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Reliability Assessment of Multiscreened Westbay Wells

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1.0 INTRODUCTION

This report reviews water-quality data collected during a reliability assessment of multiscreened Westbay wells at Los Alamos National Laboratory (LANL). The methodology for the assessment was presented in the "Work Plan to Conduct Reliability Assessment of Multiscreened Westbay Wells" (LANL 2010, 109676) that was approved by the New Mexico Environment Department (NMED) on June 15, 2010 (NMED 2007, 098182).

The primary objective of the reliability assessment is to evaluate whether data collected with Westbay sampling systems are comparable with data collected using conventional purging and sampling techniques in those same screens. Data obtained during the study are used to evaluate the comparability of data derived from nonpurging and purging sampling approaches. This evaluation provides insights into whether Westbay sampling systems are a reliable means to collect samples in the particular hydrogeologic environment in which they are deployed.

A secondary objective is to compare data collected from select screens, after redevelopment, with historical Westbay data and with data collected using a purgeable sampling system before redevelopment. The results will also be used to provide recommendations to NMED for the final configuration for wells addressed in this study and sampling systems for those wells. Recommendations for final configuration and sampling systems will be based on monitoring network objectives, the conceptual model for groundwater flow and transport in the study area, and the data confirming the nature and extent of contaminants, particularly from the deepest screens in each well.

This study focused on three wells in the Technical Area 16 (TA-16) 260 Outfall area [Consolidated Unit 16-021(c)-99] that used Westbay sampling systems. The three wells, CdV-R-15-3, CdV-R-37-2, and R-26, are shown in Figure 1.0-1 of Attachment 1 of this report (Westbay Reliability Assessment Field Summary Report). These wells were selected to facilitate and advance a review of the groundwater monitoring data and network supporting the 260 Outfall investigation pending revision to the corrective measures evaluation report. Westbay sampling systems in these wells enabled monitoring in multiple hydrologic zones, although some screened intervals have not yielded water either because they have been dry since installation or because of construction problems. Details of well-drilling methodologies and construction chronologies are found in Table 2.0-1 of the Westbay reliability assessment study work plan (LANL 2010, 109676). Details related to well screens, groundwater occurrences, and monitoring data for these three wells are provided in Table 2.0-2 of the work plan; well-construction details are provided in Table 2.0-3 of the work plan (LANL 2010, 109676).

CdV-R-15-3 contains three regional-aquifer screens in the Puye Formation. CdV-R-37-2 contains three regional-aquifer screens in dacitic Tschicoma lavas. R-26 contains an upper perched-intermediate screen in the Cerro Toledo Formation and a lower regional-aquifer screen in the Puye Formation. The Westbay sampling port in the lower screen was found to be plugged with bentonite and has not produced samples.

2.0 FIELD ACTIVITIES

Field activities for this assessment occurred between March 24 and June 17, 2011, and consisted of four phases (also called "parts" in this report). Field activities at each well are described in Attachment 1:

- Phase 1 consisted of the collection of water-quality samples from each screen using the installed Westbay system; the Westbay system was then removed, and video logging and specific-capacity testing were performed on each screen to document the initial condition of the screen and casing and to estimate the volumes of cross-flow between screens.

- Phase 2 consisted of purging and collecting water-quality samples from each screen. The first samples for Phase 2 were collected at the end of purging the volume estimated as necessary to remove cross-flow. These samples are designated as Part 2a in tables and figures in this report. Three more samples were collected after an additional 3, 6, and 10 casing volumes (CV) had been purged. These samples are designated as Parts 2b, 2c, and 2d in tables and figures in this report.

More rigorous redevelopment of CdV-R-15-3 screen 4 and CdV-R-37-2 screen 2 was conducted, with corresponding sampling, to assess the effects on water-quality constituents for each of these additional redevelopment methods. These screens are at the top of the water table and represent locations that may be useful for the overall groundwater-monitoring network for TA-16. In addition, they represent two extremes of geochemical conditions that prevail in screens equipped with Westbay sampling systems. The more rigorous redevelopment phase was intended to address whether samples collected with a Westbay system might be reliable under some conditions and whether it was feasible to rehabilitate a Westbay screen interval in a zone in which groundwater chemistry has been severely impacted by the residual effects of drilling and construction. CdV-R-15-3 screen 4 has historically provided water-quality data that appear to be reliable and representative of predrilling groundwater chemistry; water-quality samples collected from CdV-R-37-2 screen 2 are considered suspect based on the persistence of iron-reducing conditions and elevated concentrations of total organic carbon (TOC) attributed to residual downhole drilling and construction products (LANL 2007, 096330).

Redevelopment at these two water-table screens occurred in two phases:

- Redevelopment during Phase 3 involved swabbing and bailing the screen. Water-quality samples collected at the midpoint of this activity are designated Part 3a, and samples collected at the end of this activity are designated Part 3b.
- As requested by NMED (2010, 110456), redevelopment during Phase 4 used high-velocity jetting with contaminant- and tritium-free local regional groundwater while simultaneously pumping the screen. Samples collected at the end of Phase 4 are designated Part 4 in tables and figures.

3.0 ASSESSMENT PROTOCOL

The objective of this assessment is to determine if water-quality data collected from each Westbay screen are adequate to reliably monitor for contaminants associated with the TA-16 260 Outfall. The assessment protocol is similar to that used previously for perched-intermediate well R-47i (LANL 2011, 201564).

Evidence examined as part of this assessment includes (1) field parameters monitored during purging prior to sample collection; (2) final field parameters; (3) major ion concentrations; (4) trace metal concentrations; and (5) detections of organic analytes. The assessments are based on site-specific geochemical criteria and focus on data obtained during each phase of the Westbay study. The assessment outcome provides a basis for recommendations concerning the well's final configuration and data usability.

Field Parameters

Time-series data for field parameters monitored during purging and before sample collection are examined for attainment of stable values by the end of purging (Tables 2.4-1, 2.5-1, 3.4-1, 3.5-1, 4.5-1, and 4.5-2 in Attachment 1). Stabilization criteria are prescribed in Standard Operating Procedure (SOP) 5232, Groundwater Sampling, and are derived from the stabilization criteria recommended by the U.S. Environmental Protection Agency (EPA) (Yeskis and Zavala 2002, 204429) and from the Compliance Order on Consent. The most sensitive indicator parameters are dissolved oxygen (DO) and turbidity. Other parameters such as water temperature, specific conductance, pH, and oxidation-reduction potential (ORP) are also monitored but are considered less sensitive indicators of formation water.

Alkalinities in the samples collected for this study were measured at the on-site analytical laboratory and are reported in Table 2.0-2.

Inorganic Analytes

Analytical data for common inorganic ions (Table 2.0-2) and trace metals (Table 2.0-3) are examined for stability and compared with historical mean concentrations collected from the screen using the Westbay system and with groundwater background concentrations as follows:

- trends in concentrations of key indicators for the presence of the specific drilling and construction materials used in the screened interval, such as sodium (Na), sulfate (SO_4), and TOC;
- trends in relative concentrations of major ions; and
- comparison of concentrations for major ions and selected trace metals with lower and upper concentration ranges for plateau-scale and site-specific background groundwater, as described below.

Concentration trends are depicted using standard trilinear diagrams and modified Schoeller plots:

- Trilinear diagrams, also called Piper plots, show major ions as percentages of milliequivalents (meq) in two base triangles. Total meq cations and total meq anions are each set equal to 100% and the data points in the two triangles are projected onto an adjacent grid. The main purpose of the Piper diagram is to show clustering of data points to indicate samples have similar compositions.
- Schoeller plots are semilogarithmic diagrams originally developed to represent major ion analyses in milliequilivalents per liter (meq/L) and to demonstrate different hydrochemical water types on the same diagram. This type of graphical representation has the advantage that, unlike the trilinear diagrams, actual sample concentrations are displayed and compared. The modified Schoeller plot used for the reliability assessment represents analyses as mg/L or µg/L to avoid the need to make assumptions about ion speciation, which may be particularly problematic for trace metals.

Analytical data are also reported for major cations and trace metals in unfiltered groundwater samples (Table 2.0-4). These data may be compared with concentrations in the corresponding filtered samples to provide insights about the amount and composition of solids removed from the well screen, filter pack, and/or formation (NMED 2010, 110456).

Organic Analytes

Detections of volatile organic compounds (VOCs) and semivolatile organic compounds (SVOCs) in the samples collected for this study are compiled for examination of temporal trends and evidence for the presence of residual downhole products or local contaminants (Table 2.0-5). Table 2.0-5 notes VOCs and SVOCs detected in equipment blanks collected from each well during the study; no VOCs or SVOCs were detected in the field-trip blanks.

Stable Isotopes

Stable Isotopes of hydrogen and oxygen in water and nitrogen in nitrate (NO_3) have the potential to provide information on temporal trends and potential mixing of waters (Table 2.0-6). Stable nitrogen isotopes also provide indirect evidence for past or present microbial activity that fractionates these isotopes.

Field Documentation

As appropriate, field notes, groundwater sampling logs, and sample collection logs for each sampling event are also examined for observations about unusual odors, colors, or other indications of impacted water samples.

Background Values for Assessment

Plateau-scale background concentrations. For naturally occurring analytes, statistical summaries of water-quality data for background groundwater locations establish a range of concentrations against which data from the assessed screens are compared for a preliminary assessment step. Upper bounds of plateau-scale background ranges used in the reliability assessments are taken from the Groundwater Background Investigation Report, Revision 3 (GBIR R3) (LANL 2007, 095817). Upper bounds are established by the upper tolerance limit (UTL), if one is listed in GBIR R3; otherwise, the maximum detected concentration is used.

Site-specific background values for assessment. Representativeness is assessed with greater specificity by comparing analytical concentrations with those in groundwater from other deep screens in sufficiently similar hydrogeologic settings and at which effects from downhole materials or local contaminants are known to be absent or negligible. The approach allows for the inclusion of screens not hydraulically upgradient of the screen being assessed. This is similar to the inter-well comparison approach described in sections 5.2.4 and 6.3.2 of the EPA guidance document, “Statistical Analysis of Groundwater Monitoring Data at RCRA Facilities” (“Unified Guidance”) (EPA 2009, 110369). The development and use of site-specific background values is illustrated in the “Reliability Assessment of Well R-47i” (LANL 2011, 201564). Ranges of site-specific background values from the R-47i assessment report are included in the figures in this study.

4.0 EVALUATION OF WATER-QUALITY DATA

This section first presents results for regional screens for which redevelopment was limited to purging after removal of the Westbay system (sections 4.1 through 4.4), followed by sections 4.5 and 4.6, which present the results for the two regional screens that underwent more rigorous redevelopment following the purging phase. Finally, section 4.7 presents the results for the perched-intermediate screen in R-26.

Evaluation of water-quality data for these seven screens focuses on comparing prepurge (Phase 1) samples and historical data from each screen to samples collected during purging (Phase 2) and redevelopment (Parts 3 and 4).

4.1 CdV-R-15-3 Screen 5

The Well Screen Analysis Report, Revision 2, concluded CdV-R-15-3 screen 5 was one of the most severely impacted screens among those equipped with Westbay sampling systems (LANL 2007, 096330). This conclusion was based on multiple lines of geochemical evidence for highly reducing conditions that have persisted in screen 5 since the first sample was collected on January 4, 2001. Geochemical indicators of the reducing condition include elevated concentrations of iron (Fe), manganese (Mn), and sulfide, in concert with negligibly low concentrations of sulfate (SO_4), nitrate (NO_3), perchlorate (ClO_4), uranium (U), and chromium (Cr). Elevated TOC concentrations indicate reducing conditions probably resulted from residual organic drilling and construction materials in the interval. Removal of residual organics during well development may have been hindered by the accidental emplacement of bentonite-rich annular-fill material next to the lower 34% of this screen (Kopp et al. 2002, 073179).

The calculated casing volume of screen 5 is 68 gal. (White 2011, 204549). The screen was purged 807 gal. (12 CV) to remove cross-flow before the first sample was collected for Phase 2. Water-quality data collected from this screen during the study are summarized in Tables 2.0-1 through 2.0-5; selected constituents are plotted in the following figures which provide the basis for the observations in this section:

- Figure 4.1-1 shows time-series plots of field parameters monitored during purging;
- Figure 4.1-2 presents Schoeller plots for major cations and anions;
- Figure 4.1-3 presents Schoeller plots for trace metals;
- Figure 4.1-4 shows the samples plotted on a trilinear diagram;
- Figure 4.1-5 plots a time-series of major ion concentrations for samples collected for this study from each of the three screens in CdV-R-15-3; and
- Figure 4.1-6 plots a time-series of trace metal concentrations for samples collected for this study from each of the three screens in CdV-R-15-3.

Stability of Field Parameters during Purging

Most field parameters remained stable during the 10 CV purge that followed the removal of cross-flow (Table 2.0-1; Figure 4.1-1). Turbidity was the only parameter showing a discernable and consistent trend during Phase 2, during which it decreased from an initial value of 5.2 nephelometric turbidity units (NTU) to a final value of 1.6 NTU.

Comparison with Prepurge Samples

Phase 2 purging affected concentrations of many constituents relative to the no-purge sample collected using the Westbay system. The most significant changes are summarized here. Changes are described for Phase 2 samples relative to prepurge (Westbay) samples; numbers in parentheses indicate the concentration at the end of Phase 2 (Part 2d) expressed as a percentage of the concentration in the no-purge sample. The method detection limit (MDL) is substituted for those concentrations reported as not detected:

- Lower concentrations of the major cations, potassium (K), calcium (Ca) (87%), magnesium (Mg) (84%), and major anions S_{O4} (59%), Cl (89%), and fluoride (F) (78%);
- Higher concentration of the anions, NO_3 (230%) and perchlorate (ClO_4) (630%), which were at the MDL in the prepurge sample;
- Lower concentrations of the trace metals, barium (Ba) (70%), Fe (23%), and Mn (48%);
- higher concentrations of the trace metals, molybdenum (Mo) (200%), U (1500%), and vanadium (V) (400%); and
- Lower concentrations of TOC (60%) and total dissolved solids (TDS) (89%).

Redevelopment and purging resulted in an observable shift in the relative concentrations of major ions, as shown on a trilinear plot (Figure 4.1-4). The shift relative to the prepurge sample is observed with the first sample collected during Phase 2 (Part 2a), after which subsequent samples plot in the same field as the part a sample.

Toluene was detected all samples collected during Phase 2 (Table 2.0-5). This detection is significant because it was not detected in the prepurge sample. No other VOCs or SVOCs are detected in the Phase 2 samples.

