07	11:23	8.50	18.5	128	na	5.5	20	na
Second Rehabilitation Results								
12/03/07	1:30	8.42	19.2	165	0.4	331.0	293	1.44
12/03/07	1:35	8.45	19.0	157	0.5	299.0	281	1.44
12/03/07	1:40	8.46	19.1	151	0.5	207.0	255	1.44
12/03/07	1:45	8.47	18.9	149	0.5	167.4	243	1.44
12/03/07	1:50	8.49	18.7	148	0.5	130.0	235	1.44
12/03/07	1:55	8.50	18.6	147	0.5	90.6	234	1.44
12/03/07	2:05	8.48	18.5	147	0.5	69.2	204	1.44
12/03/07	2:15	8.41	18.6	145	0.5	45.5	187	1.44
12/03/07	2:25	8.45	18.5	145	0.5	37.0	178	1.44
12/03/07	2:55	8.46	18.7	144	0.6	14.8	164	1.41
12/03/07	3:25	8.15	18.6	143	0.6	8.6	159	1.41
12/03/07	3:55	7.68	18.5	142	0.6	8.0	159	1.41
12/03/07	4:25	8.35	18.9	141	0.7	6.4	164	1.41
12/04/07	10:10	8.20	20.1	29.7[b]	1.4[b]	70.6	266	1.23
12/04/07	10:30	8.42	20.2	30.1[b]	0.9[b]	35.4	208	1.23
12/04/07	10:50	8.41	20.6	29.1[b]	1.0[b]	17.4	205	1.23
12/04/07	11:10	8.42	20.7	28.7[b]	1.1[b]	15.2	201	1.23
12/04/07	11:30	8.41	21.3	28.6[b]	1.1[b]	14.3	208	1.23

Table 2.6-2 (continued)

Date	Time	pH	Temp (ºC)	Specific Conductivity (µS/cm)	DO (mg/L)	Turb (NTU)	ORP (mV)	Q (gal./min)
12/04/07	11:50	8.37	21.0	28.4[b]	1.4[b]	8.2	200	1.23
12/04/07	12:10	8.38	20.9	28.4[b]	1.3[b]	8.4	197	1.23
12/04/07	12:30	8.36	21.0	28.2[b]	1.6[b]	7.9	188	1.23
12/04/07	12:50	8.36	20.8	28.2[b]	1.5[b]	6.0	146	1.23
12/04/07	1:10	8.35	20.9	27.9[b]	1.6[b]	5.3	162	1.23
12/04/07	1:30	8.35	20.8	27.8[b]	1.5[b]	7.8	157	1.23
12/04/07	1:50	8.30	19.9	28.0[b]	2.1[b]	9.0	155	1.23
12/04/07	2:10	8.34	19.5	27.9[b]	1.6[b]	6.1	153	1.23
12/04/07	2:30	8.34	19.0	27.8[b]	na	4.1	164	1.23
12/04/07	4:40	8.34	18.7	27.8[b]	1.7[b]	4.2	158	1.23

[a] na = Not available.

[b] Data is suspect.

Appendix A

Analytical Data Results

Table A-1
Laboratory-Measured Analytical Results for R-20 Screen 1

SAMPLE ID	DATE COLLECTED	DATE RECEIVED	ER/RRES-WQH	Time	Field pH	Temp C	Cond uS/cm	Dissolved O2 mg/L	Turb NTU	ORP mV
R-20 Screen 1										
GW20-08-8880 (F)	11/29/2007	11/29/2007	08-276	Not Applicable	Not Applicable	Not Applicable	Not Applicable	Not Applicable	Not Applicable	Not Measured
GW20-08-9004 (NF)	11/29/2007	11/29/2007	08-275	Not Applicable	Not Applicable	Not Applicable	Not Applicable	Not Applicable	Not Applicable	Not Measured
GW20-08-8883 (F)	11/30/2007	12/3/2007	08-301	955	7.96	17.4	132	1	164	281
GW20-08-9007 (NF)	11/30/2007	12/3/2007	08-300	955	7.96	17.4	132	1	164	281
GW20-08-8887 (F)	11/30/2007	12/3/2007	08-301	1000	8.21	17.9	130.9	1	123	231
GW20-08-9011 (NF)	11/30/2007	12/3/2007	08-300	1000	8.21	17.9	130.9	1	123	231
GW20-08-8888 (F)	11/30/2007	12/3/2007	08-301	1005	8.27	17.9	130.7	1	101	222
GW20-08-9012 (NF)	11/30/2007	12/3/2007	08-300	1005	8.27	17.9	130.7	1	101	222
GW20-08-8889 (F)	11/30/2007	12/3/2007	08-301	1010	8.4	18.6	129.3	1.1	58	199
GW20-08-9013 (NF)	11/30/2007	12/3/2007	08-300	1010	8.4	18.6	129.3	1.1	58	199
GW20-08-8890 (F)	11/30/2007	12/3/2007	08-301	1015	8.41	19.1	129	1.1	43.5	175
GW20-08-9014 (NF)	11/30/2007	12/3/2007	08-300	1015	8.41	19.1	129	1.1	43.5	175
GW20-08-8891 (F)	11/30/2007	12/3/2007	08-301	1025	8.46	19.7	128.2	1.2	31	146
GW20-08-9015 (NF)	11/30/2007	12/3/2007	08-300	1025	8.46	19.7	128.2	1.2	31	146
GW20-08-8892 (F)	11/30/2007	12/3/2007	08-301	1035	8.48	19.6	127.6	1.2	19.5	140
GW20-08-9016 (NF)	11/30/2007	12/3/2007	08-300	1035	8.48	19.6	127.6	1.2	19.5	140
GW20-08-8893 (F)	11/30/2007	12/3/2007	08-301	1045	8.49	19.3	127	1.2	16.2	142
GW20-08-9017 (NF)	11/30/2007	12/3/2007	08-300	1045	8.49	19.3	127	1.2	16.2	142
GW20-08-8875 (F)	11/30/2007	12/3/2007	08-301	1055	8.47	20.1	126.9	1.3	14.1	139
GW20-08-8882 (F)	11/30/2007	12/3/2007	08-301	1055	8.47	20.1	126.9	1.3	14.1	139
GW20-08-8998 (NF)	11/30/2007	12/3/2007	08-300	1055	8.47	20.1	126.9	1.3	14.1	139
GW20-08-8999 (NF)	11/30/2007	12/3/2007	08-300	1055	8.47	20.1	126.9	1.3	14.1	139
GW20-08-9006 (NF)	11/30/2007	12/3/2007	08-300	1055	8.47	20.1	126.9	1.3	14.1	139
GW20-08-8894 (F)	11/30/2007	12/3/2007	08-301	1125	8.45	20.7	126	1.4	10.7	144
GW20-08-9018 (NF)	11/30/2007	12/3/2007	08-300	1125	8.45	20.7	126	1.4	10.7	144
GW20-08-8895 (F)	11/30/2007	12/3/2007	08-301	1155	8.43	20.2	125.4	1.3	9.54	149
GW20-08-9019 (NF)	11/30/2007	12/3/2007	08-300	1155	8.43	20.2	125.4	1.3	9.54	149
GW20-08-8885 (F)	11/30/2007	12/3/2007	08-301	1225	8.42	19.3	125.7	1.6	8.01	166
GW20-08-8896 (F)	11/30/2007	12/3/2007	08-301	1225	8.42	19.3	125.7	1.6	8.01	166
GW20-08-9009 (NF)	11/30/2007	12/3/2007	08-300	1225	8.42	19.3	125.7	1.6	8.01	166
GW20-08-9020 (NF)	11/30/2007	12/3/2007	08-300	1225	8.42	19.3	125.7	1.6	8.01	166
GW20-08-8901 (F)	11/30/2007	12/3/2007	08-301	1355	8.37	20.8	123.9	1.3	7.42	132
GW20-08-9025 (NF)	11/30/2007	12/3/2007	08-300	1355	8.37	20.8	123.9	1.3	7.42	132
GW20-08-8899 (F)	11/30/2007	12/3/2007	08-301	1445	8.35	19.8	123.6	1.9	7.06	175
GW20-08-9023 (NF)	11/30/2007	12/3/2007	08-300	1445	8.35	19.8	123.6	1.9	7.06	175
NF means non filtered and F means filtered. IDL means instrument detection limit, which is equivalent to not detected denoted as U.										

Table A-1
Laboratory-Measured Analytical Results for R-20 Screen 1

Discharge rate (gal/m)	Ag rslt	stdev (Ag)	Al rslt	stdev (Al)	As rslt	stdev (As)	B rslt	stdev (B)	Ba rslt	stdev (Ba)	Be rslt
Not Measured	0.001	<IDL	0.008	0.001	0.0002	<IDL	0.025	0.000	0.008	0.000	0.001
Not Measured	0.001	<IDL	0.613	0.011	0.0002	<IDL	0.028	0.001	0.081	0.002	0.001
1.5	0.001	<IDL	0.067	0.014	0.0014	0.0002	0.023	0.000	0.092	0.022	0.001
1.5	0.001	<IDL	0.465	0.005	0.0012	0.0000	0.035	0.001	0.094	0.001	0.001
1.5	0.001	<IDL	0.046	0.001	0.0009	0.0000	0.019	0.000	0.057	0.001	0.001
1.5	0.001	<IDL	0.686	0.006	0.0011	0.0000	0.019	0.000	0.087	0.001	0.001
1.5	0.001	<IDL	0.055	0.001	0.0009	0.0001	0.017	0.000	0.062	0.003	0.001
1.5	0.001	<IDL	0.371	0.006	0.0010	0.0000	0.050	0.001	0.068	0.001	0.001
1.5	0.001	<IDL	0.043	0.000	0.0010	0.0002	0.016	0.000	0.067	0.013	0.001
1.5	0.001	<IDL	0.416	0.158	0.0012	0.0002	0.032	0.000	0.083	0.011	0.001
1.5	0.001	<IDL	0.024	0.000	0.0010	0.0001	0.016	0.000	0.060	0.006	0.001
1.5	0.001	<IDL	0.462	0.002	0.0010	0.0000	0.018	0.000	0.070	0.001	0.001
1.5	0.001	<IDL	0.015	0.000	0.0010	0.0000	0.015	0.000	0.068	0.004	0.001
1.5	0.001	<IDL	0.605	0.005	0.0009	0.0000	0.017	0.000	0.065	0.000	0.001
1.5	0.001	<IDL	0.033	0.000	0.0008	0.0000	0.032	0.001	0.054	0.004	0.001
1.5	0.001	<IDL	0.256	0.003	0.0009	0.0001	0.016	0.000	0.066	0.002	0.001
1.5	0.001	<IDL	0.016	0.000	0.0008	0.0000	0.064	0.002	0.050	0.000	0.001
1.5	0.001	<IDL	0.517	0.008	0.0010	0.0001	0.055	0.001	0.064	0.007	0.001
1.47	0.001	<IDL	0.019	0.001	0.0009	0.0001	0.041	0.000	0.067	0.010	0.001
1.47	0.001	<IDL	0.035	0.000	0.0011	0.0001	0.028	0.000	0.070	0.011	0.001
1.47	0.001	<IDL	0.008	0.000	0.0002	0.0000	0.020	0.000	0.001	<IDL	0.001
1.47	0.001	<IDL	0.098	0.002	0.0009	0.0000	0.021	0.000	0.064	0.001	0.001
1.47	0.001	<IDL	0.076	0.000	0.0009	0.0000	0.056	0.002	0.063	0.002	0.001
1.47	0.001	<IDL	0.018	0.000	0.0007	0.0000	0.036	0.001	0.049	0.000	0.001
1.47	0.001	<IDL	0.183	0.003	0.0010	0.0001	0.026	0.000	0.066	0.009	0.001
1.47	0.001	<IDL	0.022	0.000	0.0007	0.0000	0.028	0.000	0.059	0.002	0.001
1.47	0.001	<IDL	0.204	0.006	0.0009	0.0001	0.024	0.000	0.079	0.014	0.001
1.47	0.001	<IDL	0.015	0.000	0.0011	0.0003	0.020	0.000	0.085	0.026	0.001
1.47	0.001	<IDL	0.018	0.000	0.0007	0.0000	0.022	0.000	0.057	0.002	0.001
1.47	0.001	<IDL	0.128	0.003	0.0008	0.0000	0.018	0.000	0.055	0.000	0.001
1.47	0.001	<IDL	0.182	0.005	0.0009	0.0002	0.021	0.001	0.069	0.014	0.001
1.47	0.001	<IDL	0.043	0.000	0.0007	0.0000	0.020	0.000	0.054	0.001	0.001
1.47	0.001	<IDL	0.179	0.005	0.0007	0.0000	0.017	0.001	0.055	0.001	0.001
1.47	0.001	<IDL	0.027	0.000	0.0007	0.0000	0.026	0.000	0.053	0.001	0.001
1.47	0.001	<IDL	0.087	0.003	0.0009	0.0001	0.021	0.001	0.075	0.011	0.001

Table A-1
Laboratory-Measured Analytical Results for R-20 Screen 1

stdev (Be)	Br(-) ppm	Br(-) (U)	TOC rslt	TOC (U)	Ca rslt	stdev (Ca)	Cd rslt	stdev (Cd)	Cl(-) ppm	Cl(-) (U)	ClO4(-) ppm
<IDL	0.01	U	---		1.8	0.0	0.001	<IDL	0.24		
<IDL	0.01	U	0.69		17.2	0.1	0.001	<IDL	0.14		
<IDL	0.03		---		12.0	0.1	0.001	<IDL	2.82		
<IDL	0.02		1.06		15.3	0.1	0.001	<IDL	2.72		
<IDL	0.03		---		11.8	0.1	0.001	<IDL	2.73		
<IDL	0.03		0.98		14.2	0.0	0.001	<IDL	2.76		
<IDL	0.02		---		11.8	0.0	0.001	<IDL	2.77		
<IDL	0.02		0.91		14.6	0.1	0.001	<IDL	2.79		
<IDL	0.02		---		11.8	0.1	0.001	<IDL	2.81		
<IDL	0.03		0.95		13.6	0.1	0.001	<IDL	2.77		
<IDL	0.02		---		11.7	0.1	0.001	<IDL	2.79		
<IDL	0.03		0.91		12.5	0.1	0.001	<IDL	2.77		
<IDL	0.03		---		11.5	0.0	0.001	<IDL	2.80		
<IDL	0.02		1.02		12.5	0.1	0.001	<IDL	2.78		
<IDL	0.02		---		11.8	0.0	0.001	<IDL	2.82		
<IDL	0.04		0.89		11.9	0.1	0.001	<IDL	2.97		
<IDL	0.03		---		11.7	0.0	0.001	<IDL	2.79		
<IDL	0.02		0.96		12.0	0.1	0.001	<IDL	2.80		
<IDL	0.03		---		11.2	0.1	0.001	<IDL	2.84		
<IDL	0.03		---		11.4	0.0	0.001	<IDL	2.81		
<IDL	0.01	U	3.29		0.2	0.0	0.001	<IDL	0.01		
<IDL	0.03		1.01		11.6	0.0	0.001	<IDL	2.75		
<IDL	0.03		0.99		11.9	0.0	0.001	<IDL	2.84		
<IDL	0.03		---		11.3	0.1	0.001	<IDL	2.78		
<IDL	0.03		1.04		12.0	0.1	0.001	<IDL	2.76		
<IDL	0.03		---		11.5	0.1	0.001	<IDL	2.83		
<IDL	0.02		1.03		11.7	0.0	0.001	<IDL	2.75		
<IDL	0.02		---		11.5	0.0	0.001	<IDL	2.78		
<IDL	0.03		---		11.3	0.1	0.001	<IDL	2.78		
<IDL	0.03		1.16		11.3	0.1	0.001	<IDL	2.73		
<IDL	0.03		1.06		11.7	0.1	0.001	<IDL	2.68		
<IDL	0.02		---		11.2	0.0	0.001	<IDL	2.81		
<IDL	0.03		1.15		11.3	0.1	0.001	<IDL	2.72		
<IDL	0.03		---		11.4	0.1	0.001	<IDL	2.77		
<IDL	0.01	U	1.08		11.4	0.0	0.001	<IDL	2.65		