Comparison with Historical Data for This Screen

Many of the observations made above for the comparison of Phase 2 samples with prepurge samples also apply to the comparison of Phase 2 (Part 2d) samples to historical mean concentrations for this screen (Tables 2.0-2 and 2.0-3; Figures 4.1-2 and 4.1-3). The similarity in the types and magnitudes of changes reflects the stability of the geochemical before to redevelopment and purging:

- Lower concentrations of the major cations, K (85%), Ca (78%), Mg (95%), and major anions SO_4 (50%), Cl (70%), and F (58%);
- Higher concentrations of the anions, NO_3 (340%) and perchlorate (ClO_4) (410%), which were at the method detection limit in the historical means for this screen;
- Lower concentrations of the trace metals, Ba (58%), Fe (21%), and Mn (63%);
- Higher concentrations of the trace metals, Mo (490%), U (1500%), and V (360%); and
- Lower concentrations of TOC (48%) and TDS (91%).

Toluene was detected all samples collected during Phase 2 (Table 2.0-5) but was not detected in historical samples collected using the Westbay system. No other VOCs or SVOCs are detected in the historical samples and the Phase 2 samples.

Observed changes and trends listed above are consistent with the following interpretation of the effects of Phase 2 purging:

- removal of the mobile fractions of residual organic and inorganic constituents;
- removal of aluminosilicates (evidenced by elevated concentrations of aluminum [Al] in the unfiltered sample for Part 2a) (Table 2.0-4);
- partial (but incomplete) restoration of oxidizing conditions; and
- dissolution of Fe- and Mn-bearing minerals.

Is the Screen Producing Reliable Data?

This screen does not appear to produce representative water-quality data after purging. Purging of screen 5 appears effective for removing mobile fractions of residual organic and inorganic constituents but has limited effectiveness in restoring the composition and distribution of reactive mineral phases to predrilling conditions. For example, although concentrations of Ba, Mn, and Sr were lower following purging, these trace metals nonetheless remain elevated above background values at the end of Phase 2 (Figure 4.1-6). Fe- and Mn-bearing mineral phases, including oxide, hydroxide, carbonate, and sulfide minerals, are commonly dominant sources and sinks for trace metals, as well as buffering pH-redox chemistry of the groundwater. Ongoing diffusion of DO into the screen interval and mineral/water reaction rates may be the primary factors limiting the rate and extent to which mineralogy and groundwater chemistry in the vicinity of the screen can be restored to predrilling conditions.

4.2 CdV-R-15-3 Screen 6

The Well Screen Analysis Report, Revision 2, concluded that CdV-R-15-3 screen 6 was slightly impacted by residual drilling effects (LANL 2007, 096330). Concentrations remained reducing throughout the period during which the Westbay system was in place, although the water quality showed improving trends. In contrast to screen 5, TOC concentrations in screen 6 were at background levels, indicating the absence of residual organic drilling and construction materials in the interval.

The calculated casing volume for this screen is 230 gal. (White 2011, 204549). The screen was purged 11,123 gal. (48 CV) before the first sample was collected for Part 2. Water-quality data collected from screen 6 during the study are plotted in the following figures:

- Figure 4.2-1 shows time-series plots of field parameters monitored during purging;
- Figure 4.2-2 presents Schoeller plots for major cations and anions;
- Figure 4.2-3 presents Schoeller plots for trace metals;
- Figure 4.2-4 shows the samples plotted on a trilinear diagram;
- Figure 4.1-5 plots a time-series of major-ion concentrations for samples collected for this study from each of the three screens in CdV-R-15-3; and
- Figure 4.1-6 plots a time-series of trace metal concentrations for samples collected for this study from each of the three screens in CdV-R-15-3.

Stability of Field Parameters during Purging

Most field parameters remained stable during the 10-CV purge that followed the removal of cross-flow (Table 2.0-1; Figure 4.2-1). Turbidity was the only parameter showing a significant trend following removal of the Westbay system, showing an initial value of 12 NTU and a final value of 2.3 NTU at the end of Phase 2.

Comparison with Prepurge Samples

Purging samples were similar to the prepurge sample for major ions with the exception of SO_4, NO_3, and ClO_4 (Table 2.0-2) in a trend similar to that seen in screen 5. Trace metals showed a greater difference between the purge and prepurge samples with most purge sample concentrations higher than the prepurge sample. Exceptions include Fe, Mo, and Sr, which show minor decreases in concentrations of the purge samples as compared with the prepurge samples. Toluene was detected in Part 2a when the first sample was collected after purging.

Comparison with Historical Data from This Screen

Purge sample concentrations were similar to the historical mean for major ions except for NO_3 and ClO_4 where the purge sample concentrations were higher than the historical mean (Table 2.0-2). Concentrations of trace metals were generally higher in the purge samples than in the historical mean. Exceptions include Fe, Cr, and Sr which were lower. Toluene that showed up with the initial purge sample is not detected in historical samples.

Is the Screen Producing Reliable Data?

Ion concentrations remain fairly stable throughout Part 2 with some minor variances in SO_4, NO_3 and Zn. As in screen 5, Fe concentrations are reduced to near background with purging but Mn concentrations actually increase. The screen remains high in Mn at the end of the study but this condition could resolve over time.

4.3 CdV-R-37-2 Screen 3

The Well Screen Analysis Report, Revision 2, concluded CdV-R-37-2 screen 3 produced reliable and representative water-quality data (LANL 2007, 096330). This conclusion was based on multiple lines of geochemical evidence for oxic conditions. Geochemical indicators of oxic conditions include negligibly low concentrations of Fe, Mn, and sulfide, in concert with background concentrations of SO_4, NO_3, ClO_4, and U. Background TOC concentrations indicate the absence of significant organic drilling and construction materials in the interval.

The calculated casing volume for this screen is 65 gal. (White 2011, 204549). The screen was purged 88 gal. 1.4 CV) before the first sample was collected for Part 2. Water-quality data collected from this screen during the study are plotted in the following figures:

- Figure 4.3-1 shows time-series plots of field parameters monitored during purging;
- Figure 4.3-2 presents Schoeller plots for major cations and anions;
- Figure 4.3-3 presents Schoeller plots for trace metals;
- Figure 4.3-4 shows the samples plotted on a trilinear diagram;
- Figure 4.3-5 plots a time-series of major ion concentrations for samples collected for this study from each of the three screens in CdV-R-37-2; and
- Figure 4.3-6 plots a time-series of trace metal concentrations for samples collected for this study from each of the three screens in CdV-R-37.2.

Stability of Field Parameters during Purging

Most field parameters remained stable during the 10-CV purge that followed the removal of cross-flow (Table 2.0-1; Figure 4.3-1). The exception was a decrease in conductivity from an initial value of 116 µS/cm to a final value of 94 µS/cm.

Comparison with Prepurge Samples

Cation concentrations generally decreased in the purge samples while anion (SO_4, F, Cl, NO_3) concentrations increased as compared with the prepurge samples (Table 2.0-2; Figure 4.3-2; Figure 4.3-5). Trace metal concentrations decreased throughout the purging portion of the study (Table 2.0-3; Figure 4.3-3; Figure 4.3-6). This screen was not purged extensively before Part 2 samples were taken and so the geochemical effects of extended purging are perhaps better recorded in this screen than in screens 5 and 6 in CdV-R-15-3.

Toluene was detected all samples collected during Phase 2, and diethylphthalate was detected in the final Phase 2 sample (Part 2d) (Table 2.0-5). Neither constituent was detected in the prepurge sample. No other VOCs or SVOCs are detected in the Phase 2 samples.

Comparison with Historical Data

Values after the 10-CV purge compare well with historical data values with the most significant variations in the concentrations of major anions (Cl, NO_3, and F).

Toluene was detected all samples collected during Phase 2, and diethylphthalate was detected in the final Phase 2 sample (Part 2d) (Table 2.0-5). Neither constituent was detected in the prepurge sample. No other VOCs or SVOCs are detected in the Phase 2 samples.

Is the Screen Producing Reliable Data?

Historical data, prepurge, and purge concentrations are all fairly similar and indicate stability in water quality in this screen. Most values fall within background concentration levels. These indicators suggest water-quality data from this screen are representative whether the sample is collected with a nonpurgeable or purgeable sampling system.

4.4 CdV-R-37-2 Screen 4

The Well Screen Analysis Report, Revision 2, concluded that CdV-R-37-2 screen 4 was moderately impacted by residual drilling effects (LANL 2007, 096330). Concentrations remained reducing throughout the period during which the Westbay system was in place, although the water quality showed significantly improving trends as observable in a comparison of historical mean concentrations and concentrations in the no-purge sample for redox-sensitive constituents such as Fe, Mn, NO_3, and ClO_4 (Tables 2.0-2 and 2.0-3). TOC concentrations in screen 4 were slightly above background levels, indicating the presence of some residual organic drilling and construction material in the interval but considerably less than that present in CdV-R-37-2 screen 2.

The calculated casing volume for this screen is 65 gal. (White 2011, 204549). The well was purged 25,257 gal. (391 CV) before the first sample was collected for Part 2. Water-quality data collected from this screen during the study are plotted in the following figures:

- Figure 4.4-1 shows time-series plots of field parameters monitored during purging;
- Figure 4.4-2 presents Schoeller plots for major cations and anions;
- Figure 4.4-3 presents Schoeller plots for trace metals;
- Figure 4.4-4 shows the samples plotted on a trilinear diagram;
- Figure 4.3-5 plots a time-series of major-ion concentrations for samples collected for this study from each of the three screens in CdV-R-37-2; and
- Figure 4.3-6 plots a time-series of trace metal concentrations for samples collected for this study from each of the three screens in CdV-R-37.2.

Stability of Field Parameters during Purging

All field parameters remained stable during the 10-CV purge that followed the removal of cross-flow (Table 2.0-1; Figure 4.4-1).

Comparison with Prepurge Samples

Cation concentrations, TOC, and SO_4 generally decreased in the purge samples while anion (F, Cl, NO_3, ClO_4) concentrations and SiO_2 and TDS increased as compared with the prepurge samples (Table 2.0-2). The concentration of NO_3 was the most significantly different with much higher concentrations in the purged samples. Trace metal concentrations generally decreased with the exception of U, V, and Zn, which increased. Vanadium showed the most significant increase from the prepurge samples. Toluene was detected in Part 2a when the first sample was taken after purging.

Comparison with Historical Data for this Screen

Similar trends were seen between the purge data and the historical mean with most major ion concentrations decreasing slightly with purging (Table 2.0-2). TOC was also lower in the purged samples. Exceptions include NO_3 and ClO_4 and SiO_2, with concentrations higher in the purged samples as compared with the historical mean. Trace metals were also generally lower, except for U and V. Fe was significantly lower in prepurge as well as the purge samples compared with the historical mean. Toluene detected during the initial purge sample is not detected in historical samples.

Is the Screen Producing Reliable Data?

The greatest data anomaly in this screen is seen in the concentrations of Fe. The historical mean for Fe is 683 µg/L as compared with Fe concentrations that are below detection limits for all of the Westbay study samples. The considerable volume of water purged from this screen to remove cross-flow essentially redeveloped it. All concentrations are now within background values and appear reliable but a longer period of record is needed to determine if these concentrations remain stable with time.

The additional redevelopment steps (Phases 3 and 4) provided significant improvement to the water quality of the samples but were insufficient to restore groundwater chemistry completely to representative conditions.

4.5 CdV-R-15-3 Screen 4

The Well Screen Analysis Report, Revision 2, concluded CdV-R-15-3 screen 4 produced reliable and representative water-quality data (LANL 2007, 096330). This conclusion was based on multiple lines of geochemical evidence for oxic conditions. Geochemical indicators of oxic conditions include negligibly low concentrations of Fe, Mn, and sulfide, in concert with background concentrations of SO_4, NO_3, ClO_4, and U. Background TOC concentrations indicate the absence of significant organic drilling and construction materials in the interval.

CdV-R-15-3 screen 4 underwent subsequent development steps after purging as summarized in section 2 and described in detail in Attachment 1. Purge samples are compared with prepurge samples and historical data first followed by comparison of the extra development samples to prepurge samples and historical data.

The calculated casing volume for this screen is 50 gal. (White 2011, 204549). The screen was purged 123 gal. (2.5 CV) before the first sample was collected for Part 2. Water-quality data collected from this screen during the study are plotted in the following figures:

- Figure 4.5-1 shows time-series plots of field parameters monitored during purging;
- Figure 4.5-2 presents Schoeller plots for major cations and anions;
- Figure 4.5-3 presents Schoeller plots for trace metals;
- Figure 4.5-4 shows the samples plotted on a trilinear diagram;
- Figure 4.1-5 plots a time-series of major ion concentrations for samples collected for this study from each of the three screens in CdV-R-15-3; and
- Figure 4.1-6 plots a time-series of trace metal concentrations for samples collected for this study from each of the three screens in CdV-R-15-3.

Stability of Field Parameters during Purging

Most field parameters remained stable during the 10-CV purge that followed the removal of cross-flow (Table 2.0-1; Figure 4.5-1). One exception is DO, which increased from a low value of 3 mg/L at the beginning of Phase 2 and stabilized at a value of 5 mg/L at the end of Phase 2. This higher DO concentration was maintained throughout Phases 3 and 4.

Comparison with Prepurge Samples

Part 2 Purge: Most major ion concentrations decreased in the purge samples as compared with the prepurge samples, with the exception of SO_4 which increased (Table 2.0-2). TDS and TOC also increased. Cl, NO_3, ClO_4, SiO_2 were largely unchanged or increased slightly in comparison with the prepurge samples. Trace metal concentrations varied in comparison with the prepurge samples. Ba, Mn, and Sr concentrations increased during the initial purge (Part 2a) but dropped to within background ranges during subsequent purging (Parts 2b-d). Cr and Ni concentrations decreased, while Al, Fe, and V concentrations remained close to prepurge values. Toluene was detected in Part 2a when the first sample was taken after purging.

Part 3 – Redevelopment

Nearly opposite trends were seen in major ion concentrations during the redevelopment phase, with all major ion concentrations increasing or remaining unchanged (Table 2.0-2). TDS decreased and TOC initially increased and then decreased. Trace metals showed the same trends during redevelopment as seen during the purging phase with the exception of V, which initially increased and then decreased in concentration as development continued. Toluene continued to be detected throughout redevelopment.

Comparison with Historical Data for This Screen

Part 2 Purge: Most major ion concentrations decreased in the purge data as compared with the historical mean with the exception of SO_4, Cl, and NO_3 which increased (Table 2.0-2). TDS also increased. TOC concentrations were higher than the historical mean during the first part of the purge but had decreased below historical mean concentrations by Part 2c (6 CV). SiO_2 concentrations were slightly lower than the historical mean. Al, Cr, Fe, Ni, and V concentrations were lower in the purge samples than in the historical mean. Mn, Mo, and Zn concentrations were higher in the purge samples than historical mean values although Mn concentrations decreased significantly from Part 2a to Part 2b. Ba and U concentrations started out higher but dropped to close to the historical mean value by the end of Part 2. Sr started out much higher than the historical mean after purging to remove cross-flow but dropped below historical mean values by the end of Part 2. Toluene that showed up with the initial purge sample is not detected in historical samples.

Part 4 – Redevelopment

Most major ion concentrations increased during Part 3 of the redevelopment phase subsequently decreasing during Part 4 (Table 2.0-2). Na, K, Ca, Mg, Fe, SiO_2, and TOC values were initially higher than the historical mean but dropped below it by the end of Part 4. Trace metal concentrations followed a similar pattern during redevelopment as they did during purging. Ba, Mo, U, and Zn concentrations were higher during redevelopment than the historical mean. Sr started out higher than historical mean values in Part 3 but dropped below the historical mean by the end of Part 4.

Is the Screen Producing Reliable Data?

Historical data, prepurge, and purge concentrations are all fairly similar and indicate stability in water quality in this screen. Most values fall within background concentration levels. These indicators suggest water-quality data from this screen are representative whether the sample is collected with a nonpurgeable or purgeable sampling system. The additional redevelopment steps (Phases 3 and 4) did not appear to cause significant changes in water chemistry.

There is a concern about detections of VOCs (toluene and acetone) that may be associated with this study.

4.6 CdV-R-37-2 Screen 2

The Well Screen Analysis Report, Revision 2, concluded CdV-R-37-2 screen 2 was one of the most severely impacted screens among those equipped with Westbay sampling systems (LANL 2007, 096330). This conclusion was based on multiple lines of geochemical evidence for highly reducing conditions that have persisted in screen 2 since collection of the first sample on January 4, 2001. Geochemical indicators of the reducing condition include elevated concentrations of Fe, Mn, and sulfide, in concert with negligibly low concentrations of SO_4, NO_3, ClO_4, and U. Elevated TOC concentrations indicate that reducing conditions probably resulted from residual organic drilling and construction materials in the interval.

The calculated casing volume for this screen is 48 gal. (White 2011, 204549). The screen was purged 189 gal. (4 CV) before the first sample was collected for Part 2. Water-quality data collected from this screen during the study are plotted in the following figures:

- Figure 4.6-1 shows time-series plots of field parameters monitored during purging;
- Figure 4.6-2 presents Schoeller plots for major cations and anions;
- Figure 4.6-3 presents Schoeller plots for trace metals;
- Figure 4.6-4 shows the samples plotted on a trilinear diagram;
- Figure 4.3-5 plots a time-series of major ion concentrations for samples collected for this study from each of the three screens in CdV-R-37-2; and
- Figure 4.3-6 plots a time-series of trace metal concentrations for samples collected for this study from each of the three screens in CdV-R-37.2.

Stability of Field Parameters during Purging

Most field parameters remained stable during the 10-CV purge that followed the removal of cross-flow (Table 2.0-1; Figure 4.6-1). One exception is temperature, for which the increase during purging possibly may reflect the limited capability of groundwater to cool the pump during operations. Low DO concentrations around 2 mg/L were maintained throughout Phases 2 through 4.

Comparison with Prepurge Samples

Part 2 Purge: Most major ion concentrations increased in the purge samples as compared with the prepurge samples with the exception of Cl, F, and ClO_4 (Table 2.0-2). SiO_2, TDS, and TOC also decreased in the purge samples as compared with the prepurge samples. Most trace metals decreased in concentration between the purge and prepurge samples with Fe, Mn, and Mo showing the greatest decreases.

Part 3 – Redevelopment

Na, K, Ca, Mg, SO_4, NO_3, and ClO_4 concentrations increased during redevelopment as compared with the prepurge samples (Table 2.0-2). Cl, F, SiO_2, TDS, and TOC all decreased during redevelopment as compared with the prepurge samples. Trace metal concentrations generally continued to decrease through the redevelopment phase in comparison with the purge and prepurge samples with the exception of V which increased slightly.

Comparison to Historical Data

Part 2 Purge: Major ion concentrations in purged data compared with historical data showed no particular trend. Anions (SO_4, Cl, NO_3) and TOC showed the most significant differences between purge data and historical averages with SO_4 and NO_3 concentrations higher in the purge samples and Cl concentrations lower (Table 2.0-2). TOC was also significantly lower. Most trace metals showed significant decreases in concentration between the purged samples and the historical mean. U and V concentrations were slightly higher than the historical mean. Zn concentrations were much higher than the historical mean after the initial purge but drooped to below historical mean values by the end of Part 2 (10 CV). Toluene that showed up with the initial purge sample is not detected in historical samples.

Part 4 – Redevelopment

Most anions increased in concentration during redevelopment as compared with the historical mean while cations decreased in concentration (Table 2.0-2). TDS and TOC also decreased in the redevelopment samples as compared with the historical mean. Trace metals decreased in concentration with redevelopment as compared with historical mean values. Exceptions to this include U and V which maintained higher concentrations in all parts of the study as compared with historical values. Toluene continued to be detected throughout redevelopment.

Is the Screen Producing Reliable Data?

Fe and Mn concentrations decreased significantly with purging from this screen (Table 2.0-3). These concentrations were elevated in historical and prepurge samples. Purging and redevelopment decreased Fe concentrations to just above background values and below UTLs for regional groundwater. Mn concentrations also dropped significantly with extended purging and redevelopment but remained above background levels and UTLs for regional groundwater. The remaining high value for Mn suggests that this screen may remain compromised. A longer period of record is needed to determine if values of trace metals and SO_4 will remain within background values and Mn values will continue to decrease in this screen.

4.7 R-26 Screen 1

The Well Screen Analysis Report, Revision 2, concluded R-26 screen 1 produced reliable and representative water-quality data (LANL 2007, 096330). This conclusion was based on multiple lines of geochemical evidence for oxic conditions. Geochemical indicators of oxic conditions include negligibly low concentrations of Fe, Mn, and sulfide, in concert with background concentrations of SO_4, NO_3, ClO_4, and U. Background TOC concentrations indicate the absence of significant organic drilling and construction materials in the interval.

Difficulties were encountered with retrieval of the Westbay sampling system from R-26; subsequent investigation found that the lower 30 ft of Westbay casing, including the lower sampling port, were encased in bentonite (Attachment 1). Redevelopment steps included swabbing, high-velocity jetting while pumping, and finally purging the well. Following redevelopment of R-26, screen 2 was abandoned

(Attachment 1), and screen 1 was purged. Field parameters were monitored during this development stage (Table 4.5-1 of Attachment 1). Following development, water-quality samples were collected after 3, 6, and 10 CV had been purged, designated as Parts 2b–d, respectively, in figures and tables in this report.

During redevelopment of R-26 from May 25 to May 27, 2011, 8908 gal. of water was purged. On May 31 and June 1, 2011, an additional 3635 gal. was purged from screen 1 after plugging and abandonment of screen 2. On June 1, 2011, 289 gal. was purged before the first sample for Part 2 was collected. Thus, a total of 12,832 gal. was purged from this screen before Part 2 sampling occurred. The calculated casing volume for this screen is 72 gal. (White 2011, 204549); the purge volume of 12, 832 gal. corresponds to 178 CV. Water-quality data collected from this screen during the study are plotted in the following figures:

- Figure 4.7-1 shows time-series plots of field parameters monitored during purging;
- Figure 4.7-2 presents Schoeller plots for major cations and anions;
- Figure 4.7-3 presents Schoeller plots for trace metals;
- Figure 4.7-4 shows the samples plotted on a trilinear diagram;
- Figure 4.7-5 plots a time-series of major ion concentrations for samples collected for this study from R-26 screen 1; and
- Figure 4.7-6 plots a time-series of trace metal concentrations for samples collected for this study from R-26 screen 1.

Stability of Field Parameters during Purging

Most field parameters showed variable trends during development to remove cross-flow but remained stable during the 10 CV purge (Table 2.0-1; Figure 4.7-1). Conductivity remained particularly elevated (180–200 µS/cm) throughout the first development phase to remove cross-flow (Figure 4.7-1). During Phase 2, conductivity remained at a background value slightly below 100 µS/cm.

Comparison to Prepurge Samples

Major ion concentrations in purged samples are similar to those for the unpurged samples with slight increases in concentration seen in SO_4, Cl, and SiO_2 (Table 2.0-2). Trace element concentrations are also similar between unpurged and purged samples, with Ba concentrations slightly higher in purged samples. Mn is the only trace element where purged values are significantly higher than nonpurged values. Cr concentrations are lower in purged samples.

Comparison with Historical Data

Most major ion concentrations are slightly higher in purged samples as compared with the historical mean (Table 2.0-2). SiO_2 is also higher in purged samples. For trace elements, Cr and Fe concentrations decrease in the purged samples as compared with the historical mean while Ba, Mn, and Mo increase in concentration in purged samples as compared with the historical mean.

Is the Screen Producing Reliable Data?

Historical data, prepurge, and purge concentrations are all fairly similar and indicate stability in water quality in this screen. Most values fall within background concentration levels. These indicators suggest water-quality data from this screen are representative regardless whether the sample is collected with a nonpurgeable or purgeable sampling system

5.0 SUMMARY

Results for CdV-R-15-3 screen 4, CdV-R-37-2 screen 3, and R-26 screen 1 show screens producing representative water-quality data using the Westbay system continue to produce representative data after redevelopment and purging (Table 5.0-1). Generally good agreement among concentrations for prepurge samples, purge samples, development samples, and historical samples from these screens support the conclusion that a screen with a history of good data will continue to show good results with purging. Little if any improvement is provided by more rigorous development.

Similarly, but at the opposite extreme, results for CdV-R-15-3 screen 5 and CdV-R-37-2 screen 2 show that a screen with an extended history of being compromised from the effects of residual organic drilling and construction materials is only partially restored by prolonged purging or redevelopment (Table 5.0-1).

A detailed examination of geochemical trends during this study is compromised to the extent to which significant volumes were purging to remove cross-flow in CdV-R-15-3 screens 5 and 6 and CdV-R-37-2 screen 3. These volumes make it difficult to discern the effects of each phase of the study on water quality parameters, such as the types and volumes of solids removed from the screen intervals before the beginning of Phase 2. Some screens were effectively redeveloped before start of Phase 2 as a result of the large number of casing volumes of water pumped to remove cross-flow. These include CdV-R-15-3 screen 6, CdV-R-37-2 screen 4, and R-26 screen 1 from which 48, 391, and 178 CV, respectively, were purged from these screens before the first sample was taken for Part 2 (Table 5.0-1).

No compelling evidence was observed in any of the screens indicating the possible presence of site contaminants such as high explosives or solvents. Toluene showed up in six out of seven of the screens. However, because toluene was not detected in any of the historical samples for these screens, it is suspected to have been introduced by materials or equipment used in this study. Inflatable packers appear to be a potential source for toluene because this constituent was not detected in the prepurge samples nor in the historical samples. A custom-made K-packer was used in R-26, the only screen in which toluene was not detected. Two other lines of evidence indicate that toluene in these samples is not a site contaminant: the absence of any cocontaminants, such as chlorinated solvents or RDX, which would have been expected if toluene in these screens had derived from TA-16 sources, and the absence of detectable tritium, which indicates the absence of modern water from the screen intervals.

Observations and conclusions from this study will be revisited as part of the pending monitoring-well network evaluation for Water Canyon/Cañon de Valle, and final recommendations will be included in that report.

6.0 REFERENCES

The following list includes all documents cited in this report. Parenthetical information following each reference provides the author(s), publication date, and ER ID. This information is also included in text citations. ER IDs 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 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.

EPA (U.S. Environmental Protection Agency), March 2009. "Statistical Analysis of Groundwater Monitoring Data at RCRA Facilities Unified Guidance," EPA 530-R-09-007, Office of Resource Conservation and Recovery, Washington, D.C. (EPA 2009, 110369)

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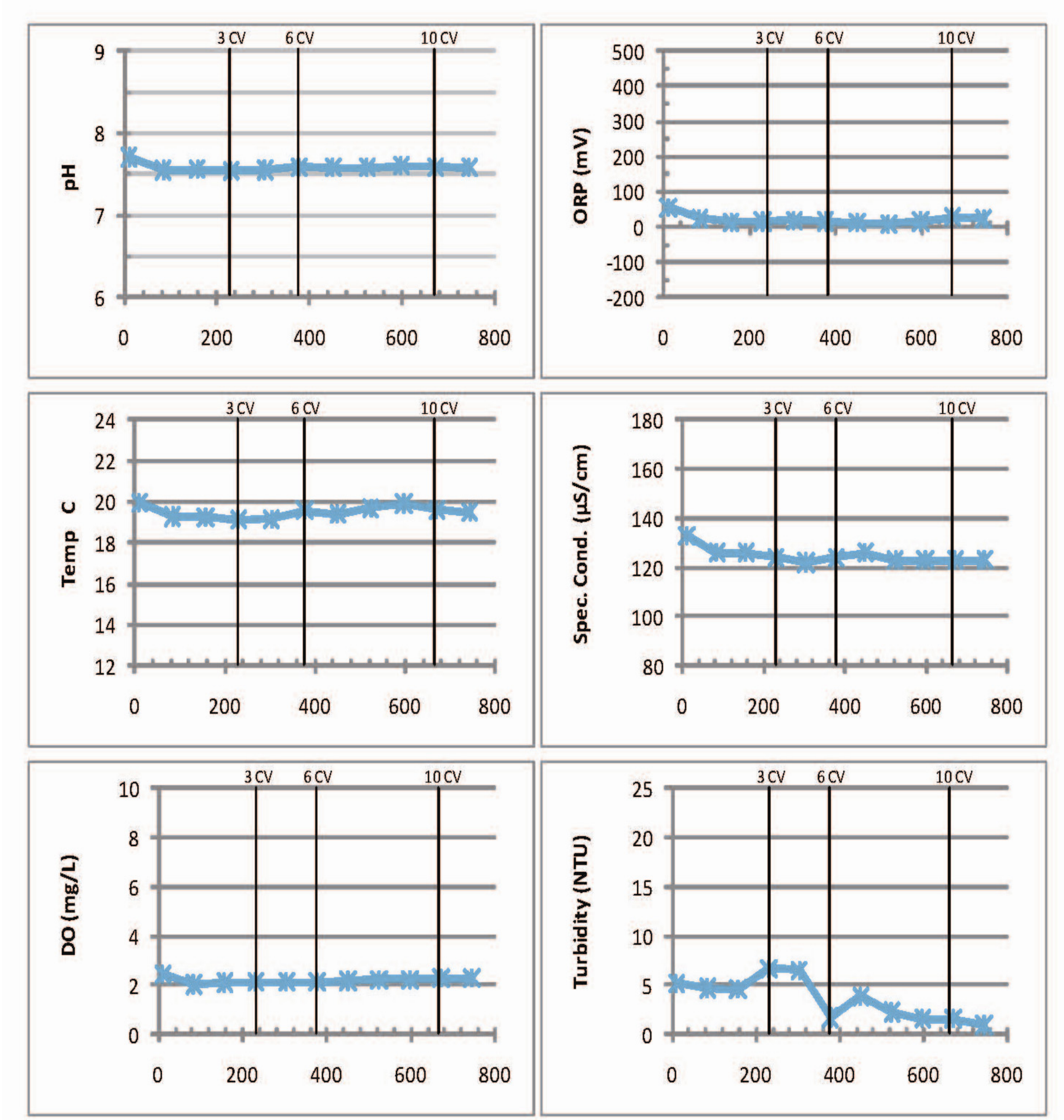
NMED (New Mexico Environment Department), August 20, 2007. "Approval of the Workplan for R-Well Rehabilitation and Replacement, Revision 2," New Mexico Environment Department letter to D. Gregory (DOE-LASO) and D. McInroy (LANL) from J.P. Bearzi (NMED-HWB), Santa Fe, New Mexico. (NMED 2007, 098182)