Table A-1
Laboratory-Measured Analytical Results for R-20 Screen 1

ClO4(-) (U)	Co rslt	stdev (Co)	Alk-CO3 rslt	ALK-CO3 (U)	Cr rslt	stdev (Cr)	Cs rslt	stdev (Cs)	Cu rslt	stdev (Cu)	F(-) ppm
	0.002	0.000	0.8	U	0.001	<IDL	0.001	<IDL	0.001	0.000	0.01
	0.001	<IDL	0.8	U	0.010	0.001	0.001	<IDL	0.014	0.001	0.02
	0.001	<IDL	5.60		0.005	0.001	0.001	<IDL	0.002	0.000	0.27
	0.003	0.000	7.21		0.004	0.000	0.001	<IDL	0.004	0.000	0.27
	0.001	<IDL	6.73		0.003	0.000	0.001	<IDL	0.001	0.000	0.27
	0.002	0.000	6.95		0.005	0.000	0.001	<IDL	0.003	0.000	0.27
	0.001	<IDL	0.8	U	0.003	0.000	0.001	<IDL	0.004	0.001	0.27
	0.001	0.000	7.27		0.004	0.000	0.001	<IDL	0.006	0.000	0.27
	0.002	0.000	6.71		0.004	0.001	0.001	<IDL	0.005	0.000	0.27
	0.001	0.000	7.21		0.006	0.001	0.001	<IDL	0.004	0.000	0.27
	0.002	0.000	0.8	U	0.004	0.000	0.001	<IDL	0.003	0.000	0.27
	0.001	<IDL	6.59		0.004	0.000	0.001	<IDL	0.004	0.000	0.26
	0.001	<IDL	6.44		0.004	0.000	0.001	<IDL	0.001	0.000	0.27
	0.001	<IDL	6.99		0.004	0.000	0.001	<IDL	0.003	0.000	0.26
	0.002	0.000	0.8	U	0.003	0.000	0.001	<IDL	0.004	0.000	0.26
	0.001	<IDL	6.55		0.005	0.000	0.001	<IDL	0.002	0.000	0.31
	0.007	0.000	0.8	U	0.003	0.000	0.001	<IDL	0.002	0.000	0.26
	0.001	<IDL	6.16		0.006	0.001	0.001	<IDL	0.002	0.000	0.26
	0.001	<IDL	0.8	U	0.004	0.001	0.001	<IDL	0.002	0.000	0.26
	0.003	0.000	0.8	U	0.006	0.001	0.001	<IDL	0.007	0.001	0.26
	0.001	<IDL	0.8	U	0.001	<IDL	0.001	<IDL	0.001	0.001	0.01
	0.001	<IDL	0.8	U	0.005	0.000	0.001	<IDL	0.002	0.000	0.26
	0.001	<IDL	6.42		0.004	0.000	0.001	<IDL	0.001	0.000	0.26
	0.003	0.000	0.8	U	0.003	0.000	0.001	<IDL	0.001	0.000	0.26
	0.001	<IDL	0.8	U	0.006	0.001	0.001	<IDL	0.002	0.000	0.26
	0.001	0.000	0.8	U	0.004	0.000	0.001	<IDL	0.001	0.000	0.26
	0.001	<IDL	6.14		0.007	0.001	0.001	<IDL	0.002	0.000	0.26
	0.004	0.001	4.66		0.006	0.002	0.001	<IDL	0.004	0.001	0.27
	0.002	0.000	0.8	U	0.003	0.000	0.001	<IDL	0.001	0.000	0.26
	0.001	<IDL	5.17		0.004	0.000	0.001	<IDL	0.001	0.000	0.27
	0.001	<IDL	0.8	U	0.006	0.001	0.001	<IDL	0.002	0.000	0.31
	0.001	<IDL	0.8	U	0.005	0.000	0.001	<IDL	0.001	0.000	0.27
	0.001	<IDL	0.8	U	0.004	0.000	0.001	<IDL	0.002	0.000	0.27
	0.001	<IDL	0.8	U	0.006	0.000	0.001	<IDL	0.001	0.000	0.26
	0.001	<IDL	0.8	U	0.006	0.001	0.001	<IDL	0.002	0.000	0.27

Table A-1
Laboratory-Measured Analytical Results for R-20 Screen 1

F(-) (U)	Fe rslt	stdev (Fe)	Alk-CO3+HCO3 rslt	ALK-CO3+HCO3 (U)	Hg rslt	stdev (Hg)	K rslt	stdev (K)	Li rslt	stdev (Li)	Mg rslt
U	0.01	0.00	7.99		0.00005	<IDL	0.26	0.00	0.001	0.000	0.13
	6.75	0.08	19.9		0.00005	<IDL	0.37	0.01	0.001	0.000	0.64
	0.15	0.00	79.7		0.00005	<IDL	2.37	0.01	0.022	0.000	2.34
	1.84	0.01	80.1		0.00005	<IDL	2.70	0.01	0.025	0.000	3.50
	0.17	0.00	78.6		0.00005	<IDL	2.45	0.01	0.023	0.000	2.43
	1.66	0.02	79.0		0.00005	<IDL	2.55	0.04	0.024	0.000	3.21
	0.18	0.00	84.7		0.00005	<IDL	2.42	0.01	0.023	0.000	2.39
	1.57	0.02	77.1		0.00005	<IDL	2.57	0.05	0.022	0.001	3.05
	0.20	0.00	77.2		0.00005	<IDL	2.30	0.01	0.021	0.000	2.30
	1.64	0.01	77.0		0.00005	<IDL	2.68	0.03	0.024	0.000	2.92
	0.18	0.00	83.7		0.00005	<IDL	2.43	0.02	0.023	0.000	2.41
	1.44	0.01	77.4		0.00005	<IDL	2.47	0.00	0.024	0.000	2.74
	0.19	0.00	76.8		0.00005	<IDL	2.31	0.04	0.022	0.000	2.32
	1.49	0.01	76.6		0.00005	<IDL	2.39	0.01	0.023	0.000	2.67
	0.33	0.00	83.1		0.00005	<IDL	2.40	0.02	0.022	0.000	2.29
	1.31	0.01	76.3		0.00005	<IDL	2.38	0.01	0.023	0.000	2.58
	0.46	0.00	82.7		0.00005	<IDL	2.49	0.01	0.023	0.000	2.40
	1.49	0.01	76.6		0.00005	<IDL	2.57	0.03	0.024	0.000	2.63
	0.57	0.00	82.2		0.00005	<IDL	2.33	0.01	0.023	0.000	2.36
	0.60	0.00	82.4		0.00005	<IDL	2.29	0.01	0.022	0.000	2.33
U	0.01	0.00	0	U	0.00005	<IDL	0.01	<IDL	0.001	0.000	0.01
	1.29	0.02	82.5		0.00005	<IDL	2.36	0.03	0.023	0.000	2.53
	1.29	0.01	76.3		0.00005	<IDL	2.43	0.02	0.024	0.000	2.52
	0.78	0.01	81.9		0.00005	<IDL	2.25	0.03	0.022	0.000	2.34
	1.24	0.01	82.0		0.00005	<IDL	2.12	0.02	0.020	0.000	2.18
	1.08	0.01	81.6		0.00005	<IDL	2.29	0.02	0.023	0.000	2.47
	1.41	0.02	75.1		0.00005	<IDL	2.21	0.05	0.021	0.001	2.32
	1.24	0.01	76.5		0.00005	<IDL	2.24	0.01	0.023	0.000	2.47
	1.15	0.01	80.8		0.00005	<IDL	2.22	0.01	0.022	0.000	2.44
	1.65	0.00	75.9		0.00005	<IDL	2.18	0.01	0.022	0.000	2.48
	1.43	0.02	81.3		0.00005	<IDL	2.06	0.02	0.020	0.000	2.23
	1.39	0.00	80.9		0.00005	<IDL	2.30	0.00	0.024	0.000	2.61
	1.90	0.01	77.3		0.00005	<IDL	2.48	0.01	0.025	0.000	2.73
	1.56	0.02	80.3		0.00005	<IDL	2.23	0.02	0.023	0.000	2.60
	1.69	0.01	0	U	0.00005	<IDL	2.09	0.02	0.020	0.000	2.34

Table A-1
Laboratory-Measured Analytical Results for R-20 Screen 1

stdev (Mg)	Mn rslt	stdev (Mn)	Mo rslt	stdev (Mo)	Na rslt	stdev (Na)	Ni rslt	stdev (Ni)	NO2(ppm)	NO2-N rslt	NO2-N (U)
0.00	0.003	0.000	0.001	<IDL	1.1	0.0	0.001	<IDL	0.01	0.003	U
0.01	0.073	0.001	0.001	<IDL	0.9	0.0	0.007	0.000	0.01	0.003	U
0.01	0.019	0.000	0.001	0.000	13.3	0.1	0.001	0.000	0.01	0.003	U
0.03	0.078	0.000	0.001	<IDL	14.1	0.1	0.003	0.000	0.01	0.003	U
0.02	0.020	0.000	0.001	0.000	13.7	0.0	0.001	<IDL	0.01	0.003	U
0.01	0.062	0.001	0.001	<IDL	14.0	0.1	0.002	0.000	0.01	0.003	U
0.02	0.021	0.000	0.001	0.000	13.5	0.1	0.007	0.001	0.01	0.003	U
0.17	0.044	0.001	0.001	0.000	13.3	0.1	0.006	0.000	0.01	0.003	U
0.01	0.021	0.000	0.001	0.000	13.0	0.1	0.001	0.000	0.01	0.003	U
0.09	0.043	0.000	0.001	0.000	13.7	0.0	0.002	0.000	0.01	0.003	U
0.02	0.021	0.000	0.001	0.000	13.7	0.1	0.007	0.000	0.01	0.003	U
0.01	0.036	0.000	0.001	0.000	13.8	0.0	0.006	0.000	0.01	0.003	U
0.03	0.019	0.000	0.001	0.000	13.1	0.2	0.001	<IDL	0.01	0.003	U
0.01	0.034	0.000	0.001	0.000	13.4	0.1	0.002	0.000	0.01	0.003	U
0.02	0.021	0.000	0.001	0.000	13.0	0.1	0.001	0.000	0.01	0.003	U
0.01	0.029	0.000	0.001	0.000	13.5	0.1	0.002	0.000	0.01	0.003	U
0.02	0.034	0.000	0.001	0.000	13.8	0.1	0.001	0.000	0.01	0.003	U
0.02	0.029	0.000	0.001	0.000	13.8	0.0	0.002	0.000	0.01	0.003	U
0.03	0.021	0.000	0.001	0.000	13.2	0.1	0.001	0.000	0.01	0.003	U
0.00	0.023	0.000	0.001	0.000	13.0	0.0	0.002	0.000	0.01	0.003	U
0.00	0.000	0.000	0.001	<IDL	0.2	0.0	0.001	<IDL	0.01	0.003	U
0.01	0.027	0.000	0.001	0.000	13.1	0.1	0.001	0.000	0.01	0.003	U
0.02	0.028	0.000	0.001	0.000	13.2	0.0	0.001	0.000	0.01	0.003	U
0.04	0.026	0.000	0.001	0.000	12.8	0.2	0.001	0.000	0.01	0.003	U
0.01	0.022	0.000	0.001	0.000	11.7	0.1	0.001	0.000	0.01	0.003	U
0.03	0.025	0.000	0.001	0.000	13.1	0.1	0.001	0.000	0.01	0.003	U
0.05	0.024	0.001	0.001	0.000	12.2	0.2	0.001	0.000	0.01	0.003	U
0.01	0.029	0.000	0.001	0.000	12.8	0.0	0.002	0.000	0.01	0.003	U
0.02	0.026	0.000	0.001	0.000	12.8	0.1	0.001	0.000	0.01	0.003	U
0.00	0.026	0.000	0.001	0.000	12.6	0.0	0.001	0.000	0.01	0.003	U
0.02	0.023	0.000	0.001	0.000	11.6	0.1	0.002	0.000	0.01	0.003	U
0.01	0.027	0.000	0.001	0.000	12.9	0.1	0.001	0.000	0.01	0.003	U
0.00	0.029	0.000	0.001	0.000	13.6	0.1	0.001	0.000	0.01	0.003	U
0.02	0.028	0.000	0.001	0.000	13.0	0.1	0.001	0.000	0.01	0.003	U
0.01	0.025	0.000	0.001	0.000	11.7	0.1	0.001	0.000	0.01	0.003	U

Table A-1
Laboratory-Measured Analytical Results for R-20 Screen 1

NO3 ppm	NO3-N rslt	NO3-N (U)	C2O4 rslt	C2O4 (U)	Pb rslt	stdev (Pb)	Lab pH	PO4(-3) rslt	PO4(-3) (U)	Rb rslt	stdev (Rb)
0.17	0.038		0.01	U	0.0002	<IDL	5.93	0.02		0.001	<IDL
0.05	0.011		0.01	U	0.0086	0.0006	9.00	0.02		0.003	0.000
1.00	0.225		0.01	U	0.0013	0.0004	8.28	0.03		0.009	0.002
0.64	0.145		0.01	U	0.0061	0.0001	8.36	0.02		0.007	0.000
1.09	0.246		0.01	U	0.0006	0.0000	8.33	0.04		0.005	0.000
0.74	0.167		0.01	U	0.0049	0.0000	8.37	0.01	U	0.007	0.000
1.03	0.232		0.01	U	0.0026	0.0001	8.11	0.01	U	0.006	0.000
0.94	0.211		0.01	U	0.0089	0.0007	8.34	0.02		0.006	0.000
1.32	0.298		0.01	U	0.0010	0.0002	8.36	0.06		0.006	0.001
0.91	0.206		0.01	U	0.0037	0.0005	8.35	0.01		0.007	0.001
1.26	0.284		0.01	U	0.0025	0.0002	8.29	0.04		0.006	0.001
1.00	0.225		0.01	U	0.0042	0.0000	8.32	0.02		0.006	0.000
1.33	0.299		0.01	U	0.0007	0.0000	8.29	0.04		0.007	0.000
1.04	0.235		0.01	U	0.0035	0.0002	8.32	0.01	U	0.006	0.000
1.21	0.273		0.01	U	0.0011	0.0001	8.19	0.02		0.005	0.000
1.13	0.254		0.01	U	0.0022	0.0000	8.30	0.01		0.006	0.000
1.31	0.297		0.01	U	0.0010	0.0000	8.23	0.04		0.005	0.000
1.15	0.259		0.01	U	0.0020	0.0003	8.30	0.01		0.006	0.001
1.40	0.316		0.01	U	0.0013	0.0002	8.20	0.03		0.006	0.001
1.34	0.304		0.01	U	0.0016	0.0003	8.17	0.02		0.007	0.001
0.01	0.002	U	0.01	U	0.0002	<IDL	5.54	0.01	U	0.001	<IDL
1.13	0.255		0.01	U	0.0018	0.0000	8.26	0.01	U	0.005	0.000
1.18	0.266		0.01	U	0.0018	0.0000	8.28	0.01	U	0.006	0.000
1.36	0.307		0.01	U	0.0010	0.0001	8.17	0.03		0.005	0.000
1.14	0.257		0.01	U	0.0017	0.0002	8.23	0.01	U	0.006	0.001
1.36	0.308		0.01	U	0.0010	0.0000	8.10	0.03		0.005	0.000
1.19	0.269		0.01	U	0.0018	0.0003	8.21	0.02		0.007	0.001
1.42	0.320		0.01	U	0.0019	0.0006	8.12	0.04		0.008	0.002
1.35	0.306		0.01	U	0.0009	0.0000	8.07	0.02		0.005	0.000
1.25	0.282		0.01	U	0.0015	0.0000	8.20	0.01	U	0.005	0.000
1.11	0.250		0.01	U	0.0016	0.0002	8.20	0.01	U	0.006	0.001
1.37	0.310		0.01	U	0.0010	0.0000	8.06	0.02		0.005	0.000
1.09	0.246		0.01	U	0.0010	0.0000	7.74	0.01	U	0.005	0.000
1.47	0.331		0.01	U	0.0009	0.0000	8.07	0.03		0.005	0.000
1.13	0.256		0.01	U	0.0022	0.0004	5.13	0.01	U	0.006	0.001