NMED (New Mexico Environment Department), June 15, 2010. "Approval with Modifications, Work Plan to Conduct Reliability Assessment of Multiscreened Westbay Wells," New Mexico Environment Department letter to G.J. Rael (DOE-LASO) and M.J. Graham (LANL) from J.P. Bearzi (NMED-HWB), Santa Fe, New Mexico. (NMED 2010, 110456)

White, S., July 19, 2011. WB casing volumes [and attachment]. E-mail message to M. Everett (LANL) from S. White (TerranearPMC), Los Alamos, NM. (White 2011, 204549)

Yeskis, D., and B. Zavala, May 2002. "Ground-Water Sampling Guidelines for Superfund and RCRA Project Managers," a *Ground Water Forum Issue Paper*, EPA 542-S-02-001, Office of Solid Waste and Emergency Response, Washington, D.C. (Yeskis and Zavala 2002, 204429)

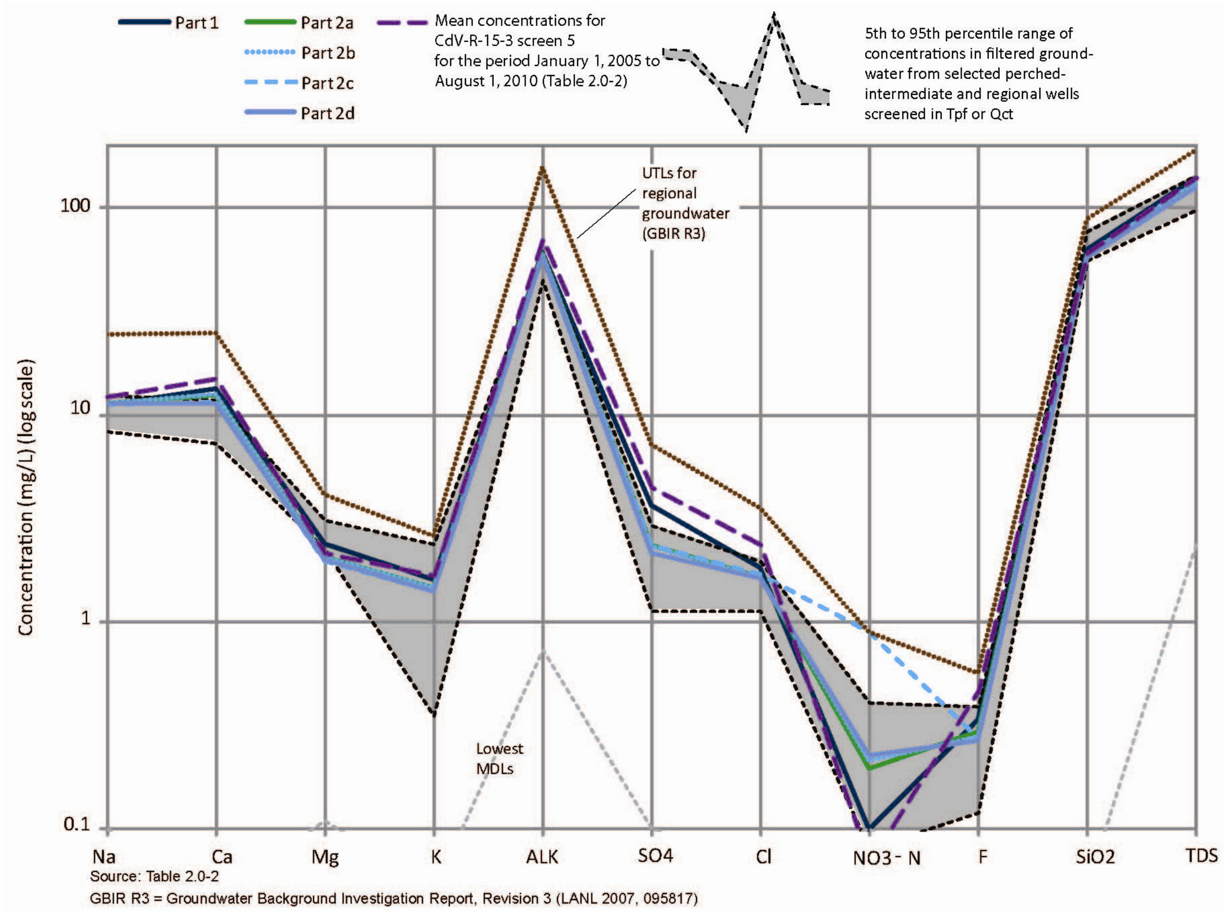


Source: Table 2.4-1; Westbay Reliability Assessment Field Summary Report

x-axis - volume purged during sampling event (gals.)

1 CV = 68.39 gallons

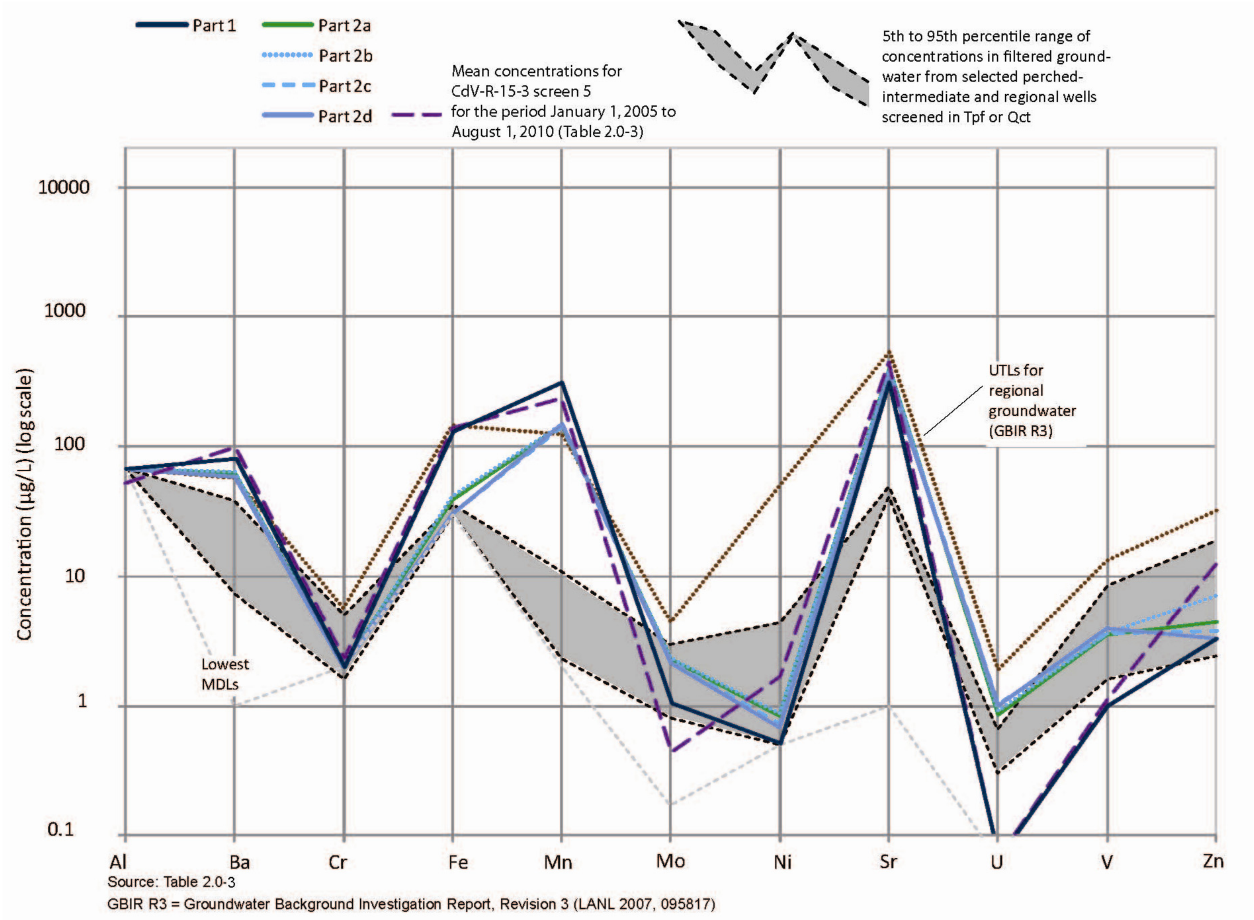
Figure 4.1-1 **Time-series plots of field parameters monitored during purging of CdV-R-15-3 screen 5**



Source: Table 2.0-2

GBIR R3 = Groundwater Background Investigation Report, Revision 3 (LANL 2007, 095817)

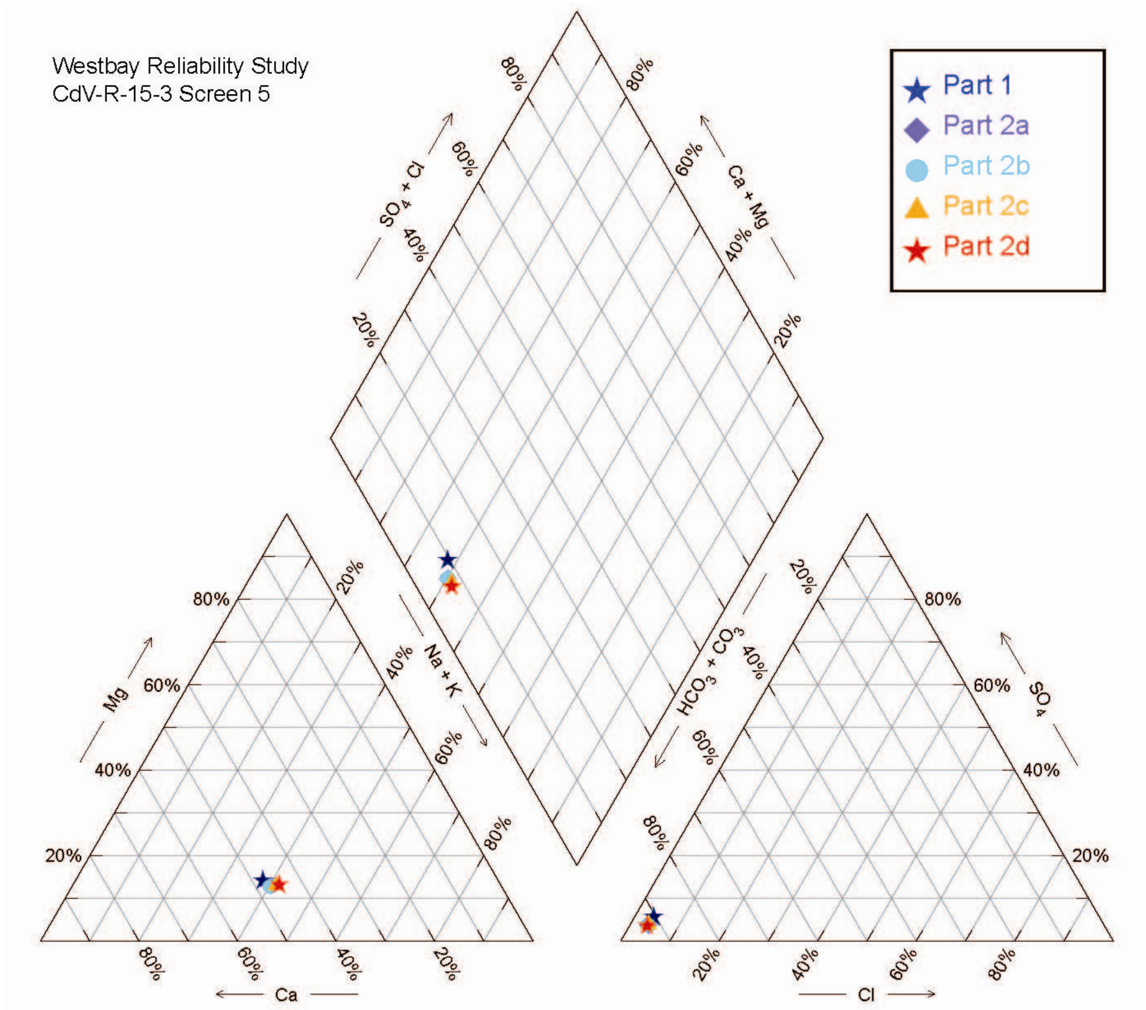
Figure 4.1-2 Schoeller plot of major ions, silica, selected anions, and TDS in filtered groundwater collected during purging of CdV-R-15-3 screen 5



Source: Table 2.0-3

GBIR R3 = Groundwater Background Investigation Report, Revision 3 (LANL 2007, 095817)

Figure 4.1-3 **Schoeller plot of trace metals in filtered groundwater collected during purging of CdV-R-15-3 screen 5**



Westbay Reliability Study Sampling Sequence

Part 1. No-purge sample

Part 2. Sampling during initial purge
  - 2a) After cross flow, when field parameters are stable
  - 2b) After 3CV
  - 2c) After 6 CV
  - 2d After 10 CV

Part 3. Sampling during swabbing and bailing
  - 3a) Midpoint
  - 3b) End

Part 4. Sampling after high-velocity jetting while pumping

Observations about major-ion trends, comparing post-development samples to no-purge sample:

Decrease in Calcium and Chloride ions

Figure 4.1-4 Trilinear (Piper) plot showing major ion chemistry of CdV-R-15-3 screen 5

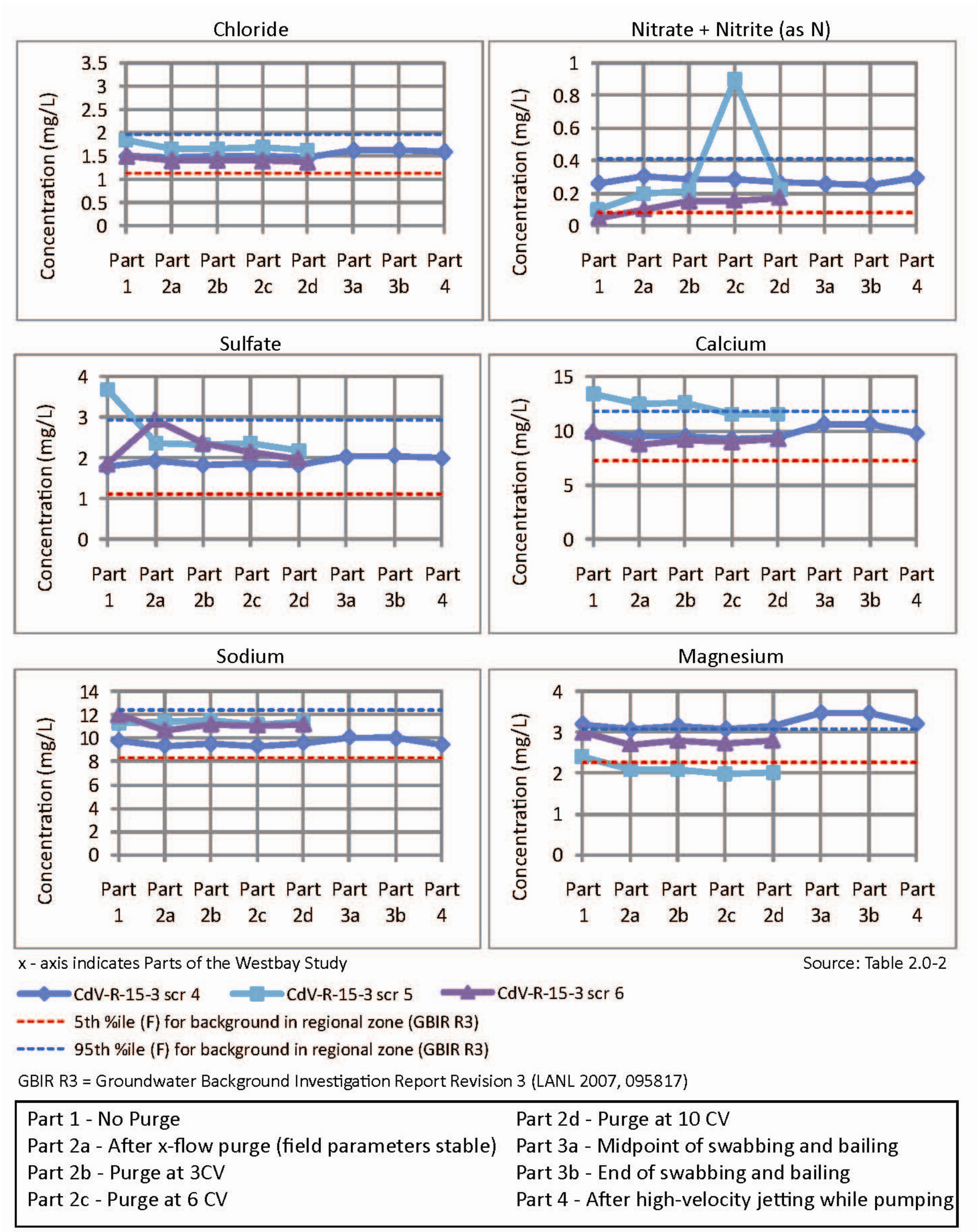
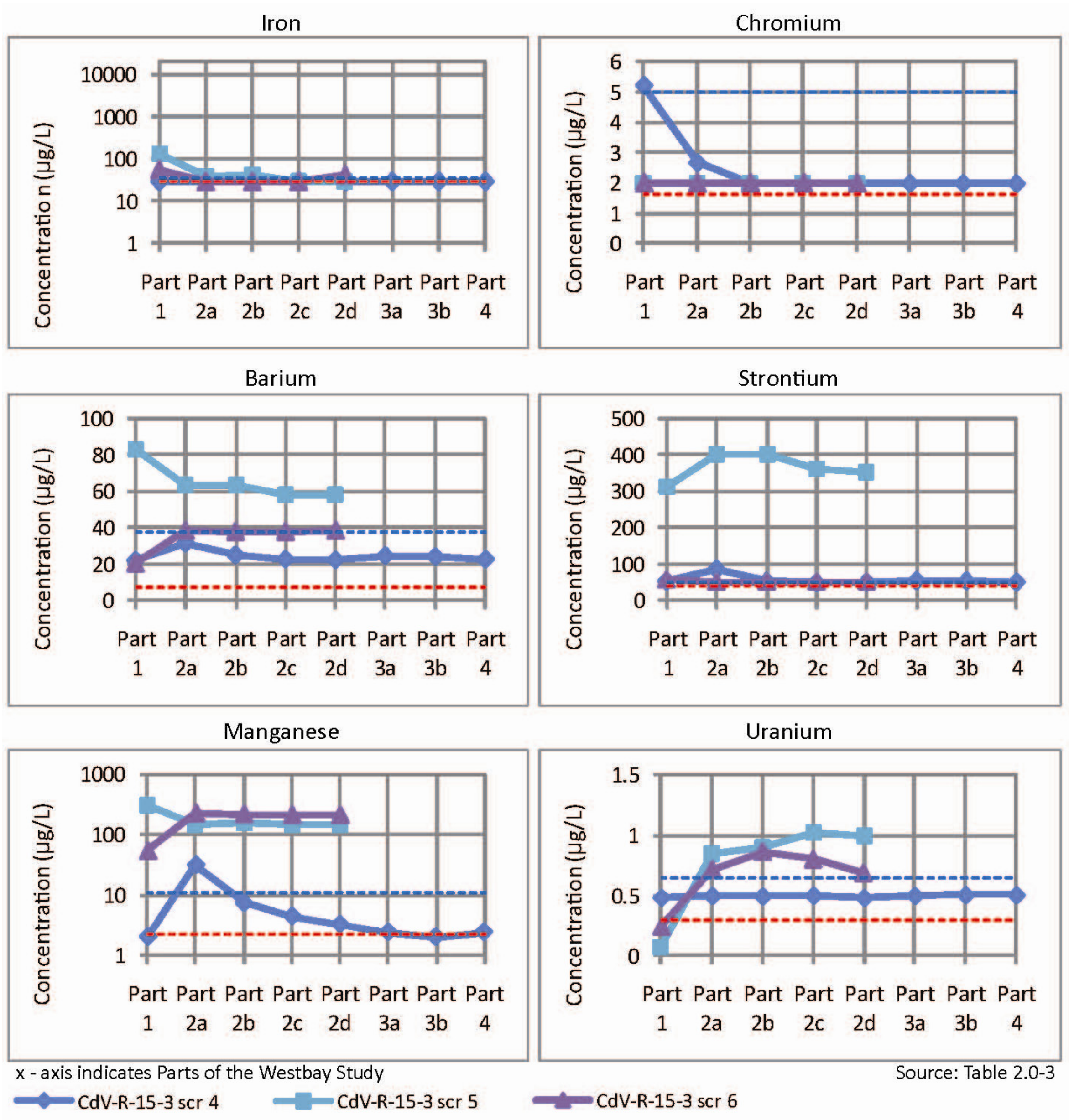


Figure 4.1-5 **Time-series plots for selected major ions and TOC for CdV-R-15-3 screens 4, 5, and 6**



x - axis indicates Parts of the Westbay Study

Source: Table 2.0-3

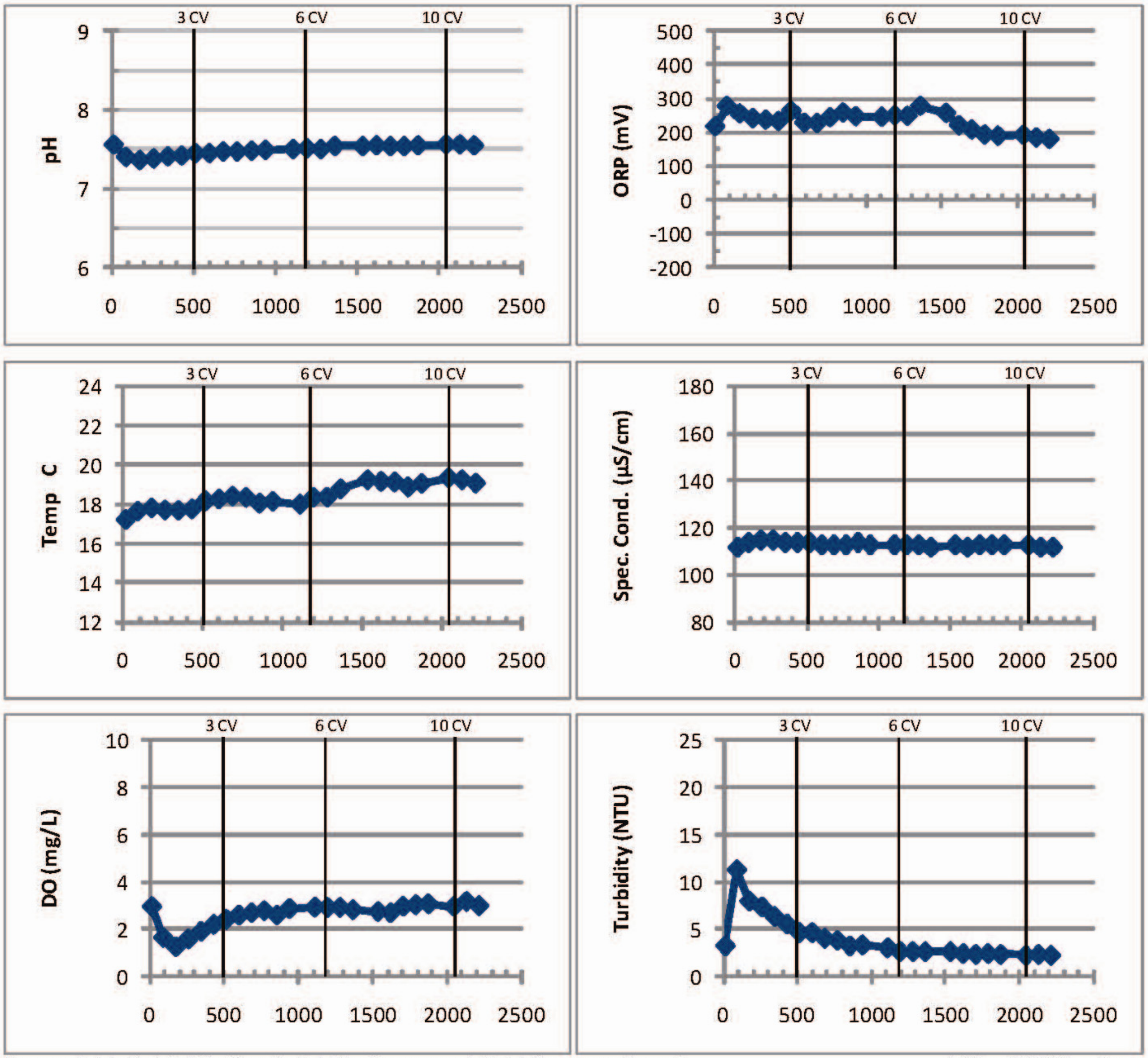
5th %ile (F) for background in regional zone (GBIR R3)

95th %ile (F) for background in regional zone (GBIR R3)

GBIR R3 = Groundwater Background Investigation Report Revision 3 (LANL 2007, 095817)

Part 1 - No Purge
Part 2a - After x-flow purge (field parameters stable)
Part 2b - Purge at 3CV
Part 2c - Purge at 6 CV
Part 2d - Purge at 10 CV
Part 3a - Midpoint of swabbing and bailing
Part 3b - End of swabbing and bailing
Part 4 - After high-velocity jetting while pumping

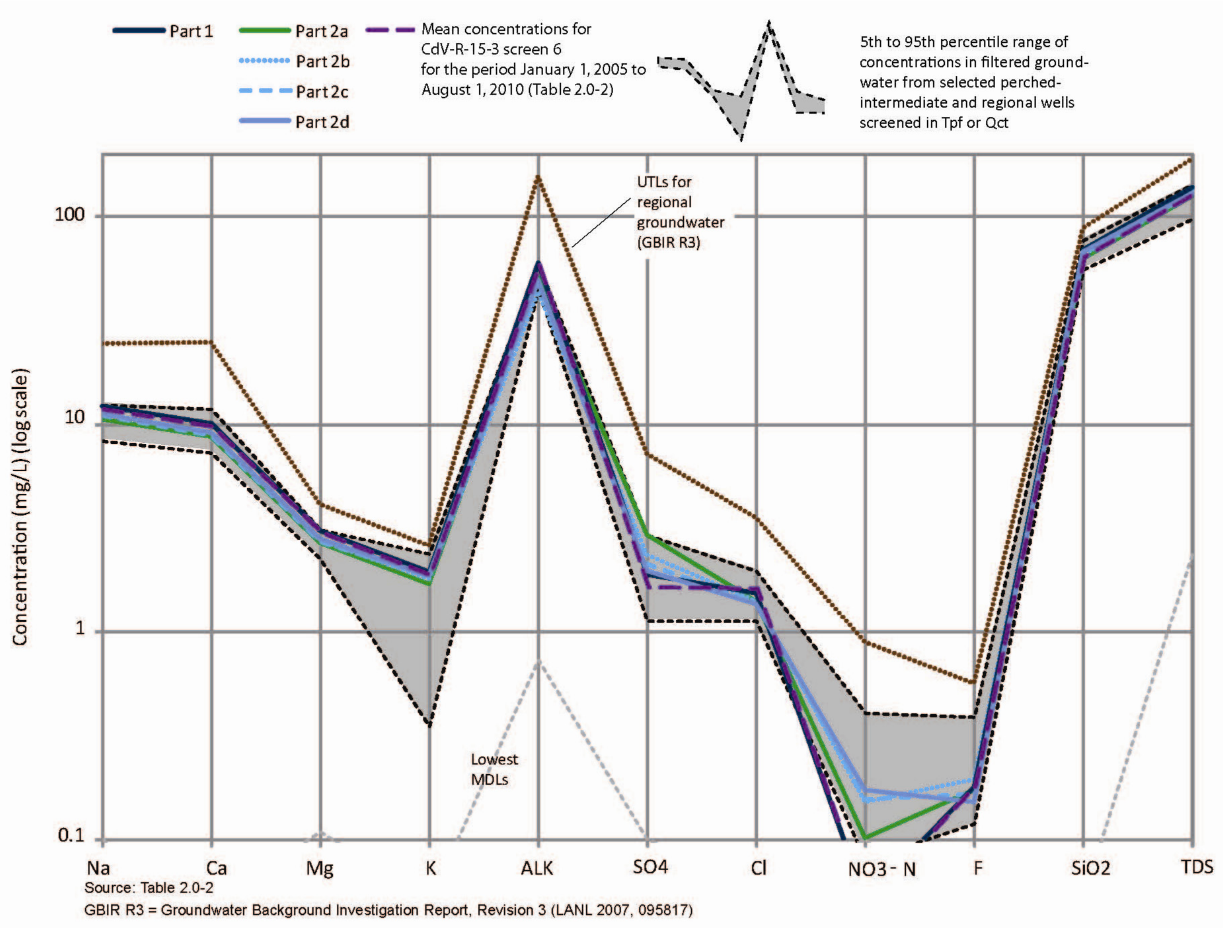
Figure 4.1-6 Time-series plots for selected trace metals for CdV-R-15-3 screens 4, 5, and 6



Source: Table 2.4-1; Westbay Reliability Assessment Field Summary Report 1 CV = 229.91 gallons

x-axis - volume purged during sampling event (gals.)