Table A-1
Laboratory-Measured Analytical Results for R-20 Screen 1

S2- rslt	S2- (U)	Sb rslt	stdev (Sb)	Se rslt	stdev (Se)	Si rslt	stdev (Si)	SiO2 rslt	stdev (SiO2)	Sn rslt	stdev (Sn)
---		0.001	<IDL	0.001	<IDL	0.6	0.0	1.2	0.0	0.001	<IDL
0.01	U	0.001	<IDL	0.001	<IDL	2.4	0.1	5.2	0.1	0.001	<IDL
---		0.001	<IDL	0.001	<IDL	30.6	0.2	65.5	0.5	0.001	<IDL
0.01	U	0.001	<IDL	0.001	<IDL	34.6	0.4	74.0	1.0	0.001	<IDL
---		0.001	<IDL	0.001	<IDL	32.5	0.3	69.6	0.6	0.001	<IDL
0.01	U	0.001	<IDL	0.001	<IDL	35.4	0.3	75.8	0.6	0.001	<IDL
---		0.001	<IDL	0.001	<IDL	32.6	0.4	69.8	0.9	0.001	<IDL
0.01	U	0.001	<IDL	0.001	<IDL	42.6	3.1	91.1	6.7	0.001	<IDL
---		0.001	<IDL	0.001	<IDL	31.4	0.3	67.1	0.6	0.001	<IDL
0.01	U	0.001	<IDL	0.001	<IDL	35.5	0.2	75.9	0.4	0.001	<IDL
---		0.001	<IDL	0.001	<IDL	32.8	0.3	70.1	0.7	0.001	<IDL
0.01	U	0.001	<IDL	0.001	<IDL	35.1	0.3	75.1	0.6	0.001	<IDL
---		0.001	<IDL	0.001	<IDL	31.9	0.3	68.2	0.7	0.001	<IDL
0.01	U	0.001	<IDL	0.001	<IDL	34.4	0.2	73.6	0.5	0.001	<IDL
---		0.001	<IDL	0.001	<IDL	31.4	0.1	67.2	0.1	0.001	<IDL
0.01	U	0.001	<IDL	0.001	<IDL	33.9	0.3	72.6	0.5	0.001	<IDL
---		0.001	<IDL	0.001	<IDL	33.3	0.2	71.2	0.5	0.001	<IDL
0.01	U	0.001	<IDL	0.001	<IDL	35.3	0.4	75.6	0.8	0.001	<IDL
---		0.001	<IDL	0.001	<IDL	32.2	0.3	68.9	0.7	0.001	<IDL
---		0.001	<IDL	0.001	<IDL	32.0	0.3	68.5	0.6	0.001	<IDL
0.01	U	0.001	<IDL	0.001	<IDL	0.4	0.0	1.0	0.0	0.001	<IDL
0.01	U	0.001	<IDL	0.001	<IDL	33.4	0.1	71.5	0.3	0.001	<IDL
0.01	U	0.001	<IDL	0.001	<IDL	33.5	0.3	71.6	0.5	0.001	<IDL
---		0.001	<IDL	0.001	<IDL	32.0	0.2	68.5	0.5	0.001	<IDL
0.01	U	0.001	<IDL	0.001	<IDL	29.3	0.3	62.7	0.5	0.001	<IDL
---		0.001	<IDL	0.001	<IDL	33.3	0.1	71.2	0.3	0.001	<IDL
0.01	U	0.001	<IDL	0.001	<IDL	31.0	0.7	66.4	1.5	0.001	<IDL
---		0.001	<IDL	0.001	<IDL	33.1	0.0	70.8	0.0	0.001	<IDL
---		0.001	<IDL	0.001	<IDL	32.7	0.2	69.9	0.4	0.001	<IDL
0.01	U	0.001	<IDL	0.001	<IDL	32.8	0.2	70.3	0.4	0.001	<IDL
0.01	U	0.001	<IDL	0.001	<IDL	30.1	0.5	64.5	1.0	0.001	<IDL
---		0.001	<IDL	0.001	<IDL	33.8	0.4	72.2	0.9	0.001	<IDL
0.01	U	0.001	<IDL	0.001	<IDL	35.3	0.3	75.6	0.7	0.001	<IDL
---		0.001	<IDL	0.001	<IDL	33.7	0.5	72.1	1.1	0.001	<IDL
0.01	U	0.001	<IDL	0.001	<IDL	30.5	0.1	65.2	0.3	0.001	<IDL

Table A-1
Laboratory-Measured Analytical Results for R-20 Screen 1

SO4(-2) rslt	SO4(-2) (U)	Sr rslt	stdev (Sr)	Th rslt	stdev (Th)	Ti rslt	stdev (Ti)	Tl rslt	stdev (Tl)	U rslt	stdev (U)
0.55		0.011	0.001	0.001	<IDL	0.002	<IDL	0.001	<IDL	0.0002	<IDL
0.66		0.063	0.003	0.001	<IDL	0.041	0.001	0.001	<IDL	0.0006	0.0000
3.65		0.199	0.042	0.001	<IDL	0.002	<IDL	0.001	<IDL	0.0014	0.0003
3.66		0.172	0.002	0.001	<IDL	0.003	0.000	0.001	<IDL	0.0026	0.0000
3.48		0.123	0.001	0.001	<IDL	0.002	<IDL	0.001	<IDL	0.0009	0.0000
3.56		0.154	0.002	0.001	0.000	0.009	0.000	0.001	<IDL	0.0020	0.0000
3.43		0.131	0.005	0.001	<IDL	0.002	<IDL	0.001	<IDL	0.0008	0.0000
3.41		0.155	0.002	0.002	0.000	0.003	0.000	0.001	<IDL	0.0014	0.0001
3.36		0.136	0.022	0.001	<IDL	0.002	<IDL	0.001	<IDL	0.0010	0.0001
3.35		0.158	0.020	0.001	<IDL	0.010	0.004	0.001	<IDL	0.0016	0.0002
3.32		0.132	0.009	0.001	<IDL	0.002	<IDL	0.001	<IDL	0.0009	0.0000
3.29		0.142	0.003	0.001	<IDL	0.008	0.000	0.001	<IDL	0.0013	0.0000
3.25		0.148	0.006	0.001	<IDL	0.002	<IDL	0.001	<IDL	0.0009	0.0000
3.27		0.138	0.001	0.001	<IDL	0.010	0.000	0.001	<IDL	0.0013	0.0000
3.15		0.125	0.003	0.001	<IDL	0.002	<IDL	0.001	<IDL	0.0008	0.0001
3.37		0.130	0.000	0.001	<IDL	0.005	0.000	0.001	<IDL	0.0010	0.0000
3.13		0.119	0.002	0.001	<IDL	0.002	<IDL	0.001	<IDL	0.0008	0.0000
3.14		0.135	0.013	0.001	<IDL	0.010	0.000	0.001	<IDL	0.0010	0.0001
3.08		0.142	0.020	0.001	<IDL	0.002	<IDL	0.001	<IDL	0.0009	0.0001
3.03		0.155	0.020	0.001	<IDL	0.002	<IDL	0.001	<IDL	0.0010	0.0002
0.03		0.001	<IDL	0.001	<IDL	0.002	0.002	0.001	<IDL	0.0002	<IDL
3.05		0.116	0.001	0.001	<IDL	0.002	0.000	0.001	<IDL	0.0010	0.0000
3.11		0.127	0.002	0.001	<IDL	0.002	0.000	0.001	<IDL	0.0009	0.0000
3.02		0.115	0.001	0.001	<IDL	0.002	<IDL	0.001	<IDL	0.0007	0.0000
3.02		0.145	0.019	0.001	<IDL	0.003	0.000	0.001	<IDL	0.0010	0.0001
3.00		0.111	0.000	0.001	<IDL	0.002	<IDL	0.001	<IDL	0.0007	0.0000
2.97		0.150	0.023	0.001	<IDL	0.003	0.000	0.001	<IDL	0.0011	0.0002
2.98		0.168	0.042	0.001	<IDL	0.002	<IDL	0.001	<IDL	0.0011	0.0003
2.99		0.109	0.002	0.001	<IDL	0.002	<IDL	0.001	<IDL	0.0007	0.0000
2.99		0.113	0.001	0.001	<IDL	0.003	0.000	0.001	<IDL	0.0007	0.0000
2.96		0.143	0.026	0.001	<IDL	0.003	0.000	0.001	<IDL	0.0010	0.0002
2.96		0.108	0.003	0.001	<IDL	0.002	<IDL	0.001	<IDL	0.0007	0.0000
2.95		0.114	0.001	0.001	<IDL	0.003	0.000	0.001	<IDL	0.0007	0.0000
2.94		0.112	0.000	0.001	<IDL	0.002	<IDL	0.001	<IDL	0.0007	0.0000
2.94		0.132	0.018	0.001	<IDL	0.002	<IDL	0.001	<IDL	0.0009	0.0001

Table A-1
Laboratory-Measured Analytical Results for R-20 Screen 1

V rslt	stdev (V)	Zn rslt	stdev (Zn)	TDS (ppm)	Cations	Anions	Balance
0.001	<IDL	0.002	0.000	14	0.16	0.18	-0.07
0.003	0.000	0.524	0.010	54	0.98	0.39	0.44
0.006	0.001	0.009	0.001	189	1.44	1.68	-0.08
0.005	0.000	0.085	0.000	207	1.75	1.74	0.00
0.004	0.000	0.005	0.000	193	1.45	1.70	-0.08
0.004	0.000	0.061	0.000	206	1.66	1.72	-0.02
0.004	0.000	0.027	0.001	194	1.44	1.60	-0.05
0.004	0.000	0.069	0.000	219	1.63	1.69	-0.02
0.004	0.001	0.007	0.001	189	1.41	1.68	-0.09
0.005	0.001	0.051	0.008	203	1.59	1.69	-0.03
0.004	0.000	0.034	0.002	193	1.45	1.58	-0.05
0.004	0.000	0.059	0.000	200	1.53	1.68	-0.05
0.004	0.000	0.005	0.000	189	1.40	1.66	-0.08
0.004	0.000	0.041	0.000	198	1.50	1.68	-0.06
0.004	0.000	0.009	0.000	189	1.42	1.57	-0.05
0.004	0.000	0.029	0.001	196	1.46	1.66	-0.06
0.004	0.000	0.009	0.000	193	1.45	1.57	-0.04
0.005	0.001	0.030	0.002	199	1.49	1.65	-0.05
0.004	0.001	0.010	0.001	189	1.39	1.56	-0.06
0.005	0.001	0.013	0.002	189	1.39	1.56	-0.06
0.001	<IDL	0.001	<IDL	2	0.02	0.03	-0.13
0.004	0.000	0.025	0.001	193	1.43	1.56	-0.04
0.004	0.000	0.025	0.000	193	1.45	1.65	-0.07
0.003	0.000	0.010	0.000	188	1.38	1.55	-0.06
0.005	0.001	0.026	0.003	182	1.35	1.55	-0.07
0.004	0.000	0.013	0.000	192	1.42	1.55	-0.04
0.005	0.001	0.029	0.003	185	1.37	1.61	-0.08
0.006	0.001	0.018	0.005	190	1.40	1.59	-0.06
0.004	0.000	0.012	0.000	189	1.39	1.53	-0.05
0.004	0.000	0.018	0.000	189	1.38	1.59	-0.07
0.005	0.001	0.024	0.004	183	1.33	1.54	-0.07
0.004	0.000	0.012	0.000	192	1.40	1.53	-0.04
0.004	0.000	0.018	0.001	193	1.45	1.47	-0.01
0.004	0.000	0.013	0.000	192	1.41	1.52	-0.04
0.005	0.001	0.024	0.004	103	1.33	0.20	0.74

Table A-2
Laboratory-Measured Analytical Results for R-20 Screen 2

SAMPLE ID	DATE COLLECTED	DATE RECEIVED	ER/RRES-WQH	Time	Field pH	Temp C	Cond uS/cm	Dissolved O2 mg/L	Turb NTU	ORP mV	Discharge rate	Ag rslt
R-20 Screen 2												
GW20-08-9118 (NF)	12/3/2007	12/4/2007	08-312	1330	8.42	19.2	164.7	0.4	331	293	1.44	0.001
GW20-08-8959 (F)	12/3/2007	12/4/2007	08-311	1330	8.42	19.2	164.7	0.4	331	293	1.44	0.001
GW20-08-9074 (NF)	12/3/2007	12/4/2007	08-312	1335	8.45	19	156.7	0.5	299	281	1.44	0.001
GW20-08-8944 (F)	12/3/2007	12/4/2007	08-311	1335	8.45	19	156.7	0.5	299	281	1.44	0.001
GW20-08-9075 (NF)	12/3/2007	12/4/2007	08-312	1340	8.46	19.1	151.2	0.5	207	255	1.44	0.001
GW20-08-8945 (F)	12/3/2007	12/4/2007	08-311	1340	8.46	19.1	151.2	0.5	207	255	1.44	0.001
GW20-08-9076 (NF)	12/3/2007	12/4/2007	08-312	1345	8.47	18.9	149.3	0.5	1674	243	1.44	0.001
GW20-08-8946 (F)	12/3/2007	12/4/2007	08-311	1345	8.47	18.9	149.3	0.5	1674	243	1.44	0.001
GW20-08-9077 (NF)	12/3/2007	12/4/2007	08-312	1350	8.49	18.7	148.3	0.5	130	235	1.44	0.001
GW20-08-8947 (F)	12/3/2007	12/4/2007	08-311	1350	8.49	18.7	148.3	0.5	130	235	1.44	0.001
GW20-08-9078 (NF)	12/3/2007	12/4/2007	08-312	1355	8.5	18.6	147.1	0.5	90.6	234	1.44	0.001
GW20-08-8948 (F)	12/3/2007	12/4/2007	08-311	1355	8.5	18.6	147.1	0.5	90.6	234	1.44	0.001
GW20-08-9079 (NF)	12/3/2007	12/4/2007	08-312	1405	8.48	18.5	145.6	0.5	65.2	204	1.44	0.001
GW20-08-8949 (F)	12/3/2007	12/4/2007	08-311	1405	8.48	18.5	145.6	0.5	65.2	204	1.44	0.001
GW20-08-9080 (NF)	12/3/2007	12/4/2007	08-312	1415	8.41	18.6	144.6	0.5	45.5	187	1.44	0.001
GW20-08-8950 (F)	12/3/2007	12/4/2007	08-311	1415	8.41	18.6	144.6	0.5	45.5	187	1.44	0.001
GW20-08-9119 (NF)	12/3/2007	12/4/2007	08-312	1425	8.45	18.5	144.5	0.5	37	178	1.44	0.001
GW20-08-8960 (F)	12/3/2007	12/4/2007	08-311	1425	8.45	18.5	144.5	0.5	37	178	1.44	0.001
GW20-08-9081 (NF)	12/3/2007	12/4/2007	08-312	1455	8.46	18.7	143.7	0.6	14.8	164	1.41	0.001
GW20-08-8951 (F)	12/3/2007	12/4/2007	08-311	1455	8.46	18.7	143.7	0.6	14.8	164	1.41	0.001
GW20-08-9082 (NF)	12/3/2007	12/4/2007	08-312	1525	8.15	18.6	142.9	0.6	8.59	159	1.41	0.001
GW20-08-8952 (F)	12/3/2007	12/4/2007	08-311	1525	8.15	18.6	142.9	0.6	8.59	159	1.41	0.001
GW20-08-9083 (NF)	12/3/2007	12/4/2007	08-312	1555	7.68	18.5	141.9	0.6	7.99	159	1.41	0.001
GW20-08-8953 (F)	12/3/2007	12/4/2007	08-311	1555	7.68	18.5	141.9	0.6	7.99	159	1.41	0.001
GW20-08-9066 (NF)	12/3/2007	12/4/2007	08-312	1625	8.35	18.9	141.1	0.7	6.37	164	1.41	0.001
GW20-08-9068 (NF)	12/3/2007	12/4/2007	08-312	1625	8.35	18.9	141.1	0.7	6.37	164	1.41	0.001
GW20-08-9122 (NF)	12/3/2007	12/4/2007	08-312	1625	8.35	18.9	141.1	0.7	6.37	164	1.41	0.001
GW20-08-8938 (F)	12/3/2007	12/4/2007	08-311	1625	8.35	18.9	141.1	0.7	6.37	164	1.41	0.001
GW20-08-8963 (F)	12/3/2007	12/4/2007	08-311	1625	8.35	18.9	141.1	0.7	6.37	164	1.41	0.001
GW20-08-9121 (NF)	12/3/2007	12/4/2007	08-318	Not Measured	Not Measured	Not Measured	Not Measured	Not Measured	Not Measured	Not Measured	Not Measured	0.001
GW20-08-9084 (NF)	12/4/2007	12/4/2007	08-318	1010	8.2	20.1	29.7	1.47	70.6	266	1.23	0.001
GW20-08-8954 (F)	12/4/2007	12/4/2007	08-317	1010	8.2	20.1	29.7	1.47	70.6	266	1.23	0.001
GW20-08-9085 (NF)	12/4/2007	12/4/2007	08-318	1110	8.42	20.7	28.7	1.14	15.2	201	1.23	0.001
GW20-08-8955 (F)	12/4/2007	12/4/2007	08-317	1110	8.42	20.7	28.7	1.14	15.2	201	1.23	0.001
GW20-08-9086 (NF)	12/4/2007	12/4/2007	08-318	1210	8.38	20.9	28.4	1.37	8.35	197	1.23	0.001
GW20-08-8956 (F)	12/4/2007	12/4/2007	08-317	1210	8.38	20.9	28.4	1.37	8.35	197	1.23	0.001
GW20-08-9087 (NF)	12/4/2007	12/4/2007	08-318	1310	8.35	20.9	27.9	1.61	5.3	162	1.23	0.001
GW20-08-8957 (F)	12/4/2007	12/4/2007	08-317	1310	8.35	20.9	27.9	1.61	5.3	162	1.23	0.001
GW20-08-9088 (NF)	12/4/2007	12/4/2007	08-318	1410	8.34	19.5	27.9	1.57	6.1	153	1.23	0.001
GW20-08-8958 (F)	12/4/2007	12/4/2007	08-317	1410	8.34	19.5	27.9	1.57	6.1	153	1.23	0.001
GW20-08-8962 (F)	12/4/2007	12/4/2007	08-317	1440	8.34	18.7	27.8	1.65	4.15	158	1.23	0.001
GW20-08-9072 (NF)	12/5/2007	12/5/2007	08-332	Not Measured	Not Measured	Not Measured	Not Measured	Not Measured	Not Measured	Not Measured	Not Measured	0.001
GW20-08-8942 (F)	12/5/2007	12/5/2007	08-331	Not Measured	Not Measured	Not Measured	Not Measured	Not Measured	Not Measured	Not Measured	Not Measured	0.001
NF means not filtered and F means filtered. IDL means instrument detection limit, which is equivalent to not detected denoted as U.												