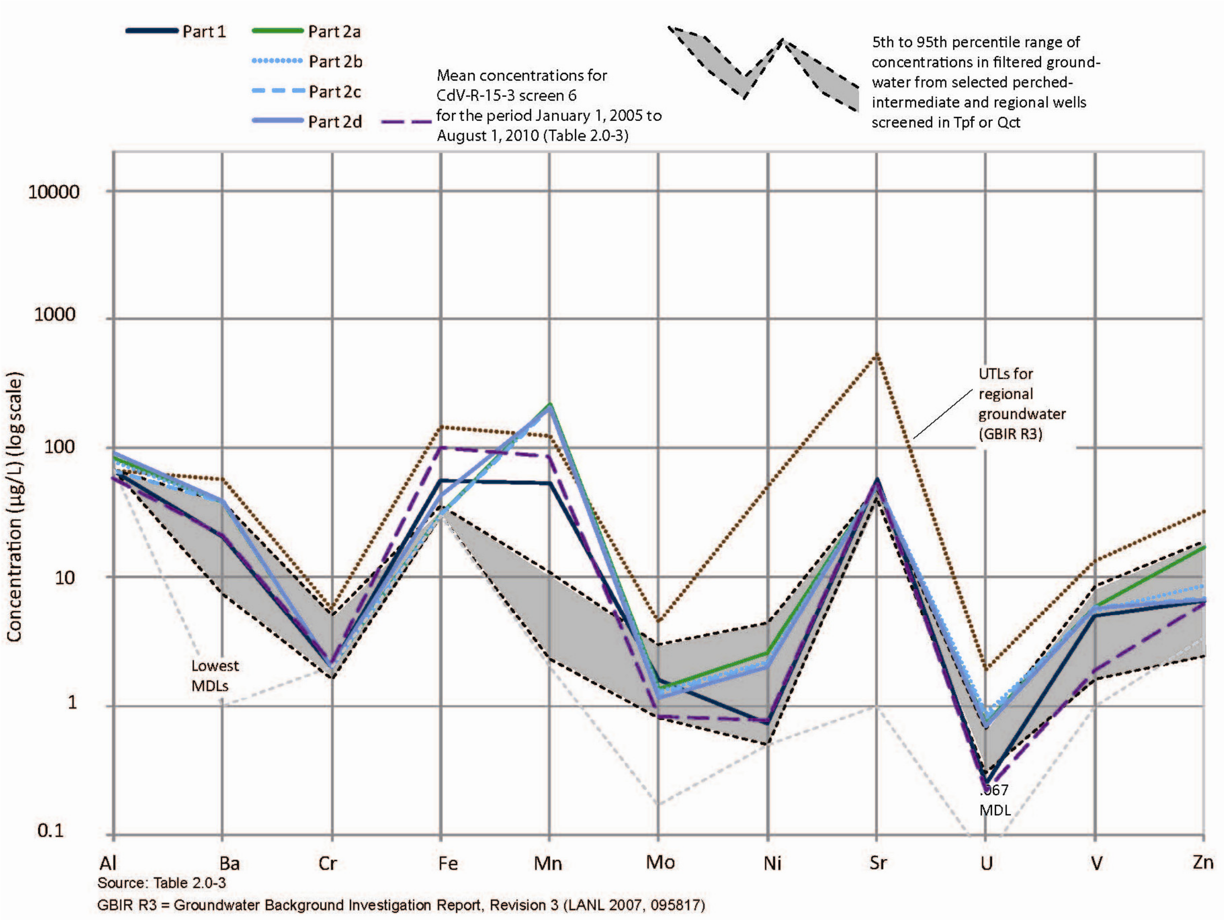
Figure 4.2-1 **Time-series plots of field parameters monitored during purging of CdV-R-15-3 screen 6**



Source: Table 2.0-2

GBIR R3 = Groundwater Background Investigation Report, Revision 3 (LANL 2007, 095817)

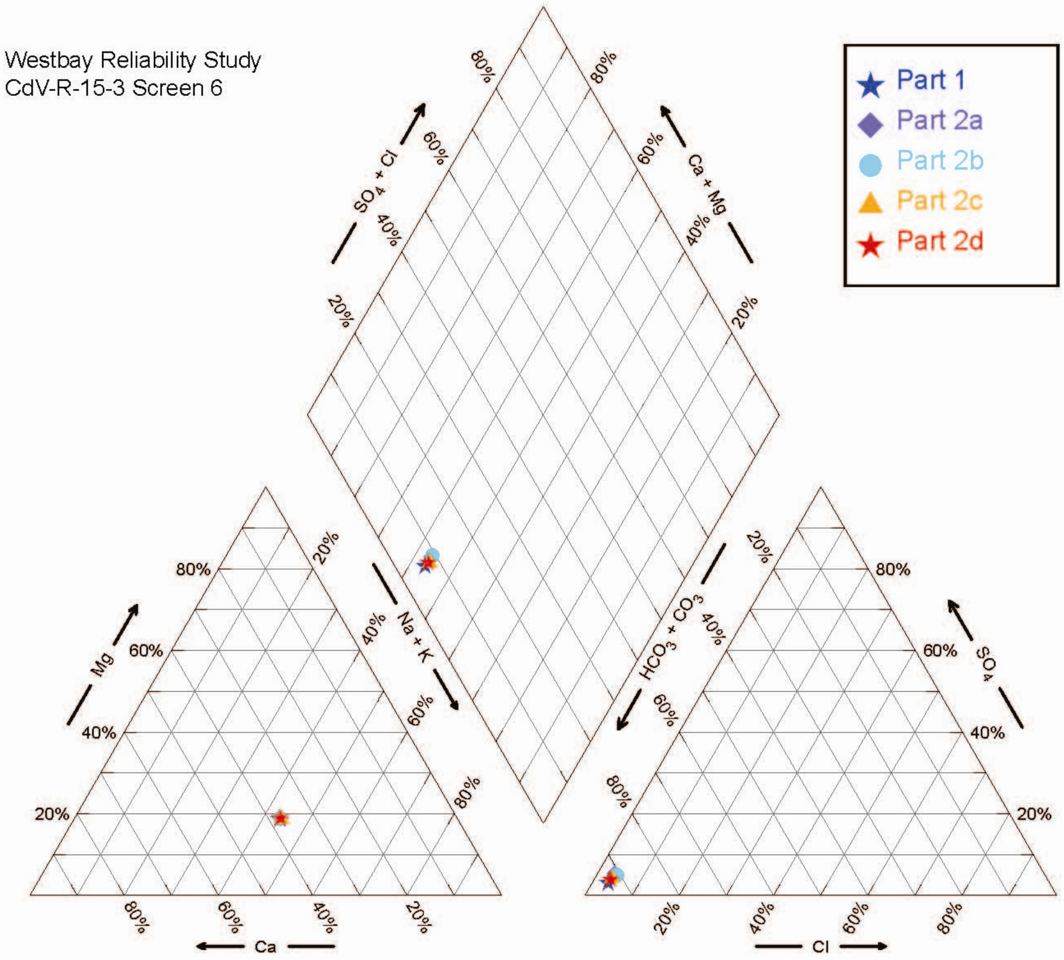
Figure 4.2-2 **Schoeller plot of major ions, silica, selected anions, and TDS in filtered groundwater from CdV-R-15-3 screen 6**



Source: Table 2.0-3

GBIR R3 = Groundwater Background Investigation Report, Revision 3 (LANL 2007, 095817)

Figure 4.2-3 Schoeller plot of trace metals in filtered groundwater from CdV-R-15-3 screen 6



Westbay Reliability Study Sampling Sequence

Part 1. No-purge sample

Part 2. Sampling during initial purge
  - 2a) After cross flow, when field parameters are stable
  - 2b) After 3CV
  - 2c) After 6 CV
  - 2d After 10 CV

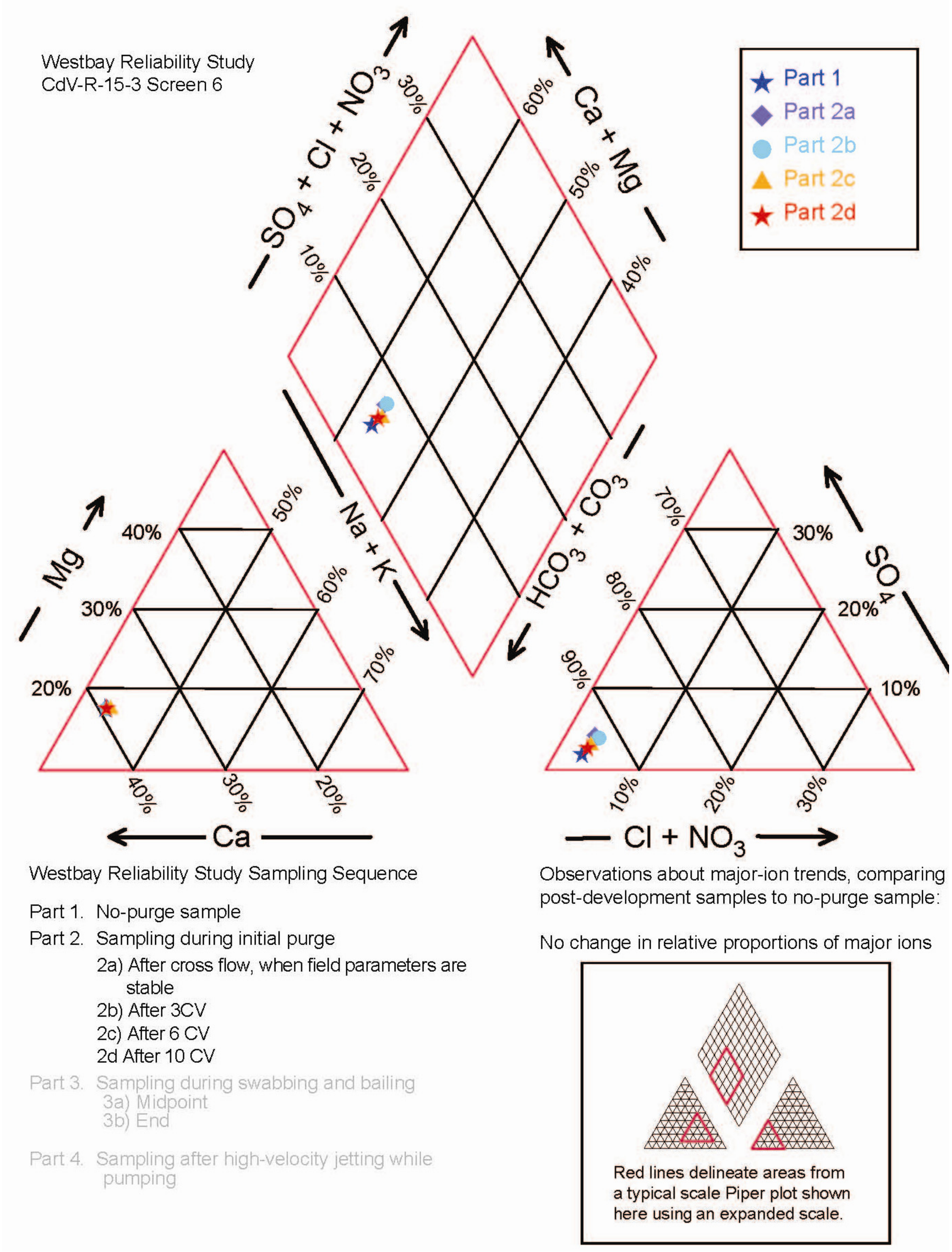
Part 3. Sampling during swabbing and bailing
  - 3a) Midpoint
  - 3b) End

Part 4. Sampling after high-velocity jetting while pumping

Observations about major-ion trends, comparing post-development samples to no-purge sample:

Sulfate increases in 2a then decreases in 2b-d
Chloride decreases
Alkalinity decreases

Figure 4.2-4a Trilinear (Piper) plot showing major ion chemistry of CdV-R-15-3 screen 6



Westbay Reliability Study Sampling Sequence

Part 1. No-purge sample

Part 2. Sampling during initial purge
- 2a) After cross flow, when field parameters are stable
- 2b) After 3CV
- 2c) After 6 CV
- 2d After 10 CV