Table A-2
Laboratory-Measured Analytical Results for R-20 Screen 2

stdev (Ag)	Al rslt	stdev (Al)	As rslt	stdev (As)	B rslt	stdev (B)	Ba rslt	stdev (Ba)	Be rslt	stdev (Be)	Br(-) ppm	Br(-) (U)
<IDL	1.451	0.129	0.0016	0.0001	0.017	0.000	0.168	0.003	0.001	<IDL	0.03	
<IDL	0.092	0.002	0.0010	0.0000	0.016	0.000	0.087	0.003	0.001	<IDL	0.03	
<IDL	0.959	0.061	0.0015	0.0001	0.042	0.001	0.161	0.005	0.001	<IDL	0.03	
<IDL	0.161	0.002	0.0010	0.0000	0.036	0.000	0.082	0.000	0.001	<IDL	0.03	
<IDL	0.557	0.049	0.0013	0.0001	0.032	0.000	0.127	0.001	0.001	<IDL	0.03	
<IDL	0.208	0.004	0.0011	0.0000	0.031	0.001	0.088	0.001	0.001	<IDL	0.03	
<IDL	0.392	0.005	0.0012	0.0001	0.033	0.000	0.113	0.010	0.001	<IDL	0.02	
<IDL	0.094	0.001	0.0010	0.0000	0.023	0.000	0.079	0.009	0.001	<IDL	0.03	
<IDL	0.413	0.013	0.0011	0.0000	0.027	0.001	0.104	0.002	0.001	<IDL	0.03	
<IDL	0.133	0.001	0.0010	0.0001	0.020	0.000	0.075	0.002	0.001	<IDL	0.03	
<IDL	0.332	0.006	0.0011	0.0000	0.023	0.000	0.103	0.000	0.001	<IDL	0.03	
<IDL	0.065	0.002	0.0010	0.0000	0.047	0.000	0.078	0.000	0.001	<IDL	0.03	
<IDL	0.272	0.005	0.0010	0.0000	0.021	0.000	0.093	0.000	0.001	<IDL	0.03	
<IDL	0.015	0.000	0.0010	0.0000	0.036	0.000	0.082	0.001	0.001	<IDL	0.02	
<IDL	0.230	0.003	0.0010	0.0000	0.020	0.000	0.091	0.001	0.001	<IDL	0.03	
<IDL	0.059	0.000	0.0010	0.0000	0.029	0.000	0.082	0.002	0.001	<IDL	0.02	
<IDL	0.259	0.003	0.0010	0.0000	0.015	0.000	0.097	0.001	0.001	<IDL	0.03	
<IDL	0.043	0.001	0.0010	0.0001	0.021	0.000	0.089	0.005	0.001	<IDL	0.03	
<IDL	0.117	0.001	0.0010	0.0000	0.019	0.000	0.081	0.001	0.001	<IDL	0.03	
<IDL	0.014	0.000	0.0009	0.0000	0.025	0.001	0.082	0.001	0.001	<IDL	0.03	
<IDL	0.115	0.001	0.0010	0.0000	0.017	0.000	0.082	0.001	0.001	<IDL	0.03	
<IDL	0.007	0.000	0.0009	0.0001	0.023	0.000	0.085	0.003	0.001	<IDL	0.03	
<IDL	0.113	0.001	0.0009	0.0000	0.016	0.000	0.075	0.002	0.001	<IDL	0.03	
<IDL	0.040	0.001	0.0010	0.0001	0.018	0.001	0.095	0.010	0.001	<IDL	0.03	
<IDL	0.007	0.000	0.0002	<IDL	0.015	0.000	0.001	<IDL	0.001	<IDL	0.01	U
<IDL	0.048	0.001	0.0008	0.0000	0.063	0.001	0.073	0.000	0.001	<IDL	0.03	
<IDL	0.086	0.002	0.0009	0.0000	0.019	0.000	0.084	0.005	0.001	<IDL	0.03	
<IDL	0.005	0.000	0.0008	0.0000	0.017	0.000	0.081	0.001	0.001	<IDL	0.03	
<IDL	0.007	0.000	0.0009	0.0001	0.022	0.001	0.081	0.003	0.001	<IDL	0.03	
<IDL	0.062	0.002	0.0008	0.0000	0.055	0.002	0.082	0.001	0.001	<IDL	0.02	
<IDL	0.616	0.036	0.0010	0.0000	0.027	0.001	0.113	0.004	0.001	<IDL	0.03	
<IDL	0.020	0.000	0.0009	0.0000	0.020	0.001	0.089	0.003	0.001	<IDL	0.03	
<IDL	0.316	0.157	0.0009	0.0000	0.024	0.001	0.086	0.001	0.001	<IDL	0.03	
<IDL	0.050	0.001	0.0008	0.0000	0.020	0.000	0.088	0.001	0.001	<IDL	0.02	
<IDL	0.186	0.025	0.0009	0.0000	0.022	0.000	0.090	0.002	0.001	<IDL	0.02	
<IDL	0.022	0.003	0.0012	0.0003	0.060	0.003	0.132	0.039	0.001	<IDL	0.03	
<IDL	0.092	0.001	0.0008	0.0000	0.020	0.000	0.080	0.004	0.001	<IDL	0.02	
<IDL	0.012	0.000	0.0008	0.0000	0.038	0.002	0.086	0.008	0.001	<IDL	0.02	
<IDL	0.080	0.005	0.0009	0.0000	0.019	0.000	0.084	0.004	0.001	<IDL	0.03	
<IDL	0.004	0.000	0.0008	0.0000	0.024	0.001	0.092	0.002	0.001	<IDL	0.02	
<IDL	0.007	0.000	0.0008	0.0000	0.019	0.000	0.086	0.001	0.001	<IDL	0.02	
<IDL	0.042	0.000	0.0002	<IDL	0.019	0.000	0.018	0.000	0.001	<IDL	Not Measured	
<IDL	0.003	0.000	0.0002	<IDL	0.037	0.000	0.008	0.000	0.001	<IDL	Not Measured	

Table A-2
Laboratory-Measured Analytical Results for R-20 Screen 2

TOC rslt	TOC (U)	Ca rslt	stdev (Ca)	Cd rslt	stdev (Cd)	Cl(-) ppm	Cl(-) (U)	ClO4(-) ppm	ClO4(-) (U)	Co rslt	stdev (Co)	Alk-CO3 rslt
2.06		21.8	0.0	0.001	<IDL	3.48				0.001	0.000	0.8
---		14.1	0.1	0.001	<IDL	3.51				0.003	0.000	0.8
2.14		20.7	0.1	0.001	<IDL	3.47				0.001	0.000	7.6
---		13.4	0.1	0.001	<IDL	3.53				0.001	<IDL	0.8
1.98		18.1	0.1	0.001	<IDL	3.46				0.002	0.000	7.64
---		13.4	0.1	0.001	<IDL	3.56				0.001	0.000	0.8
1.86		17.8	0.0	0.001	<IDL	3.47				0.001	<IDL	7.63
---		12.9	0.1	0.001	<IDL	3.55				0.002	0.000	0.8
1.88		16.0	0.1	0.001	<IDL	3.43				0.001	<IDL	0.8
---		13.7	0.1	0.001	<IDL	3.50				0.001	<IDL	0.8
1.90		15.7	0.1	0.001	<IDL	3.43				0.001	<IDL	0.8
---		13.9	0.1	0.001	<IDL	3.48				0.001	<IDL	0.8
1.88		15.0	0.1	0.001	<IDL	3.42				0.001	<IDL	0.8
---		13.6	0.0	0.001	<IDL	3.50				0.001	<IDL	0.8
2.07		14.6	0.1	0.001	<IDL	3.41				0.001	<IDL	6
---		13.3	0.1	0.001	<IDL	3.45				0.001	<IDL	0.8
2.12		14.4	0.0	0.001	<IDL	3.39				0.001	<IDL	0.8
---		13.8	0.1	0.001	<IDL	3.44				0.009	0.000	0.8
2.06		13.5	0.1	0.001	<IDL	3.43				0.001	<IDL	5.75
---		13.5	0.1	0.001	<IDL	3.43				0.001	<IDL	0.8
2.14		14.0	0.1	0.001	<IDL	3.58				0.001	<IDL	0.8
---		13.5	0.1	0.001	<IDL	3.40				0.001	<IDL	0.8
2.13		13.5	0.0	0.001	<IDL	3.35				0.001	<IDL	0.8
---		13.1	0.1	0.001	<IDL	3.34				0.003	0.000	0.8
0.36		0.1	0.0	0.001	<IDL	0.01	U			0.001	<IDL	0.8
2.14		13.1	0.1	0.001	<IDL	3.32				0.001	<IDL	0.8
2.16		12.6	0.0	0.001	<IDL	3.32				0.001	<IDL	0.8
---		12.5	0.1	0.001	<IDL	3.38				0.001	<IDL	0.8
---		12.8	0.1	0.001	<IDL	3.35				0.001	<IDL	0.8
1.46		12.9	0.1	0.001	<IDL	3.00				0.001	<IDL	0.8
2.28		15.1	0.0	0.001	<IDL	3.19				0.001	<IDL	0.8
---		13.4	0.0	0.001	<IDL	3.26				0.001	<IDL	6.63
1.85		13.5	0.1	0.001	<IDL	3.17				0.001	<IDL	0.8
---		12.8	0.0	0.001	<IDL	3.15				0.004	0.000	5.58
1.65		12.8	0.1	0.001	<IDL	3.14				0.001	<IDL	0.8
---		12.8	0.1	0.001	<IDL	3.14				0.001	<IDL	0.8
1.61		12.6	0.0	0.001	<IDL	3.03				0.001	<IDL	0.8
---		12.7	0.1	0.001	<IDL	3.09				0.001	<IDL	0.8
1.51		12.7	0.1	0.001	<IDL	3.02				0.001	<IDL	0.8
---		12.4	0.1	0.001	<IDL	3.04				0.001	<IDL	0.8
---		12.1	0.0	0.001	<IDL	3.02				0.001	<IDL	0.8
0.67		1.6	0.0	0.001	<IDL	Not Measured				0.001	<IDL	0.8
---		0.7	0.0	0.001	<IDL	Not Measured				0.001	0.000	0.8

Table A-2
Laboratory-Measured Analytical Results for R-20 Screen 2

ALK-CO3 (U)	Cr rslt	stdev (Cr)	Cs rslt	stdev (Cs)	Cu rslt	stdev (Cu)	F(-) ppm	F(-) (U)	Fe rslt	stdev (Fe)	Alk-CO3+HCO3 rslt	ALK-CO3+HCO3 (U)
U	0.010	0.000	0.001	<IDL	0.007	0.000	0.33		4.47	0.07	87.0	
U	0.002	0.000	0.001	<IDL	0.006	0.000	0.33		0.24	0.00	83.2	
	0.009	0.000	0.001	<IDL	0.007	0.000	0.33		4.21	0.07	79.0	
U	0.004	0.000	0.001	<IDL	0.001	0.000	0.33		0.29	0.00	81.6	
	0.007	0.000	0.001	<IDL	0.004	0.000	0.33		2.73	0.02	78.1	
U	0.004	0.000	0.001	<IDL	0.002	0.000	0.33		0.38	0.00	81.2	
	0.007	0.001	0.001	<IDL	0.004	0.000	0.33		2.43	0.02	77.6	
U	0.004	0.000	0.001	<IDL	0.001	<IDL	0.33		0.23	0.00	80.7	
U	0.006	0.000	0.001	<IDL	0.003	0.000	0.33		2.13	0.00	81.1	
U	0.004	0.000	0.001	<IDL	0.006	0.000	0.33		0.24	0.00	80.7	
U	0.006	0.000	0.001	<IDL	0.003	0.000	0.33		1.93	0.02	87.5	
U	0.006	0.000	0.001	<IDL	0.001	<IDL	0.32		0.22	0.00	79.6	
U	0.006	0.000	0.001	<IDL	0.004	0.000	0.33		1.63	0.01	75.2	
U	0.003	0.000	0.001	<IDL	0.001	<IDL	0.32		0.16	0.00	79.2	
	0.006	0.001	0.001	<IDL	0.002	0.000	0.32		1.61	0.02	74.6	
U	0.003	0.000	0.001	<IDL	0.002	0.000	0.32		0.20	0.00	78.6	
U	0.006	0.000	0.001	<IDL	0.002	0.000	0.32		1.34	0.00	78.5	
U	0.004	0.000	0.001	<IDL	0.002	0.000	0.31		0.24	0.00	76.4	
	0.005	0.000	0.001	<IDL	0.002	0.000	0.32		1.10	0.01	73.7	
U	0.003	0.000	0.001	<IDL	0.003	0.000	0.31		0.43	0.00	77.3	
U	0.004	0.000	0.001	<IDL	0.001	0.000	0.32		0.99	0.00	78.2	
U	0.004	0.000	0.001	<IDL	0.001	0.000	0.30		0.48	0.01	77.0	
U	0.005	0.000	0.001	<IDL	0.002	0.000	0.31		1.04	0.00	78.1	
U	0.006	0.001	0.001	<IDL	0.001	0.000	0.30		0.64	0.01	77.0	
U	0.001	<IDL	0.001	<IDL	0.001	<IDL	0.01	U	0.01	<IDL	5.63	
U	0.005	0.000	0.001	<IDL	0.001	0.000	0.30		1.03	0.00	85.3	
U	0.004	0.000	0.001	<IDL	0.004	0.000	0.30		1.05	0.01	76.6	
U	0.004	0.000	0.001	<IDL	0.001	0.000	0.34		0.70	0.01	76.9	
U	0.004	0.000	0.001	<IDL	0.001	<IDL	0.30		0.71	0.00	75.5	
U	0.006	0.000	0.001	<IDL	0.002	0.000	0.28		1.48	0.03	75.4	
U	0.008	0.001	0.001	<IDL	0.003	0.000	0.29		2.49	0.01	82.2	
	0.004	0.000	0.001	<IDL	0.001	<IDL	0.29		0.90	0.02	77.1	
U	0.005	0.000	0.001	<IDL	0.002	0.000	0.29		1.24	0.01	77.4	
	0.003	0.000	0.001	<IDL	0.002	0.000	0.29		0.59	0.02	71.7	
U	0.005	0.000	0.001	<IDL	0.003	0.000	0.29		1.17	0.01	76.6	
U	0.009	0.003	0.001	<IDL	0.001	0.000	0.28		0.72	0.02	76.6	
U	0.005	0.000	0.001	<IDL	0.002	0.000	0.28		1.27	0.01	75.9	
U	0.005	0.000	0.001	<IDL	0.001	<IDL	0.28		0.80	0.02	76.0	
U	0.006	0.001	0.001	<IDL	0.002	0.000	0.28		1.33	0.03	75.5	
U	0.005	0.000	0.001	<IDL	0.002	0.000	0.28		0.74	0.01	75.6	
U	0.004	0.000	0.001	<IDL	0.001	<IDL	0.28		1.21	0.01	75.6	
U	0.002	0.000	0.001	<IDL	0.005	0.000	Not Measured		1.64	0.01	5.03	
U	0.001	<IDL	0.001	<IDL	0.001	<IDL	Not Measured		0.03	0.00	4.10	

Table A-2
Laboratory-Measured Analytical Results for R-20 Screen 2

Hg rslt	stdev (Hg)	K rslt	stdev (K)	Li rslt	stdev (Li)	Mg rslt	stdev (Mg)	Mn rslt	stdev (Mn)	Mo rslt	stdev (Mo)	Na rslt
0.00005	<IDL	3.23	0.01	0.025	0.001	4.14	0.64	0.134	0.000	0.001	0.000	14.5
0.00005	<IDL	2.90	0.02	0.023	0.000	2.34	0.02	0.039	0.001	0.002	0.000	14.3
0.00005	<IDL	3.30	0.07	0.024	0.000	3.32	0.05	0.117	0.001	0.001	0.000	14.8
0.00005	<IDL	3.03	0.01	0.024	0.000	2.39	0.02	0.034	0.000	0.002	0.000	15.0
0.00005	<IDL	3.03	0.04	0.024	0.000	2.86	0.02	0.093	0.004	0.001	0.000	14.4
0.00005	<IDL	2.80	0.01	0.022	0.000	2.22	0.01	0.033	0.000	0.002	0.000	13.8
0.00005	<IDL	2.99	0.01	0.023	0.000	2.72	0.02	0.079	0.000	0.001	0.000	14.4
0.00005	<IDL	2.74	0.01	0.022	0.000	2.16	0.01	0.031	0.000	0.002	0.000	13.6
0.00005	<IDL	2.94	0.01	0.023	0.000	2.63	0.01	0.064	0.000	0.002	0.000	13.9
0.00005	<IDL	2.90	0.01	0.023	0.000	2.28	0.01	0.031	0.000	0.002	0.000	14.0
0.00005	<IDL	2.97	0.02	0.024	0.000	2.63	0.02	0.061	0.001	0.002	0.000	14.2
0.00005	<IDL	2.93	0.01	0.023	0.000	2.30	0.01	0.025	0.000	0.002	0.000	14.1
0.00005	<IDL	2.98	0.00	0.024	0.000	2.53	0.01	0.050	0.000	0.002	0.000	14.1
0.00005	<IDL	2.78	0.01	0.022	0.000	2.19	0.01	0.028	0.000	0.002	0.000	13.5
0.00005	<IDL	2.80	0.02	0.023	0.000	2.42	0.02	0.047	0.000	0.002	0.000	13.5
0.00005	<IDL	2.65	0.04	0.021	0.000	2.11	0.02	0.026	0.000	0.002	0.000	12.9
0.00005	<IDL	2.87	0.01	0.023	0.000	2.40	0.02	0.041	0.000	0.002	0.000	13.4
0.00005	<IDL	2.64	0.05	0.021	0.001	2.13	0.03	0.039	0.001	0.002	0.000	13.0
0.00005	<IDL	2.78	0.01	0.023	0.000	2.35	0.01	0.035	0.000	0.002	0.000	13.6
0.00005	<IDL	2.77	0.01	0.023	0.000	2.24	0.01	0.028	0.000	0.002	0.000	13.6
0.00005	<IDL	2.80	0.02	0.023	0.001	2.32	0.02	0.032	0.000	0.002	0.000	13.3
0.00005	<IDL	2.46	0.04	0.020	0.000	2.00	0.04	0.025	0.000	0.002	0.000	12.2
0.00005	<IDL	2.78	0.01	0.023	0.000	2.34	0.02	0.033	0.000	0.002	0.000	13.3
0.00005	<IDL	2.60	0.01	0.022	0.000	2.21	0.01	0.031	0.000	0.002	0.000	12.9
0.00005	<IDL	0.01	<IDL	0.001	<IDL	0.01	<IDL	0.001	<IDL	0.001	0.000	0.3
0.00005	<IDL	2.70	0.01	0.023	0.000	2.27	0.01	0.031	0.000	0.002	0.000	13.4
0.00005	<IDL	2.70	0.03	0.023	0.000	2.26	0.02	0.031	0.000	0.002	0.000	13.4
0.00005	<IDL	2.65	0.01	0.022	0.000	2.21	0.02	0.028	0.000	0.002	0.000	13.2
0.00005	<IDL	2.65	0.02	0.022	0.000	2.16	0.00	0.028	0.000	0.002	0.000	13.0
0.00005	<IDL	2.70	0.03	0.023	0.000	2.42	0.04	0.035	0.001	0.002	0.000	12.9
0.00005	<IDL	2.75	0.02	0.022	0.000	2.82	0.03	0.058	0.001	0.002	0.000	12.8
0.00005	<IDL	2.86	0.09	0.024	0.001	2.46	0.07	0.038	0.001	0.002	0.000	13.5
0.00005	<IDL	2.60	0.02	0.021	0.000	2.44	0.04	0.037	0.000	0.002	0.000	12.7
0.00005	<IDL	2.47	0.07	0.020	0.001	2.10	0.06	0.032	0.001	0.002	0.000	11.9
0.00005	<IDL	2.44	0.02	0.021	0.000	2.36	0.01	0.034	0.000	0.002	0.000	12.1
0.00005	<IDL	2.49	0.10	0.021	0.001	2.24	0.07	0.029	0.001	0.001	0.000	12.4
0.00005	<IDL	2.36	0.03	0.020	0.000	2.28	0.02	0.033	0.000	0.002	0.000	11.9
0.00005	<IDL	2.10	0.05	0.017	0.001	1.91	0.04	0.024	0.001	0.001	0.000	10.4
0.00005	<IDL	2.23	0.02	0.019	0.000	2.16	0.02	0.032	0.000	0.002	0.000	11.3
0.00005	<IDL	1.69	0.04	0.013	0.000	1.60	0.02	0.021	0.000	0.002	0.000	8.6
0.00005	<IDL	2.35	0.01	0.020	0.000	2.23	0.01	0.031	0.000	0.002	0.000	11.8
0.00005	<IDL	0.22	0.00	0.001	0.000	0.19	0.00	0.013	0.000	0.001	0.000	0.7
0.00005	<IDL	0.16	0.00	0.001	<IDL	0.09	0.00	0.003	0.000	0.001	0.000	0.6

Table A-2
Laboratory-Measured Analytical Results for R-20 Screen 2

stdev (Na)	Ni rslt	stdev (Ni)	NO2(ppm)	NO2-N rslt	NO2-N (U)	NO3 ppm	NO3-N rslt	NO3-N (U)	C2O4 rslt	C2O4 (U)	Pb rslt	stdev (Pb)
0.1	0.004	0.000	0.01	0.003	U	0.59	0.132		0.01	U	0.0082	0.0004
0.1	0.001	0.000	0.01	0.003	U	0.71	0.160		0.01	U	0.0009	0.0000
0.1	0.005	0.000	0.01	0.003	U	0.70	0.158		0.01	U	0.0070	0.0001
0.0	0.001	0.000	0.01	0.003	U	0.78	0.177		0.01	U	0.0008	0.0000
0.1	0.003	0.000	0.01	0.003	U	0.82	0.186		0.01	U	0.0049	0.0001
0.1	0.001	0.000	0.01	0.003	U	0.82	0.185		0.01	U	0.0010	0.0000
0.2	0.003	0.000	0.01	0.003	U	0.87	0.196		0.01	U	0.0040	0.0001
0.0	0.001	0.000	0.01	0.003	U	0.91	0.205		0.01	U	0.0006	0.0000
0.0	0.003	0.000	0.01	0.003	U	0.93	0.209		0.01	U	0.0032	0.0002
0.0	0.001	0.000	0.01	0.003	U	0.95	0.214		0.01	U	0.0007	0.0000
0.1	0.003	0.000	0.01	0.003	U	0.96	0.217		0.01	U	0.0028	0.0000
0.0	0.001	0.000	0.01	0.003	U	1.00	0.226		0.01	U	0.0005	0.0000
0.0	0.002	0.000	0.01	0.003	U	1.06	0.240		0.01	U	0.0021	0.0001
0.0	0.001	0.000	0.01	0.003	U	1.07	0.241		0.01	U	0.0004	0.0000
0.1	0.002	0.000	0.01	0.003	U	1.08	0.244		0.01	U	0.0019	0.0000
0.1	0.001	0.000	0.01	0.003	U	1.09	0.246		0.01	U	0.0005	0.0000
0.1	0.002	0.000	0.01	0.003	U	1.12	0.252		0.01	U	0.0015	0.0000
0.3	0.002	0.000	0.01	0.003	U	1.11	0.252		0.01	U	0.0008	0.0000
0.1	0.002	0.000	0.01	0.003	U	1.20	0.270		0.01	U	0.0010	0.0000
0.1	0.001	0.000	0.01	0.003	U	1.20	0.272		0.01	U	0.0005	0.0000
0.1	0.002	0.000	0.01	0.003	U	1.29	0.290		0.01	U	0.0008	0.0000
0.2	0.001	0.000	0.01	0.003	U	1.24	0.279		0.01	U	0.0006	0.0000
0.1	0.002	0.000	0.01	0.003	U	1.27	0.287		0.01	U	0.0008	0.0000
0.1	0.002	0.000	0.01	0.003	U	1.28	0.289		0.01	U	0.0006	0.0001
0.0	0.001	0.000	0.01	0.003	U	0.01	0.002	U	0.01	U	0.0002	<IDL
0.0	0.001	0.000	0.01	0.003	U	1.30	0.293		0.01	U	0.0007	0.0000
0.1	0.002	0.000	0.01	0.003	U	1.30	0.294		0.01	U	0.0009	0.0000
0.1	0.001	0.000	0.01	0.003	U	1.34	0.302		0.01	U	0.0007	0.0000
0.0	0.001	0.000	0.01	0.003	U	1.30	0.294		0.01	U	0.0005	0.0000
0.2	0.002	0.000	0.01	0.003	U	1.39	0.314		0.01	U	0.0003	0.0000
0.1	0.002	0.000	0.01	0.003	U	0.64	0.145		0.01	U	0.0032	0.0001
0.3	0.001	0.000	0.01	0.003	U	0.88	0.198		0.01	U	0.0005	0.0000
0.0	0.002	0.000	0.01	0.003	U	1.27	0.286		0.01	U	0.0008	0.0000
0.3	0.002	0.000	0.01	0.003	U	1.27	0.288		0.01	U	0.0004	0.0000
0.1	0.002	0.000	0.01	0.003	U	1.34	0.302		0.01	U	0.0007	0.0000
0.5	0.002	0.000	0.06	0.018		1.35	0.304		0.01	U	0.0004	0.0001
0.1	0.002	0.000	0.01	0.003	U	1.36	0.308		0.01	U	0.0005	0.0000
0.2	0.001	0.000	0.01	0.003	U	1.38	0.312		0.01	U	0.0003	0.0000
0.1	0.002	0.000	0.01	0.003	U	1.40	0.317		0.01	U	0.0007	0.0000
0.1	0.001	0.000	0.01	0.003	U	1.39	0.314		0.01	U	0.0003	0.0000
0.1	0.001	0.000	0.01	0.003	U	1.40	0.316		0.01	U	0.0002	0.0000
0.0	0.002	0.000									0.0043	0.0001
0.0	0.001	0.000									0.0002	<IDL

Table A-2
Laboratory-Measured Analytical Results for R-20 Screen 2

Lab pH	PO4(-3) rslt	PO4(-3) (U)	Rb rslt	stdev (Rb)	S2- rslt	S2- (U)	Sb rslt	stdev (Sb)	Se rslt	stdev (Se)	Si rslt	stdev (Si)
8.18	0.15		0.010	0.000	0.01	U	0.001	<IDL	0.001	<IDL	37.8	0.5
8.09	0.17		0.006	0.000	---		0.001	<IDL	0.001	<IDL	33.0	0.1
8.31	0.15		0.012	0.000	0.03		0.001	<IDL	0.001	<IDL	36.3	0.6
8.11	0.17		0.006	0.000	---		0.001	<IDL	0.001	<IDL	34.7	0.1
8.32	0.15		0.009	0.001	0.02		0.001	<IDL	0.001	<IDL	34.8	0.3
8.08	0.17		0.006	0.000	---		0.001	<IDL	0.001	<IDL	32.5	0.2
8.29	0.15		0.008	0.000	0.01		0.001	<IDL	0.001	<IDL	33.9	0.3
8.20	0.16		0.006	0.000	---		0.001	<IDL	0.001	<IDL	31.6	0.2
8.30	0.14		0.008	0.000	0.01		0.001	<IDL	0.001	<IDL	34.7	0.3
8.21	0.16		0.006	0.000	---		0.001	<IDL	0.001	<IDL	34.2	0.3
7.72	0.15		0.007	0.000	0.01	U	0.001	<IDL	0.001	<IDL	34.5	0.1
8.16	0.18		0.006	0.000	---		0.001	<IDL	0.001	<IDL	34.6	0.3
7.53	0.14		0.007	0.000	0.01	U	0.001	<IDL	0.001	<IDL	35.1	0.2
8.16	0.15		0.006	0.000	---		0.001	<IDL	0.001	<IDL	33.3	0.2
8.27	0.13		0.007	0.000	0.01	U	0.001	<IDL	0.001	<IDL	34.3	0.4
8.09	0.15		0.006	0.000	---		0.001	<IDL	0.001	<IDL	32.5	0.5
8.08	0.12		0.007	0.000	0.01	U	0.001	<IDL	0.001	<IDL	34.9	0.2
7.97	0.14		0.007	0.000	---		0.001	<IDL	0.001	<IDL	32.9	0.5
8.21	0.12		0.006	0.000	0.01	U	0.001	<IDL	0.001	<IDL	35.4	0.3
8.05	0.14		0.006	0.000	---		0.001	<IDL	0.001	<IDL	34.9	0.4
8.16	0.11		0.006	0.000	0.01	U	0.001	<IDL	0.001	<IDL	35.5	0.3
8.06	0.12		0.006	0.000	---		0.001	<IDL	0.001	<IDL	31.3	0.5
8.14	0.09		0.006	0.000	0.010		0.001	<IDL	0.001	<IDL	35.9	0.4
8.06	0.11		0.007	0.001	---		0.001	<IDL	0.001	<IDL	34.2	0.2
7.37	0.01	U	0.001	<IDL	0.01	U	0.001	<IDL	0.001	<IDL	0.4	0.0
8.23	0.10		0.005	0.000	0.01	U	0.001	<IDL	0.001	<IDL	34.8	0.2
8.00	0.09		0.006	0.000			0.001	<IDL	0.001	<IDL	35.1	0.4
8.07	0.11		0.006	0.000	---		0.001	<IDL	0.001	<IDL	34.4	0.4
7.90	0.11		0.006	0.000	0.01	U	0.001	<IDL	0.001	<IDL	33.7	0.0
7.84	0.07		0.006	0.000	0.01	U	0.001	<IDL	0.001	<IDL	37.2	0.7
7.94	0.09		0.008	0.001	0.01	U	0.001	<IDL	0.001	<IDL	36.8	0.5
8.25	0.10		0.006	0.000	---		0.001	<IDL	0.001	<IDL	35.0	1.4
8.07	0.10		0.006	0.000	0.01	U	0.001	<IDL	0.001	<IDL	35.9	0.2
8.22	0.11		0.006	0.000	---		0.001	<IDL	0.001	<IDL	31.9	1.0
8.06	0.10		0.006	0.000	0.01	U	0.001	<IDL	0.001	<IDL	35.5	0.2
8.16	0.09		0.009	0.002	---		0.001	<IDL	0.001	<IDL	34.3	1.1
7.97	0.08		0.006	0.000	0.01	U	0.001	<IDL	0.001	<IDL	34.8	0.3
8.10	0.08		0.006	0.000	---		0.001	<IDL	0.001	<IDL	29.2	0.8
7.96	0.08		0.006	0.000	0.041		0.001	<IDL	0.001	<IDL	33.4	0.3
8.08	0.09		0.006	0.000	---		0.001	<IDL	0.001	<IDL	24.6	0.4
8.05	0.09		0.005	0.000	---		0.001	<IDL	0.001	<IDL	34.6	0.4
5.62	Not Measured		0.001	<IDL	0.03		0.001	<IDL	0.001	<IDL	1.5	0.0
5.87	Not Measured		0.001	<IDL	---		0.001	<IDL	0.001	<IDL	0.9	0.0