Part 3. Sampling during swabbing and bailing
- 3a) Midpoint
- 3b) End

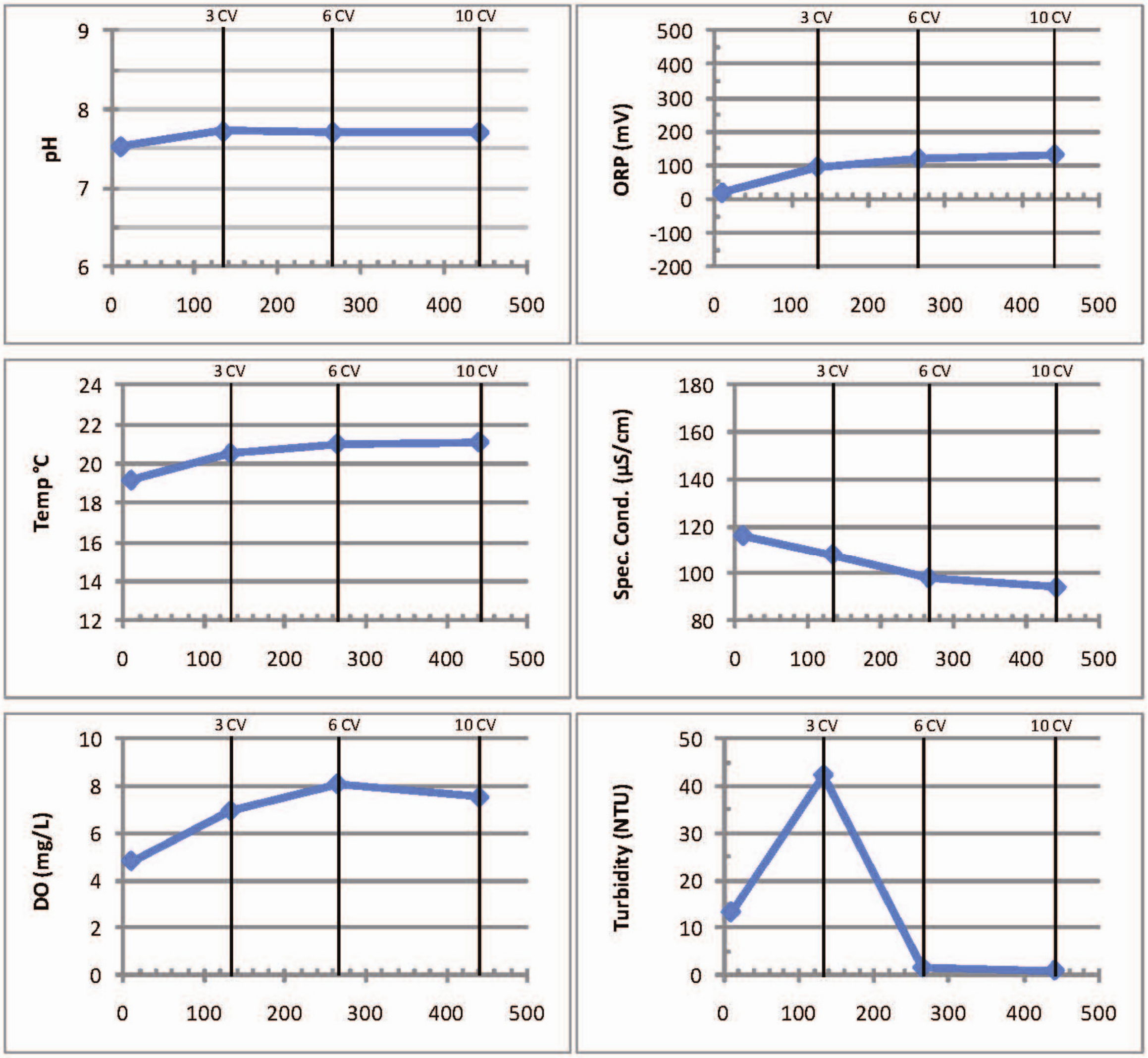
Part 4. Sampling after high-velocity jetting while pumping

Observations about major-ion trends, comparing post-development samples to no-purge sample:

No change in relative proportions of major ions

Red lines delineate areas from a typical scale Piper plot shown here using an expanded scale.

Figure 4.2-4b **Trilinear (Piper) plot (expanded scale) showing major ion chemistry of CdV-R-15-3 screen 6**

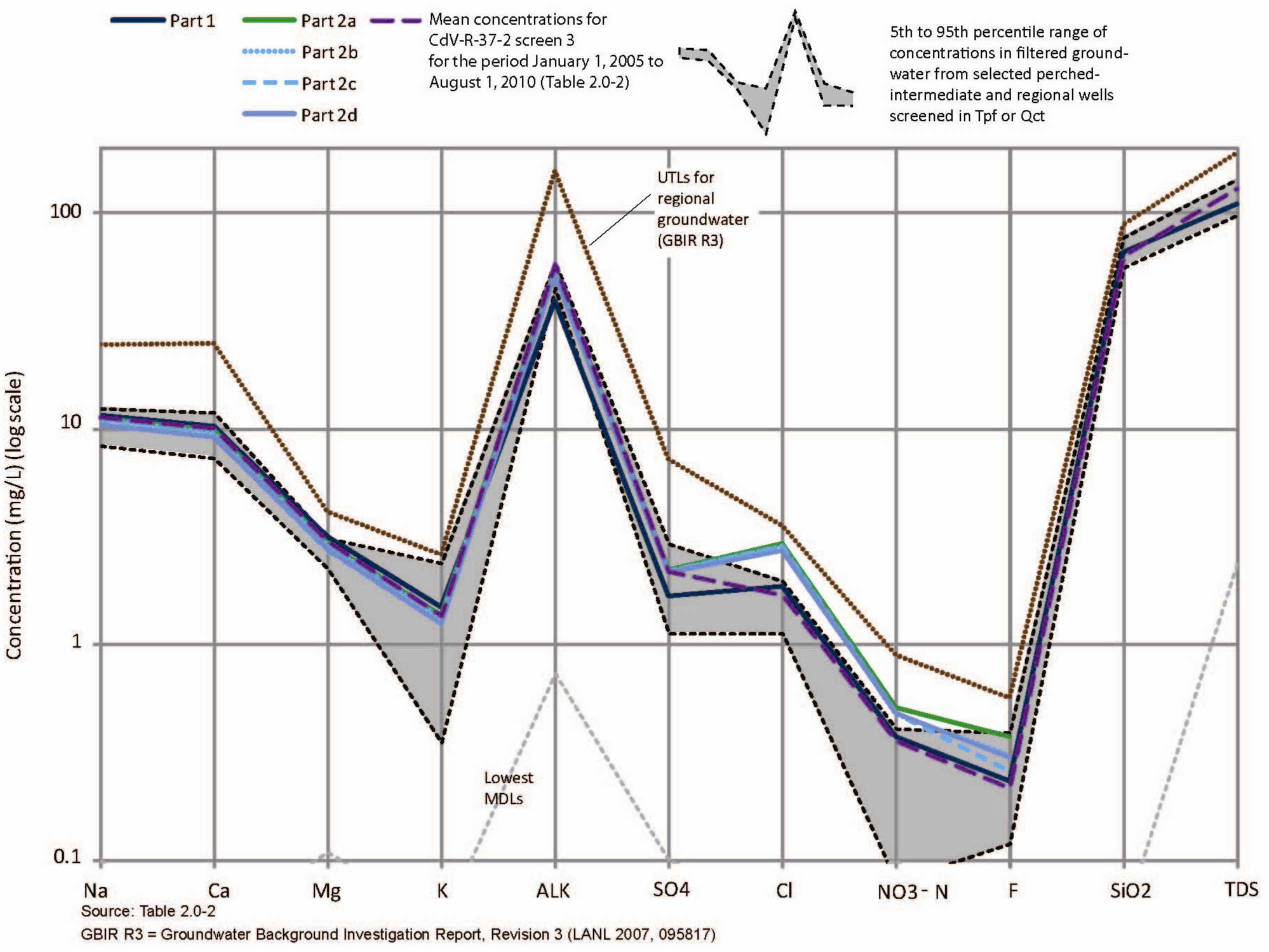


Source: Table 3.4-1; Westbay Reliability Assessment Field Summary Report

x-axis - volume purged during sampling event (gals.)

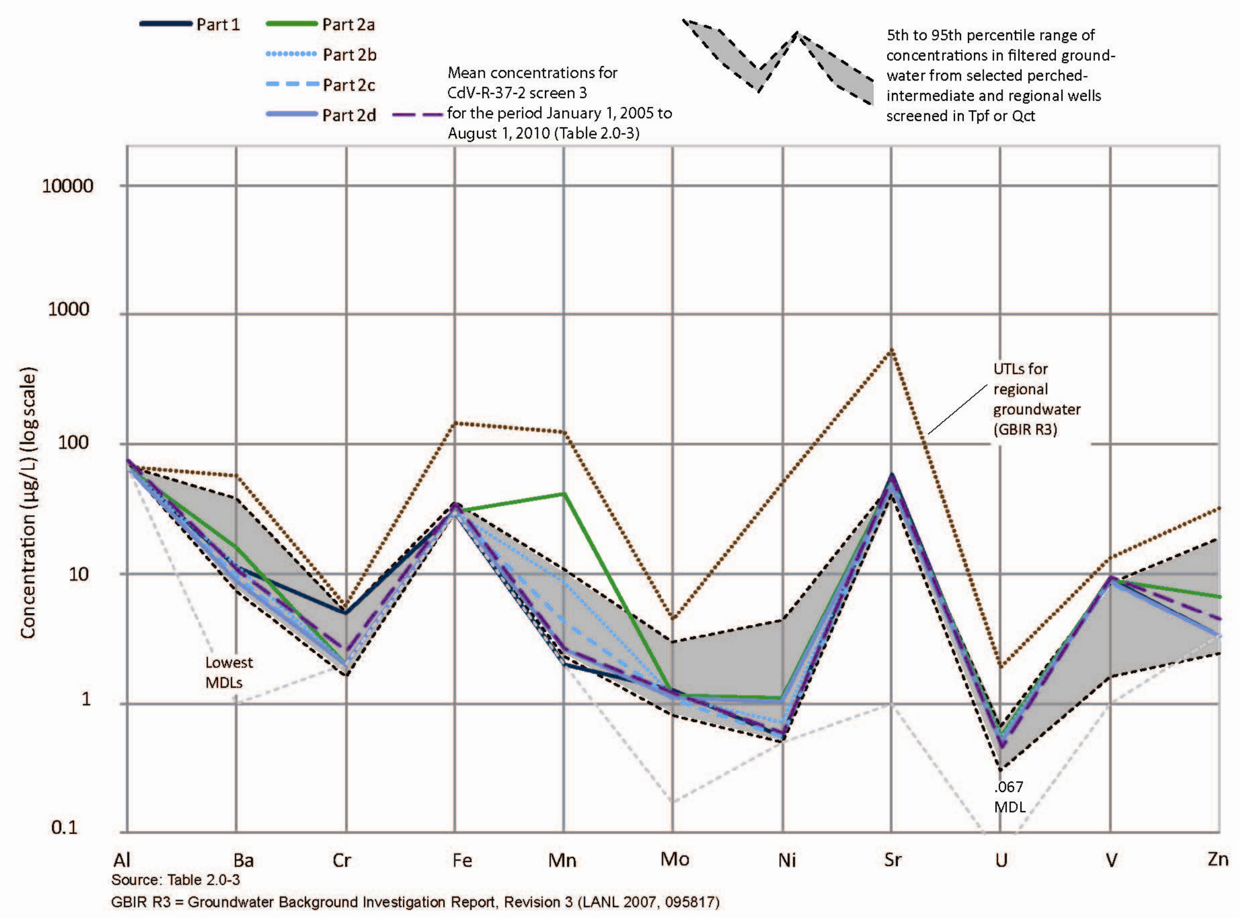
1 CV = 64.63 gallons

Figure 4.3-1 **Time-series plots of field parameters monitored during purging of CdV-R-37-2 screen 3**



Source: Table 2.0-2
GBIR R3 = Groundwater Background Investigation Report, Revision 3 (LANL 2007, 095817)

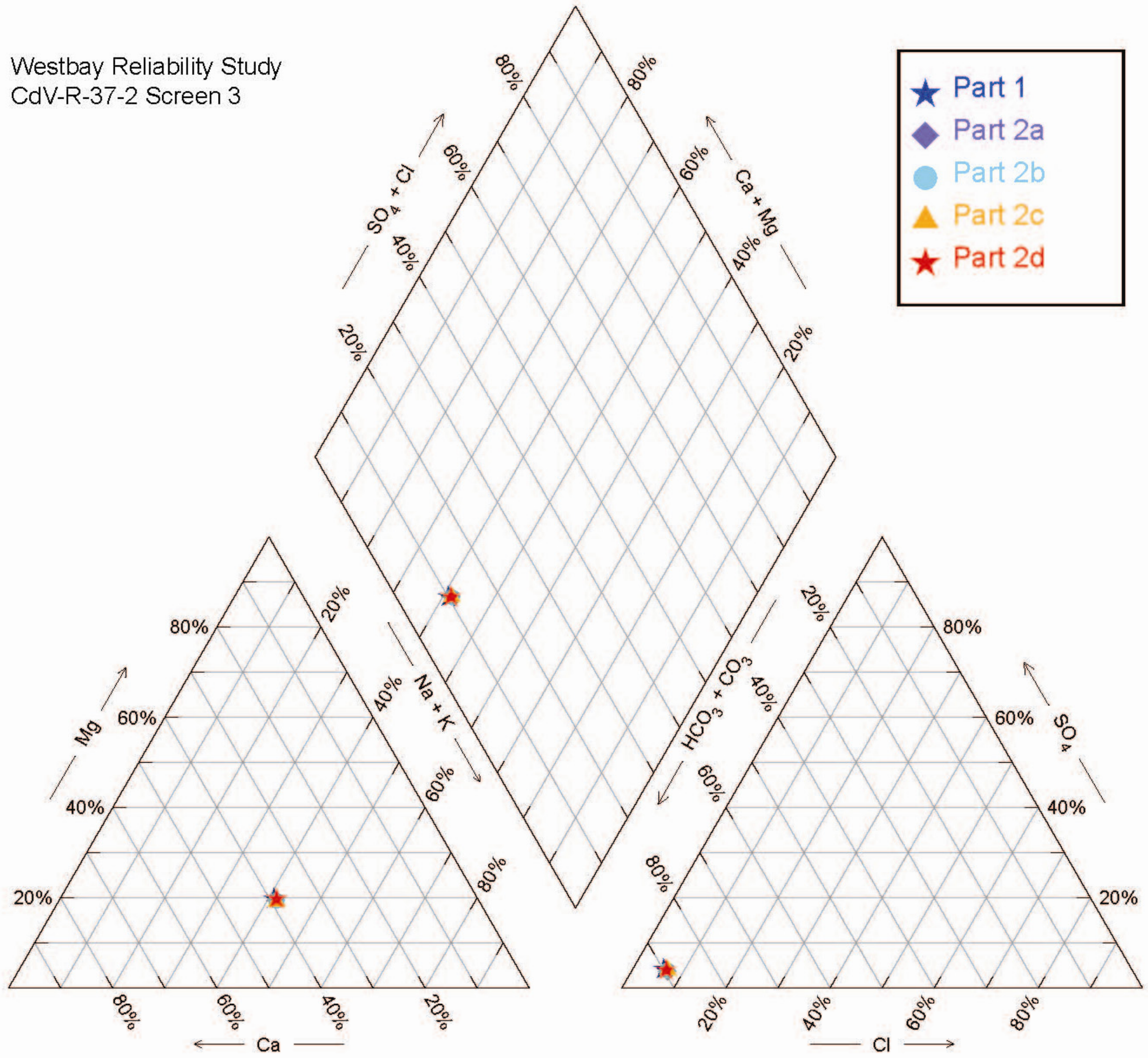
Figure 4.3-2 Schoeller plot of major ions, silica, selected anions, and TDS in filtered groundwater from CdV-R-37-2 screen 3