Table A-2
Laboratory-Measured Analytical Results for R-20 Screen 2

SiO2 rslt	stdev (SiO2)	Sn rslt	stdev (Sn)	SO4(-2) rslt	SO4(-2) (U)	Sr rslt	stdev (Sr)	Th rslt	stdev (Th)	Ti rslt	stdev (Ti)	Tl rslt
80.9	1.1	0.001	<IDL	10.7		0.345	0.000	0.001	0.000	0.033	0.006	0.001
70.7	0.2	0.001	<IDL	10.5		0.238	0.004	0.001	<IDL	0.008	0.000	0.001
77.7	1.3	0.001	<IDL	10.7		0.348	0.007	0.004	0.000	0.006	0.001	0.001
74.2	0.2	0.001	<IDL	10.7		0.228	0.001	0.001	<IDL	0.012	0.000	0.001
74.5	0.6	0.001	<IDL	10.8		0.314	0.015	0.002	0.000	0.005	0.002	0.001
69.6	0.4	0.001	<IDL	10.8		0.238	0.003	0.001	<IDL	0.015	0.000	0.001
72.5	0.6	0.001	<IDL	10.8		0.266	0.007	0.002	0.000	0.003	0.000	0.001
67.6	0.5	0.001	<IDL	10.7		0.244	0.003	0.001	<IDL	0.008	0.000	0.001
74.2	0.7	0.001	<IDL	10.6		0.274	0.006	0.001	0.000	0.006	0.001	0.001
73.2	0.6	0.001	<IDL	10.7		0.236	0.000	0.001	<IDL	0.005	0.000	0.001
73.9	0.2	0.001	<IDL	10.6		0.252	0.006	0.001	0.000	0.010	0.006	0.001
74.1	0.7	0.001	<IDL	10.6		0.225	0.000	0.001	<IDL	0.005	0.000	0.001
75.1	0.4	0.001	<IDL	10.5		0.237	0.003	0.001	<IDL	0.005	0.000	0.001
71.3	0.4	0.001	<IDL	10.5		0.224	0.002	0.001	<IDL	0.002	<IDL	0.001
73.4	0.8	0.001	<IDL	10.4		0.232	0.002	0.001	<IDL	0.005	0.001	0.001
69.6	1.1	0.001	<IDL	10.4		0.239	0.001	0.001	<IDL	0.002	<IDL	0.001
74.6	0.4	0.001	<IDL	10.4		0.250	0.004	0.001	<IDL	0.004	0.000	0.001
70.4	1.1	0.001	<IDL	10.5		0.260	0.002	0.001	<IDL	0.002	<IDL	0.001
75.7	0.7	0.001	<IDL	10.4		0.227	0.001	0.001	<IDL	0.003	0.000	0.001
74.6	0.9	0.001	<IDL	10.3		0.234	0.000	0.001	<IDL	0.002	<IDL	0.001
76.0	0.6	0.001	<IDL	10.4		0.214	0.002	0.001	<IDL	0.002	0.000	0.001
66.9	1.1	0.001	<IDL	10.2		0.236	0.002	0.001	<IDL	0.002	<IDL	0.001
76.8	0.8	0.001	<IDL	9.89		0.220	0.005	0.001	<IDL	0.003	0.000	0.001
73.3	0.5	0.001	<IDL	9.82		0.262	0.020	0.001	<IDL	0.002	<IDL	0.001
0.9	0.0	0.001	<IDL	0.02		0.001	<IDL	0.001	<IDL	0.002	0.002	0.001
74.4	0.5	0.001	<IDL	9.61		0.199	0.001	0.001	<IDL	0.001	0.000	0.001
75.0	0.8	0.001	<IDL	9.63		0.226	0.000	0.001	<IDL	0.003	0.000	0.001
73.6	0.8	0.001	<IDL	9.70		0.223	0.008	0.001	<IDL	0.002	<IDL	0.001
72.2	0.0	0.001	<IDL	9.70		0.218	0.001	0.001	<IDL	0.002	<IDL	0.001
79.6	1.4	0.001	<IDL	7.05		0.207	0.005	0.001	<IDL	0.002	<IDL	0.001
78.8	1.1	0.001	<IDL	8.28		0.250	0.005	0.001	0.000	0.012	0.000	0.001
74.8	2.9	0.001	<IDL	8.24		0.238	0.004	0.001	<IDL	0.002	<IDL	0.001
76.8	0.5	0.001	<IDL	8.09		0.230	0.005	0.001	<IDL	0.005	0.002	0.001
68.2	2.1	0.001	<IDL	8.03		0.232	0.000	0.001	<IDL	0.002	<IDL	0.001
76.0	0.4	0.001	<IDL	7.78		0.211	0.001	0.001	<IDL	0.003	0.000	0.001
73.4	2.4	0.001	<IDL	7.79		0.344	0.094	0.001	<IDL	0.002	<IDL	0.001
74.5	0.6	0.001	<IDL	7.33		0.200	0.004	0.001	<IDL	0.003	0.000	0.001
62.5	1.7	0.001	<IDL	7.38		0.221	0.011	0.001	<IDL	0.002	<IDL	0.001
71.5	0.7	0.001	<IDL	7.23		0.213	0.005	0.001	<IDL	0.002	<IDL	0.001
52.7	0.8	0.001	<IDL	7.21		0.217	0.004	0.001	<IDL	0.002	<IDL	0.001
74.1	0.8	0.001	<IDL	7.04		0.207	0.002	0.001	<IDL	0.002	<IDL	0.001
3.3	0.0	0.001	<IDL			0.014	0.000	0.001	<IDL	0.002	0.000	0.001
1.9	0.0	0.001	<IDL			0.009	0.000	0.001	<IDL	0.002	<IDL	0.001

Table A-2
Laboratory-Measured Analytical Results for R-20 Screen 2

stdev (Tl)	U rslt	stdev (U)	V rslt	stdev (V)	Zn rslt	stdev (Zn)	TDS (ppm)	Cations	Anions	Balance
<IDL	0.0020	0.0002	0.006	0.000	0.552	0.002	235	2.18	1.83	0.09
<IDL	0.0011	0.0000	0.002	0.000	0.043	0.001	204	1.60	1.74	-0.04
<IDL	0.0021	0.0000	0.006	0.001	0.466	0.000	228	2.07	1.92	0.04
<IDL	0.0010	0.0000	0.003	0.000	0.048	0.000	207	1.61	1.72	-0.04
<IDL	0.0015	0.0000	0.005	0.000	0.321	0.003	218	1.87	1.90	-0.01
<IDL	0.0011	0.0000	0.003	0.000	0.056	0.001	201	1.54	1.72	-0.06
<IDL	0.0014	0.0000	0.005	0.001	0.279	0.001	215	1.84	1.89	-0.01
<IDL	0.0008	0.0000	0.003	0.000	0.031	0.001	197	1.49	1.71	-0.07
<IDL	0.0013	0.0000	0.004	0.000	0.205	0.001	210	1.71	1.72	0.00
<IDL	0.0008	0.0000	0.003	0.000	0.033	0.000	204	1.56	1.71	-0.05
<IDL	0.0012	0.0000	0.004	0.000	0.191	0.002	216	1.71	1.82	-0.03
<IDL	0.0009	0.0000	0.004	0.000	0.024	0.001	204	1.58	1.69	-0.03
<IDL	0.0011	0.0000	0.004	0.000	0.132	0.001	204	1.66	1.62	0.01
<IDL	0.0008	0.0000	0.003	0.000	0.014	0.001	199	1.53	1.68	-0.05
<IDL	0.0011	0.0000	0.004	0.000	0.116	0.003	205	1.60	1.78	-0.05
<IDL	0.0008	0.0000	0.003	0.000	0.013	0.001	196	1.48	1.67	-0.06
<IDL	0.0010	0.0000	0.004	0.000	0.083	0.001	204	1.58	1.67	-0.03
<IDL	0.0010	0.0001	0.004	0.000	0.015	0.000	195	1.51	1.63	-0.04
<IDL	0.0009	0.0000	0.004	0.000	0.049	0.001	205	1.54	1.75	-0.06
<IDL	0.0008	0.0000	0.004	0.000	0.012	0.002	201	1.53	1.65	-0.04
<IDL	0.0009	0.0000	0.004	0.000	0.032	0.001	205	1.55	1.67	-0.04
<IDL	0.0008	0.0001	0.004	0.000	0.011	0.001	191	1.44	1.64	-0.06
<IDL	0.0009	0.0001	0.004	0.000	0.025	0.000	204	1.53	1.65	-0.04
<IDL	0.0010	0.0001	0.005	0.000	0.011	0.001	198	1.48	1.63	-0.05
<IDL	0.0002	<IDL	0.001	<IDL	0.001		8	0.02	0.12	-0.73
<IDL	0.0009	0.0000	0.004	0.000	0.026	0.000	208	1.50	1.76	-0.08
<IDL	0.0009	0.0000	0.004	0.000	0.025	0.001	200	1.48	1.62	-0.05
<IDL	0.0009	0.0000	0.004	0.000	0.010	0.000	198	1.46	1.63	-0.05
<IDL	0.0008	0.0000	0.004	0.000	0.013	0.000	195	1.46	1.60	-0.05
<IDL	0.0010	0.0000	0.005	0.000	0.021	0.000	200	1.48	1.54	-0.02
<IDL	0.0015	0.0000	0.005	0.001	0.134	0.001	212	1.63	1.68	-0.01
<IDL	0.0009	0.0000	0.003	0.000	0.029	0.000	205	1.55	1.78	-0.07
<IDL	0.0011	0.0000	0.004	0.000	0.040	0.000	201	1.51	1.60	-0.03
<IDL	0.0009	0.0000	0.003	0.000	0.013	0.000	189	1.41	1.66	-0.08
<IDL	0.0012	0.0000	0.004	0.000	0.036	0.001	198	1.44	1.58	-0.05
<IDL	0.0015	0.0004	0.007	0.002	0.011	0.001	195	1.44	1.58	-0.05
<IDL	0.0010	0.0000	0.005	0.000	0.026	0.000	194	1.40	1.55	-0.05
<IDL	0.0011	0.0001	0.005	0.000	0.010	0.001	180	1.31	1.55	-0.09
<IDL	0.0010	0.0000	0.005	0.000	0.020	0.000	190	1.37	1.54	-0.06
<IDL	0.0010	0.0000	0.004	0.000	0.008	0.001	167	1.17	1.54	-0.14
<IDL	0.0010	0.0001	0.004	0.000	0.013	0.000	192	1.37	1.54	-0.06
<IDL	0.0002	<IDL	0.001	<IDL	0.062	0.053	14	0.14	0.11	0.11
<IDL	0.0002	<IDL	0.001	<IDL	0.001		8	0.07	0.10	-0.13

Appendix B

Evaluation of Water Quality Using Well Screen Analysis Methodology

Table B-1a. Data Used

					B	Ba	TOC		Ca	Cl	ClO4		Cr	F		Fe	Alk	Mg	Mn	Na	Ni	NO3-N		PO4		S		SO4	Sr	U	V	Zn	
Original row	Sequence of collection	Truncated ID	F/UF	SAMPLE ID	B rslt	Ba rslt	TOC rslt	TOC (U)	Ca rslt	Cl(-) ppm	ClO4(-) ppm	ClO4 (-) (U)	Cr rslt	F(-) ppm	F(-) (U)	Fe rslt	Alk-CO3+HCO3 rslt	Mg rslt	Mn rslt	Na rslt	Ni rslt	NO-3-N rslt	NO-3-N (U)	PO4(-3) rslt	PO4(-3) (U)	S2- rslt	S2- (U)	SO4(-2) rslt	Sr rslt	U rslt	V rslt	Zn rslt	Status
1	1	83	F	GW20-08-8883	0.002	0.092			12.0	2.8	0.005	U	0.005	0.27		0.15	80	2.34	0.019	13.30	0.001	0.225		0.03				3.7	0.199	0.0014	0.006		
3	2	87	F	GW20-08-8887	0.002	0.057			11.8	2.7	0.005	U	0.003	0.27		0.17	79	2.43	0.020	13.70	0.001	0.246		0.04				3.5	0.123	0.0009	0.004	0.005	
5	3	88	F	GW20-08-8888	0.002	0.062			11.8	2.8	0.005	U	0.003	0.27		0.18	85	2.39	0.021	13.50	0.007	0.232		0.01	U			3.4	0.131	0.0008	0.004	0.027	
7	4	89	F	GW20-08-8889	0.002	0.067			11.8	1.8	0.005	U	0.004	0.27		0.20	77	2.30	0.021	13.00	0.001	0.298		0.06				3.4	0.136	0.0010	0.004	0.007	
9	5	90	F	GW20-08-8890	0.002	0.060			11.7	2.8	0.005	U	0.004	0.27		0.18	84	2.41	0.021	13.70	0.007	0.284		0.04				3.3	0.132	0.0009	0.004	0.034	
11	6	91	F	GW20-08-8891	0.002	0.068			11.5	2.8	0.005	U	0.004	0.27		0.19	77	2.32	0.019	13.10	0.001	0.299		0.04				3.3	0.148	0.0009	0.004	0.005	
13	7	92	F	GW20-08-8892	0.032	0.054			11.8	2.8	0.005	U	0.003	0.26		0.33	83	2.29	0.021	13.00	0.001	0.273		0.02				3.2	0.125	0.0008	0.004	0.009	
15	8	93	F	GW20-08-8893	0.034	0.050			11.7	3.0	0.005	U	0.003	0.26		0.46	83	2.40	0.034	13.80	0.001	0.297		0.04				3.1	0.119	0.0008	0.004	0.009	
17	9	75	F	GW20-08-8875	0.008	0.067			11.2	2.8	0.005	U	0.004	0.26		0.57	82	2.36	0.021	13.20	0.001	0.316		0.03				3.1	0.142	0.0009	0.005	0.010	
18	10	82	F	GW20-08-8882	0.002	0.070			11.4	2.8	0.005	U	0.006	0.26		0.60	82	2.33	0.023	13.00	0.002	0.304		0.02				3.0	0.155	0.0010	0.003	0.013	
22	11	94	F	GW20-08-8894	0.005	0.049			11.3	2.8	0.005	U	0.003	0.26		0.78	82	2.34	0.026	12.80	0.001	0.307		0.03				3.0	0.115	0.0007	0.004	0.010	
24	12	95	F	GW20-08-8895	0.002	0.059			11.5	2.8	0.005	U	0.004	0.26		1.08	82	2.47	0.025	13.10	0.001	0.308		0.03				3.0	0.111	0.0007	0.006	0.013	
26	13	85	F	GW20-08-8885	0.002	0.085			11.5	2.7	0.005	U	0.006	0.27		1.24	77	2.47	0.029	12.80	0.002	0.320		0.04				3.0	0.168	0.0011	0.006	0.018	
27	14	96	F	GW20-08-8896	0.002	0.057			11.3	2.7	0.005	U	0.003	0.26		1.15	81	2.44	0.026	12.80	0.001	0.306		0.02				3.0	0.109	0.0007	0.004	0.012	
30	15	8901	F	GW20-08-8901	0.002	0.054			11.2	2.7	0.005	U	0.005	0.27		1.39	81	2.61	0.027	12.90	0.001	0.310		0.02				3.0	0.108	0.0007	0.004	0.012	
32	16	99	F	GW20-08-8899	0.002	0.053			11.4	2.7	0.005	U	0.006	0.26		1.58	77	2.60	0.028	13.00	0.001	0.331		0.03				2.9	0.112	0.0007	0.004	0.013	
2	1	7	UF	GW20-08-9007	0.012	0.094	1.1		15.3				0.004			1.84	80	3.50	0.078	14.10	0.003					0.01	U		0.172	0.0026	0.005	0.085	
4	2	11	UF	GW20-08-9011	0.002	0.087	1.0		14.2				0.005			1.66	79	3.21	0.062	14.00	0.002					0.01	U		0.154	0.0020	0.004	0.061	
6	3	12	UF	GW20-08-9012	0.050	0.068	0.9		14.6				0.004			1.57	77	3.05	0.044	13.30	0.006					0.01	U		0.155	0.0014	0.004	0.069	
8	4	13	UF	GW20-08-9013	0.032	0.083	1.0		13.6				0.006			1.64	77	2.92	0.043	13.70	0.002					0.01	U		0.158	0.0016	0.005	0.051	
10	5	14	UF	GW20-08-9014	0.002	0.070	0.9		12.5				0.004			1.44	77	2.74	0.036	13.80	0.006					0.01	U		0.142	0.0013	0.004	0.059	
12	6	15	UF	GW20-08-9015	0.002	0.065	1.0		12.5				0.004			1.49	77	2.67	0.034	13.40	0.002					0.01	U		0.138	0.0013	0.004	0.041	
14	7	16	UF	GW20-08-9016	0.002	0.066	0.9		11.9				0.005			1.31	76	2.58	0.029	13.50	0.002					0.01	U		0.130	0.0010	0.004	0.029	
16	8	17	UF	GW20-08-9017	0.055	0.064	1.0		12.0				0.006			1.49	77	2.63	0.029	13.80	0.002					0.01	U		0.135	0.0010	0.005	0.030	
20	9	8999	UF	GW20-08-8999	0.002	0.064	1.0		11.6				0.005			1.29	83	2.53	0.027	13.10	0.001					0.01	U		0.116	0.0010	0.004	0.025	
21	10	6	UF	GW20-08-9006	0.033	0.063	1.0		11.9				0.004			1.29	76	2.53	0.028	13.20	0.001					0.01	U		0.127	0.0009	0.004	0.025	
23	11	18	UF	GW20-08-9018	0.026	0.066	1.0		12.0	0.01			0.006			1.24	82	2.18	0.022	11.70	0.001					0.01	U		0.145	0.0010	0.005	0.026	
25	12	19	UF	GW20-08-9019	0.021	0.079	1.0		11.7				0.007			1.41	82	2.32	0.024	12.20	0.001					0.01	U		0.150	0.0011	0.005	0.029	
28	13	9	UF	GW20-08-9009	0.002	0.055	1.2		11.3				0.004			1.65	75	2.48	0.026	12.60	0.001					0.01	U		0.113	0.0007	0.004	0.018	
29	14	20	UF	GW20-08-9020	0.017	0.069	1.06		11.7				0.006			1.43	76	2.23	0.023	11.60	0.002					0.01	U		0.143	0.0010	0.005	0.024	
31	15	25	UF	GW20-08-9025	0.037	0.055	1.15		11.3				0.004			1.90	81	2.73	0.029	13.60	0.001					0.01	U		0.114	0.0007	0.004	0.018	
32	16	23	UF	GW20-08-9023	0.015	0.075	1.08		11.4				0.006			1.69	80	2.34	0.025	11.70	0.001					0.01	U		0.132	0.0009	0.005	0.024	

Table B-1b.

Results of Well Screen Analysis for R-20(screen 1) During the 2007 Pumping Test Conducted on November 30, 2007. (Threshold values revised 8-Nov-07; identical to those used in DQM)

Well	Port depth (ft)	Scr #	Sample collection date	Event	Tritium (pCi/L)	Modern water?	3H plume?	Field pH		Low pH?	High pH?	Test Gen-1	Alkalinity (mg/L CaCO3)		Test Gen-2	Turbidity (NTU)		Test Gen-3	Acetone (ug/L)		Lab Qual Code	Test B1		NH3-N (mg/L)	Lab Qual Code	Test B2		TKN (mg/L)	Lab Qual Code	Test B3		TOC (mg/L)	Lab Qual Code	Test B4	Ba ug/L		Test D3	Test E1	Ca mg/L		Test E2	Test E2b	Test E2	Cl mg/L	Test A1	F mg/L	Lab Qual Code	Test A2	Mg mg/L	Test E3
						pCi/L	pCi/L			SU	SU				mg/L			NTU				ug/L				mg/L				mg/L				mg/			ug/L	ug/L			mg/	mg/L	Within		mg/L			mg/L		mg/L
						>UL	>UL			>LL	<UL				<UL			<UL				<U				<UL				<UL				<U			>LL	<UL			>LL	<UL	range		<UL			<UL		<UL
						1	17			6.4	9.0				157			5				5				0.05				0.5				1.4			1.4	57			4.3	42			3.6			0.6		4.2
R-20	907	1	30-Nov-07	1	ND	ND	ND	8.21	Fld	Yes	Yes	P	80	UF	P	164		Fail		ND		ND		ND		ND		ND		ND		1.1	UF	P	92		P	Fail	12.0		Yes	Yes	P	2.8	P	0.27		P	2.34	P
R-20	907	1	30-Nov-07	2	ND	ND	ND	8.27	Fld	Yes	Yes	P	79	UF	P	123		Fail		ND		ND		ND		ND		ND		ND		1.0	UF	P	57		P	P	11.8		Yes	Yes	P	2.7	P	0.27		P	2.43	P
R-20	907	1	30-Nov-07	3	ND	ND	ND	8.40	Fld	Yes	Yes	P	77	UF	P	101		Fail		ND		ND		ND		ND		ND		ND		0.9	UF	P	62		P	Fail	11.8		Yes	Yes	P	2.8	P	0.27		P	2.39	P
R-20	907	1	30-Nov-07	4	ND	ND	ND	8.41	Fld	Yes	Yes	P	77	UF	P	58		Fail		ND		ND		ND		ND		ND		ND		1.0	UF	P	67		P	Fail	11.8		Yes	Yes	P	1.8	P	0.27		P	2.30	P
R-20	907	1	30-Nov-07	5	ND	ND	ND	8.46	Fld	Yes	Yes	P	77	UF	P	43.5		Fail		ND		ND		ND		ND		ND		ND		0.9	UF	P	60		P	Fail	11.7		Yes	Yes	P	2.8	P	0.27		P	2.41	P
R-20	907	1	30-Nov-07	6	ND	ND	ND	8.48	Fld	Yes	Yes	P	77	UF	P	31		Fail		ND		ND		ND		ND		ND		ND		1.0	UF	P	68		P	Fail	11.5		Yes	Yes	P	2.8	P	0.27		P	2.32	P
R-20	907	1	30-Nov-07	7	ND	ND	ND	8.49	Fld	Yes	Yes	P	76	UF	P	31		Fail		ND		ND		ND		ND		ND		ND		0.9	UF	P	54		P	P	11.8		Yes	Yes	P	2.8	P	0.26		P	2.29	P
R-20	907	1	30-Nov-07	8	ND	ND	ND	8.47	Fld	Yes	Yes	P	77	UF	P	19.5		Fail		ND		ND		ND		ND		ND		ND		1.0	UF	P	50		P	P	11.7		Yes	Yes	P	3.0	P	0.26		P	2.40	P
R-20	907	1	30-Nov-07	9	ND	ND	ND	8.47	Fld	Yes	Yes	P	83	UF	P	16.2		Fail		ND		ND		ND		ND		ND		ND		1.0	UF	P	67		P	Fail	11.2		Yes	Yes	P	2.8	P	0.26		P	2.36	P
R-20	907	1	30-Nov-07	10	ND	ND	ND	8.47	Fld	Yes	Yes	P	76	UF	P	14.1		Fail		ND		ND		ND		ND		ND		ND		1.0	UF	P	70		P	Fail	11.4		Yes	Yes	P	2.8	P	0.26		P	2.33	P
R-20	907	1	30-Nov-07	11	ND	ND	ND	8.45	Fld	Yes	Yes	P	82	UF	P	10.7		Fail		ND		ND		ND		ND		ND		ND		1.0	UF	P	49		P	P	11.3		Yes	Yes	P	2.8	P	0.26		P	2.34	P
R-20	907	1	30-Nov-07	12	ND	ND	ND	8.43	Fld	Yes	Yes	P	82	UF	P	9.54		Fail		ND		ND		ND		ND		ND		ND		1.0	UF	P	59		P	Fail	11.5		Yes	Yes	P	2.8	P	0.26		P	2.47	P
R-20	907	1	30-Nov-07	13	ND	ND	ND	8.42	Fld	Yes	Yes	P	75	UF	P	8.01		Fail		ND		ND		ND		ND		ND		ND		1.2	UF	P	85		P	Fail	11.5		Yes	Yes	P	2.7	P	0.27		P	2.47	P
R-20	907	1	30-Nov-07	14	ND	ND	ND	8.10	Fld	Yes	Yes	P	76	UF	P	7.5		Fail		ND		ND		ND		ND		ND		ND		1.06	UF	P	57		P	P	11.3		Yes	Yes	P	2.7	P	0.26		P	2.44	P
R-20	907	1	30-Nov-07	15	ND	ND	ND	8.37	Fld	Yes	Yes	P	81	UF	P	7.42		Fail		ND		ND		ND		ND		ND		ND		1.15	UF	P	54		P	P	11.2		Yes	Yes	P	2.7	P	0.27		P	2.61	P
R-20	907	1	30-Nov-07	16	ND	ND	ND	8.35	Fld	Yes	Yes	P	80	UF	P	7.06		Fail		ND		ND		ND		ND		ND		ND		1.08	UF	P	53		P	P	11.4		Yes	Yes	P	2.7	P	0.26		P	2.60	P

Table B-1b.

Results of Well Screen Analysis for R-20(screen 1) During the 2007 Pumping Test Conducted on November 30, 2007. (Threshold values revised 8-Nov-07; identical to those used in DQM)

Well	Port depth (ft)	Scr #	Sample collection date	Event		NO3-N mg/L	Lab Qual Code	Test Gen-5	Test C10	ORP	Comment	Test C3	DO		Test C11		ClO4 ug/L	Lab Qual Code	Test Gen-4	Test C7		PO4-P	Lab Qual Code	UOM	Test A6	Na mg/L	Molar ratio Na/Cl	Test A4		SO4 mg/L	Lab Qual Code	Test C1	Test A5	Sulfide		Test C2		B ug/L	Lab Qual Code	Test A1		Cr (F) ug/L	Lab Qual Code		Test Gen-6	Test C9
									mg/L			mV			mg/L					ug/L		Threshold			mg/L P			mg/L				mg/L	mg/L			mg/L										ug/L
								<UL	>LL			>LL			>LL				<UL	>LL		as P			<UL			<UL				>LL	<UL			<UL				<UL					<UL	>LL
								0. 89	0.01			0			2				0.5	0.22		0.34			0.08			25				1.7	7.2			0.01				38.8					5.75	0.39
R-20	907	1	30-Nov-07	1		0.225		P	P	281		P	1.0		Fail	<	5	U	DL	DL		0.03		mg/L as PO4	P	13.3	7.3	P		3.7		P	P	0.01	U	P		25		P		5.0			P	P
R-20	907	1	30-Nov-07	2		0.246		P	P	231		P	1.0		Fail	<	5	U	DL	DL		0.04		mg/L as PO4	P	13.7	7.7	P		3.5		P	P	0.01	U	P		23		P		3.0			P	P
R-20	907	1	30-Nov-07	3		0.232		P	P	222		P	1.0		Fail	<	5	U	DL	DL		0.01	U	mg/L as PO4	P	13.5	7.5	P		3.4		P	P	0.01	U	P		19		P		3.0			P	P
R-20	907	1	30-Nov-07	4		0.298		P	P	199		P	1.1		Fail	<	5	U	DL	DL		0.06		mg/L as PO4	P	13.0	11.2	P		3.4		P	P	0.01	U	P		17		P		4.0			P	P
R-20	907	1	30-Nov-07	5		0.284		P	P	175		P	1.1		Fail	<	5	U	DL	DL		0.04		mg/L as PO4	P	13.7	7.6	P		3.3		P	P	0.01	U	P		16		P		4.0			P	P
R-20	907	1	30-Nov-07	6		0.299		P	P	160		P	1.2		Fail	<	5	U	DL	DL		0.04		mg/L as PO4	P	13.1	7.3	P		3.3		P	P	0.01	U	P		16		P		4.0			P	P
R-20	907	1	30-Nov-07	7		0.273		P	P	146		P	1.2		Fail	<	5	U	DL	DL		0.02		mg/L as PO4	P	13.0	7.2	P		3.2		P	P	0.01	U	P		15		P		3.0			P	P
R-20	907	1	30-Nov-07	8		0.297		P	P	140		P	1.2		Fail	<	5	U	DL	DL		0.04		mg/L as PO4	P	13.8	7.2	P		3.1		P	P	0.01	U	P		32		P		3.0			P	P
R-20	907	1	30-Nov-07	9		0.316		P	P	142		P	1.2		Fail	<	5	U	DL	DL		0.03		mg/L as PO4	P	13.2	7.3	P		3.1		P	P	0.01	U	P		64		Fail		4.0			P	P
R-20	907	1	30-Nov-07	10		0.304		P	P	139		P	1.3		Fail	<	5	U	DL	DL		0.02		mg/L as PO4	P	13.0	7.3	P		3.0		P	P	0.01	U	P		41		Fail		6.0			Fail	P
R-20	907	1	30-Nov-07	11		0.307		P	P	144		P	1.4		Fail	<	5	U	DL	DL		0.03		mg/L as PO4	P	12.8	6.9	P		3.0		P	P	0.01	U	P		28		P		3.0			P	P
R-20	907	1	30-Nov-07	12		0.308		P	P	149		P	1.3		Fail	<	5	U	DL	DL		0.03		mg/L as PO4	P	13.1	7.3	P		3.0		P	P	0.01	U	P		36		P		4.0			P	P
R-20	907	1	30-Nov-07	13		0.320		P	P	166		P	1.6		Fail	<	5	U	DL	DL		0.04		mg/L as PO4	P	12.8	7.2	P		3.0		P	P	0.01	U	P		28		P		6.0			Fail	P
R-20	907	1	30-Nov-07	14		0.306		P	P	128		P	1.3		Fail	<	5	U	DL	DL		0.02		mg/L as PO4	P	12.8	7.4	P		3.0		P	P	0.01	U	P		22		P		3.0			P	P
R-20	907	1	30-Nov-07	15		0.310		P	P	132		P	1.3		Fail	<	5	U	DL	DL		0.02		mg/L as PO4	P	12.9	7.4	P		3.0		P	P	0.01	U	P		20		P		5.0			P	P
R-20	907	1	30-Nov-07	16		0.331		P	P	173		P	1.9		Fail	<	5	U	DL	DL		0.03		mg/L as PO4	P	13.0	7.6	P		2.9		P	P	0.01	U	P		26		P		6.0			Fail	P

Table B-1b.

Results of Well Screen Analysis for R-20(screen 1) During the 2007 Pumping Test Conducted on November 30, 2007. (Threshold values revised 8-Nov-07; identical to those used in DQM)

Well	Port depth (ft)	Scr #	Sample collection date	Event	Cr (NF) ug/L	Lab Qual Code	Test F3	Ratio Cr (NF/F)	Test F4	Fe (F) ug/L	Lab Qual Code	Test C5	Fe (NF) ug/L	Lab Qual Code	Test F1	Ratio Fe(NF/F)	Test F2	Mn (F) ug/L	Lab Qual Code	Test C6	Ni (F) ug/L	Lab Qual Code	Test F5	Sr ug/L	Test D2	Test E3	U ug/L	Lab Qual Code	Test C8	Test D1	Test E5
							ug/L		Ratio			ug/L			ug/L		Ratio			ug/L			ug/L		ug/L	ug/L			ug/L	ug/L	ug/L
							<UL		<UL			<UL			<UL		<UL			<UL			<UL		>LL	<UL			>LL	>LL	<UL
							10		5			147			1270		10			124			50		44	540			0.06	0.06	1.9
R-20	907	1	30-Nov-07	1	4.0		P	0.8	NA	150		Fail	1840		No	12.3	Fail	19		P	1		P	199	P	P	1.4		P	P	P
R-20	907	1	30-Nov-07	2	5.0		P	1.7	NA	170		Fail	1660		No	9.8	P	20		P	1		P	123	P	P	0.9		P	P	P
R-20	907	1	30-Nov-07	3	4.0		P	1.3	NA	180		Fail	1570		No	8.7	P	21		P	7		P	131	P	P	0.8		P	P	P
R-20	907	1	30-Nov-07	4	6.0		P	1.5	NA	200		Fail	1640		No	8.2	P	21		P	1		P	136	P	P	1.0		P	P	P
R-20	907	1	30-Nov-07	5	4.0		P	1.0	NA	180		Fail	1440		No	8.0	P	21		P	7		P	132	P	P	0.9		P	P	P
R-20	907	1	30-Nov-07	6	4.0		P	1.0	NA	190		Fail	1490		No	7.8	P	19		P	1		P	148	P	P	0.9		P	P	P
R-20	907	1	30-Nov-07	7	5.0		P	1.7	NA	330		Fail	1310		No	4.0	P	21		P	1		P	125	P	P	0.8		P	P	P
R-20	907	1	30-Nov-07	8	6.0		P	2.0	NA	460		Fail	1490		No	3.2	P	34		P	1		P	119	P	P	0.8		P	P	P
R-20	907	1	30-Nov-07	9	5.0		P	1.3	NA	570		Fail	1290		No	2.3	P	21		P	1		P	142	P	P	0.9		P	P	P
R-20	907	1	30-Nov-07	10	4.0		P	0.7	NA	600		Fail	1290		No	2.2	P	23		P	2		P	155	P	P	1.0		P	P	P
R-20	907	1	30-Nov-07	11	6.0		P	2.0	NA	780		Fail	1240		No	1.6	P	26		P	1		P	115	P	P	0.7		P	P	P
R-20	907	1	30-Nov-07	12	7.0		P	1.8	NA	1080		Fail	1410		No	1.3	P	25		P	1		P	111	P	P	0.7		P	P	P
R-20	907	1	30-Nov-07	13	4.0		P	0.7	NA	1240		Fail	1650		No	1.3	P	29		P	2		P	168	P	P	1.1		P	P	P
R-20	907	1	30-Nov-07	14	6.0		P	2.0	NA	1150		Fail	1430		No	1.2	P	26		P	1		P	109	P	P	0.7		P	P	P
R-20	907	1	30-Nov-07	15	4.0		P	0.8	NA	1390		Fail	1900		No	1.4	P	27		P	1		P	108	P	P	0.7		P	P	P
R-20	907	1	30-Nov-07	16	6.0		P	1.0	NA	1580		Fail	1690		No	1.1	P	28		P	1		P	112	P	P	0.7		P	P	P

Table B-1b.

Results of Well Screen Analysis for R-20(screen 1) During the 2007 Pumping Test Conducted on November 30, 2007. (Threshold values revised 8-Nov-07; identical to those used in DQM)

Well	Port depth (ft)	Scr #	Sample collection date	Event	V ug/L	Lab qual code	Test C4	Zn ug/L	Lab Qual Code	Test D4	Tests Passed	Tests Failed	Total tests with P/Fail outcome	% Pass	Is 3H detected?	General Indicators	Category A	Category B		Category C							Category D				Category E					Category F
										ug/L							Residual	Residual		Redox Indicators							Sorption				Carbonate					Metal
							>LL			>LL							Inorganics	Organics	SO4	Fe/Mn						NO3					minerals					Corrosion
							2.27			0.4										V	Fe	Mn	ClO4	U	Cr		U	Sr	Ba	Zn	Ba	Ca	Mg	Sr	U	
R-20	907	1	30-Nov-07	1	6		P	9		P	29	5	34	85	ND	Turb					Fe					DO										
R-20	907	1	30-Nov-07	2	4		P	5		P	31	3	34	91	ND	Turb					Fe					DO										
R-20	907	1	30-Nov-07	3	4		P	27		P	30	4	34	88	ND	Turb					Fe					DO										
R-20	907	1	30-Nov-07	4	4		P	7		P	30	4	34	88	ND	Turb					Fe					DO										
R-20	907	1	30-Nov-07	5	4		P	34		P	30	4	34	88	ND	Turb					Fe					DO										
R-20	907	1	30-Nov-07	6	4		P	5		P	30	4	34	88	ND	Turb					Fe					DO										
R-20	907	1	30-Nov-07	7	4		P	9		P	31	3	34	91	ND	Turb					Fe					DO										
R-20	907	1	30-Nov-07	8	4		P	9		P	31	3	34	91	ND	Turb					Fe					DO										
R-20	907	1	30-Nov-07	9	5		P	10		P	30	4	34	88	ND	Turb					Fe					DO										
R-20	907	1	30-Nov-07	10	3		P	13		P	29	5	34	85	ND	Turb					Fe					DO										
R-20	907	1	30-Nov-07	11	4		P	10		P	31	3	34	91	ND	Turb					Fe					DO										
R-20	907	1	30-Nov-07	12	6		P	13		P	30	4	34	88	ND	Turb					Fe					DO										
R-20	907	1	30-Nov-07	13	6		P	18		P	29	5	34	85	ND	Turb					Fe					DO										
R-20	907	1	30-Nov-07	14	4		P	12		P	31	3	34	91	ND	Turb					Fe					DO										
R-20	907	1	30-Nov-07	15	4		P	12		P	31	3	34	91	ND	Turb					Fe					DO										
R-20	907	1	30-Nov-07	16	4		P	13		P	30	4	34	88	ND	Turb					Fe					DO										

Table B-1b.
Results of Well Screen Analysis for R-20(screen 1) During the 2007 Pumping Test Conducted on November 30, 2007. (Threshold values revised 8-Nov-07; identical to those used in DQM)

Well	Port depth (ft)	Scr #	Sample collection date	Event	General Indicators							Category A Inorganic Indicators						Category B Organic Indicators				Category C1 Redox (SO4)			Category C2 Redox (Fe/Mn)						Category C3 Redox (NO3)	
					Mod water	Gen-1	Gen-2	Gen-3	Gen-4	Gen-5	Gen-6	A1	A2	A3	A4	A5	A6	B1	B2	B3	B4	C1	C2	C3	C4	C5	C6	C7	C8	C9	C10	C11
					3H	In pH	Alk	Turb	ClO4	NO3-N	Cr	B	Cl	Na	SO4	F	PO4	Ace	NH3	TKN	TOC	SO4	S	ORP	V	Fe	Mn	ClO4	U	Cr	NO3-N	DO
					UL=1	range	UL=52	UL=5	UL=0.5	UL=0.89	UL=5.75	UL=39	UL=3.6	UL=24.5	UL=7.2	UL=0.5	UL=3.4	5	0.05	0.35	1.37	LL=1.65	UL=0.01	LL=0	LL=2.27	UL=147	UL=124	LL=0.22	LL=0.06	LL=0.39	LL=0.01	LL=2
R-20	907	1	30-Nov-07	1	ND	P	P	Fail	DL	P	P	P	P	P	P	P	P	ND	ND	ND	P	P	P	P	P	Fail	P	DL	P	P	P	Fail
R-20	907	1	30-Nov-07	2	ND	P	P	Fail	DL	P	P	P	P	P	P	P	P	ND	ND	ND	P	P	P	P	P	Fail	P	DL	P	P	P	Fail
R-20	907	1	30-Nov-07	3	ND	P	P	Fail	DL	P	P	P	P	P	P	P	P	ND	ND	ND	P	P	P	P	P	Fail	P	DL	P	P	P	Fail
R-20	907	1	30-Nov-07	4	ND	P	P	Fail	DL	P	P	P	P	P	P	P	P	ND	ND	ND	P	P	P	P	P	Fail	P	DL	P	P	P	Fail
R-20	907	1	30-Nov-07	5	ND	P	P	Fail	DL	P	P	P	P	P	P	P	P	ND	ND	ND	P	P	P	P	P	Fail	P	DL	P	P	P	Fail
R-20	907	1	30-Nov-07	6	ND	P	P	Fail	DL	P	P	P	P	P	P	P	P	ND	ND	ND	P	P	P	P	P	Fail	P	DL	P	P	P	Fail
R-20	907	1	30-Nov-07	7	ND	P	P	Fail	DL	P	P	P	P	P	P	P	P	ND	ND	ND	P	P	P	P	P	Fail	P	DL	P	P	P	Fail
R-20	907	1	30-Nov-07	8	ND	P	P	Fail	DL	P	P	P	P	P	P	P	P	ND	ND	ND	P	P	P	P	P	Fail	P	DL	P	P	P	Fail
R-20	907	1	30-Nov-07	9	ND	P	P	Fail	DL	P	Fail	Fail	P	P	P	P	P	ND	ND	ND	P	P	P	P	P	Fail	P	DL	P	P	P	Fail
R-20	907	1	30-Nov-07	10	ND	P	P	Fail	DL	P	P	Fail	P	P	P	P	P	ND	ND	ND	P	P	P	P	P	Fail	P	DL	P	P	P	Fail
R-20	907	1	30-Nov-07	11	ND	P	P	Fail	DL	P	P	P	P	P	P	P	P	ND	ND	ND	P	P	P	P	P	Fail	P	DL	P	P	P	Fail
R-20	907	1	30-Nov-07	12	ND	P	P	Fail	DL	P	P	P	P	P	P	P	P	ND	ND	ND	P	P	P	P	P	Fail	P	DL	P	P	P	Fail
R-20	907	1	30-Nov-07	13	ND	P	P	Fail	DL	P	Fail	P	P	P	P	P	P	ND	ND	ND	P	P	P	P	P	Fail	P	DL	P	P	P	Fail
R-20	907	1	30-Nov-07	14	ND	P	P	Fail	DL	P	P	P	P	P	P	P	P	ND	ND	ND	P	P	P	P	P	Fail	P	DL	P	P	P	Fail
R-20	907	1	30-Nov-07	15	ND	P	P	Fail	DL	P	P	P	P	P	P	P	P	ND	ND	ND	P	P	P	P	P	Fail	P	DL	P	P	P	Fail
R-20	907	1	30-Nov-07	16	ND	P	P	Fail	DL	P	Fail	P	P	P	P	P	P	ND	ND	ND	P	P	P	P	P	Fail	P	DL	P	P	P	Fail

Table B-1b.

Results of Well Screen Analysis for R-20(screen 1) During the 2007 Pumping Test Conducted on November 30, 2007. (Threshold values revised 8-Nov-07; identical to those used in DQM)

Well	Port depth (ft)	Scr #	Sample collection date	Event	Category D Adsorption				Category E Carbonate mineralogy							Category F Metal corrosion					Categories under which drilling flags are to be assigned					
					D1	D2	D3	D4	E1	E2a	E2b	E2	E3	E4	E5	F1	F2	F3	F4	F5						
					U	Sr	Ba	Zn	Ba	Ca	Ca	Ca	Mg	Sr	U	FeT	FeR	CrT	CrR	Ni	**A**	**B**	**C**	**D**	**E**	**F**
					LL=0.06	LL=44	LL=4.9	LL=0.4	UL=57	LL=4.3	UL=42	In range	UL=4.2	UL=540	UL=1.90	UL=500	UL=10	UL=10	UL=5	UL=50						
R-20	907	1	30-Nov-07	1	P	P	P	P	P	P	P	P	P	P	P	No	P	P	NA	P	–	Organics	Fe	–	–	–
R-20	907	1	30-Nov-07	2	P	P	P	P	P	P	P	P	P	P	P	No	P	P	NA	P	–	Organics	Fe	–	–	–
R-20	907	1	30-Nov-07	3	P	P	P	P	P	P	P	P	P	P	P	No	P	P	NA	P	–	Organics	Fe	–	–	–
R-20	907	1	30-Nov-07	4	P	P	P	P	P	P	P	P	P	P	P	No	P	P	NA	P	–	Organics	Fe	–	–	–
R-20	907	1	30-Nov-07	5	P	P	P	P	P	P	P	P	P	P	P	No	P	P	NA	P	–	Organics	Fe	–	–	–
R-20	907	1	30-Nov-07	6	P	P	P	P	P	P	P	P	P	P	P	No	P	P	NA	P	–	Organics	Fe	–	–	–
R-20	907	1	30-Nov-07	7	P	P	P	P	P	P	P	P	P	P	P	No	P	P	NA	P	–	Organics	Fe	–	–	–
R-20	907	1	30-Nov-07	8	P	P	P	P	P	P	P	P	P	P	P	No	P	P	NA	P	–	Organics	Fe	–	–	–
R-20	907	1	30-Nov-07	9	P	P	P	P	P	P	P	P	P	P	P	No	P	P	NA	P	–	Organics	Fe	–	–	–
R-20	907	1	30-Nov-07	10	P	P	P	P	P	P	P	P	P	P	P	No	P	P	NA	P	–	Organics	Fe	–	–	–
R-20	907	1	30-Nov-07	11	P	P	P	P	P	P	P	P	P	P	P	No	P	P	NA	P	–	Organics	Fe	–	–	–
R-20	907	1	30-Nov-07	12	P	P	P	P	P	P	P	P	P	P	P	No	P	P	NA	P	–	Organics	Fe	–	–	–
R-20	907	1	30-Nov-07	13	P	P	P	P	P	P	P	P	P	P	P	No	P	P	NA	P	–	Organics	Fe	–	–	–
R-20	907	1	30-Nov-07	14	P	P	P	P	P	P	P	P	P	P	P	No	P	P	NA	P	–	Organics	Fe	–	–	–
R-20	907	1	30-Nov-07	15	P	P	P	P	P	P	P	P	P	P	P	No	P	P	NA	P	–	Organics	Fe	–	–	–
R-20	907	1	30-Nov-07	16	P	P	P	P	P	P	P	P	P	P	P	No	P	P	NA	P	–	Organics	Fe	–	–	–

Table B-2.
Constituents of Contaminant Plumes Present in Laboratory Monitoring Wells

Scr ID	Sat Zone	Well	Port depth (ft)	Scr #	Watershed	Modern water present?	Upgradient source for contaminated discharge?	Plume present?	Plume Constituents: Tritium	B	Cl	F	Na	ClO4	Cr	NO3	SO4	U	Ca	Mg	Ni	TOC	Other
49	RT	R-20	907	1	Pajarito	No	TA-18	—	No	No	No	No	No	No	No	No	No	No	No	No	No	No	—
50	RT	R-20	1150	2	Pajarito	No	TA-18	—	No	No	No	No	No	No	No	No	No	No	No	No	No	No	—

RT = Regional aquifer (top)

X = Yes (present)
— = Not known with certainty to be present
? = Likely to be present, but not certain due to inadequate data record

Appendix C

Video Logging (on DVD included with this report)