Source: Table 2.0-3

GBIR R3 = Groundwater Background Investigation Report, Revision 3 (LANL 2007, 095817)

Figure 4.3-3 Schoeller plot of trace metals in filtered groundwater from CdV-R-37-2 screen 3



Westbay Reliability Study Sampling Sequence

Part 1. No-purge sample

Part 2. Sampling during initial purge
  - 2a) After cross flow, when field parameters are stable
  - 2b) After 3CV
  - 2c) After 6 CV
  - 2d After 10 CV

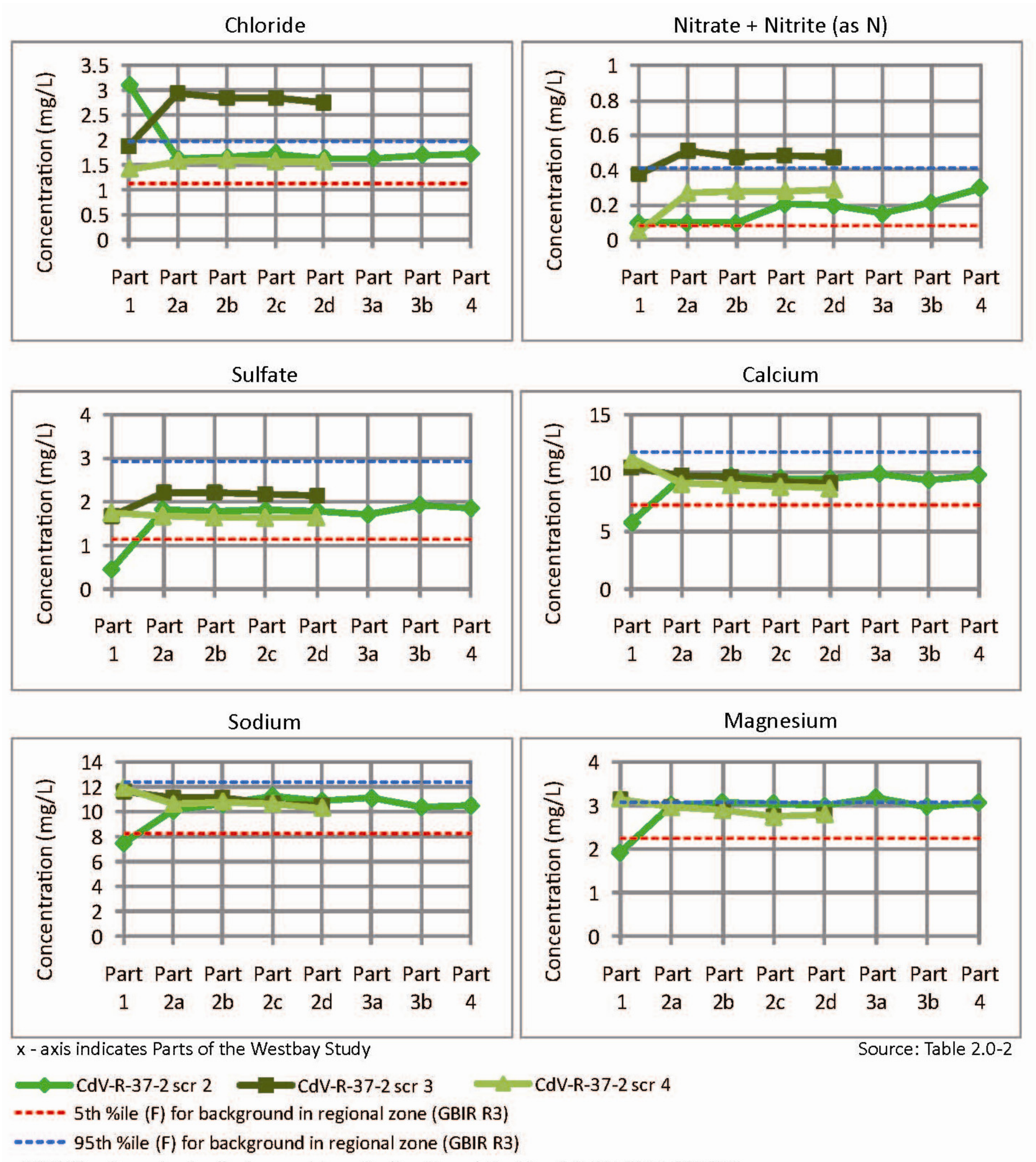
Part 3. Sampling during swabbing and bailing
  - 3a) Midpoint
  - 3b) End

Part 4. Sampling after high-velocity jetting while pumping

Observations about major-ion trends, comparing post-development samples to no-purge sample:

No change in relative proportions of major ions

Figure 4.3-4 Trilinear (Piper) plot showing major ion chemistry of CdV-R-37-2 screen 3



Part 1 - No Purge
Part 2a - After x-flow purge (field parameters stable)
Part 2b - Purge at 3CV
Part 2c - Purge at 6 CV
Part 2d - Purge at 10 CV
Part 3a - Midpoint of swabbing and bailing
Part 3b - End of swabbing and bailing
Part 4 - After high-velocity jetting while pumping

Figure 4.3-5 Time-series plots for selected major ion species for CdV-R-37-2 screens 2, 3, and 4

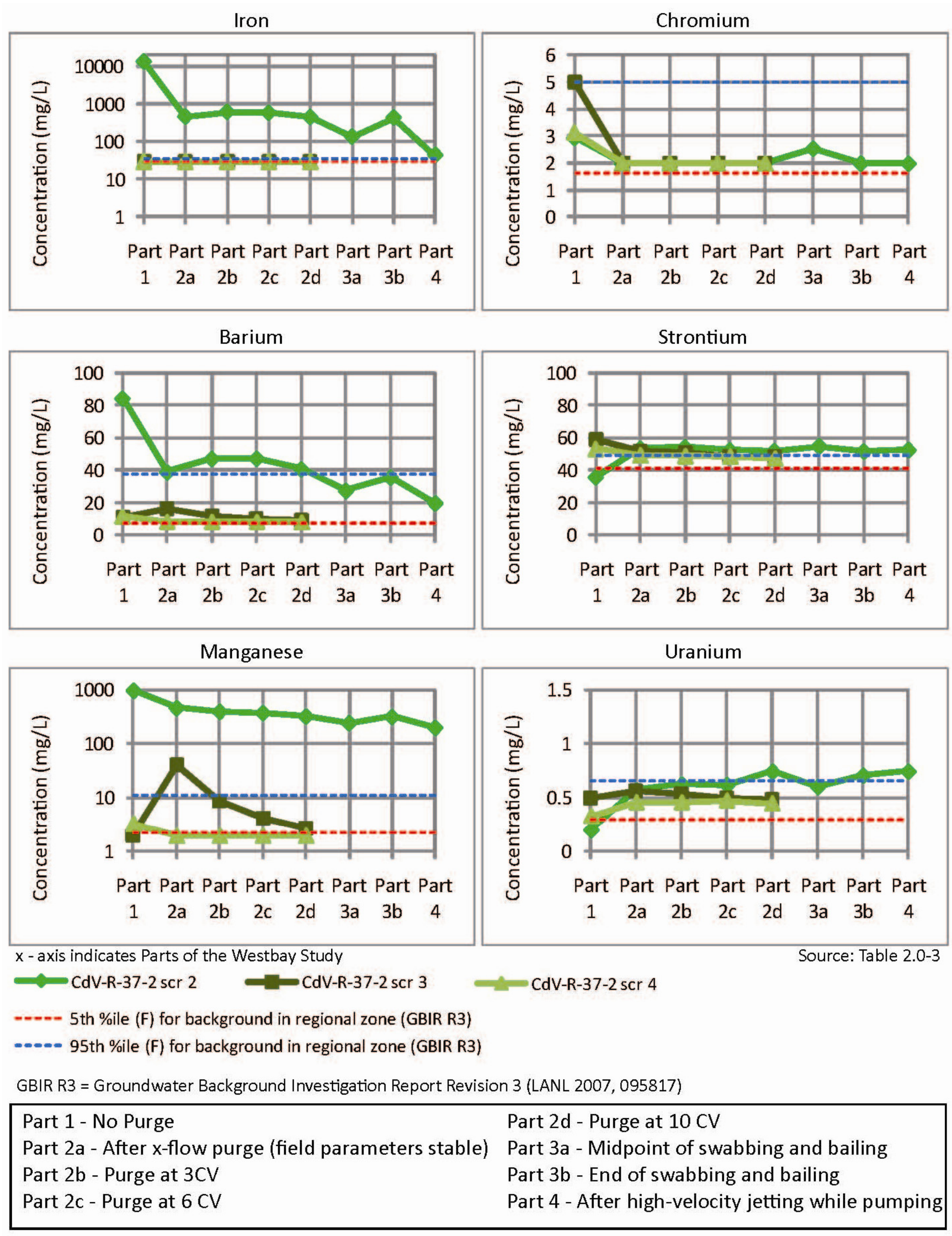
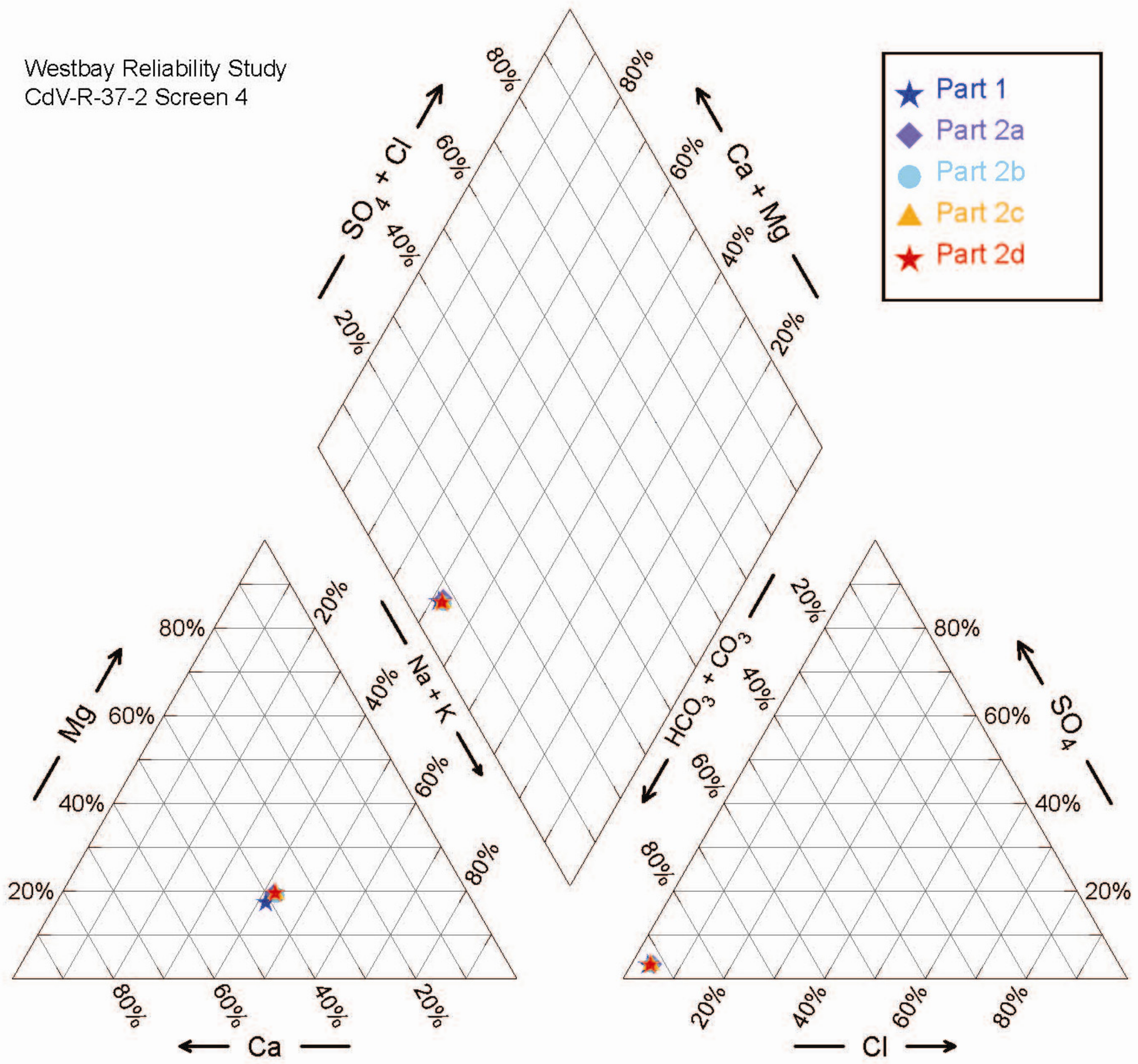


Figure 4.3-6 Time-series plots for selected trace metals for CdV-R-37-2 screens 2, 3, and 4



Westbay Reliability Study Sampling Sequence

Part 1. No-purge sample

Part 2. Sampling during initial purge

- 2a) After cross flow, when field parameters are stable
- 2b) After 3CV
- 2c) After 6 CV
- 2d After 10 CV

Part 3. Sampling during swabbing and bailing

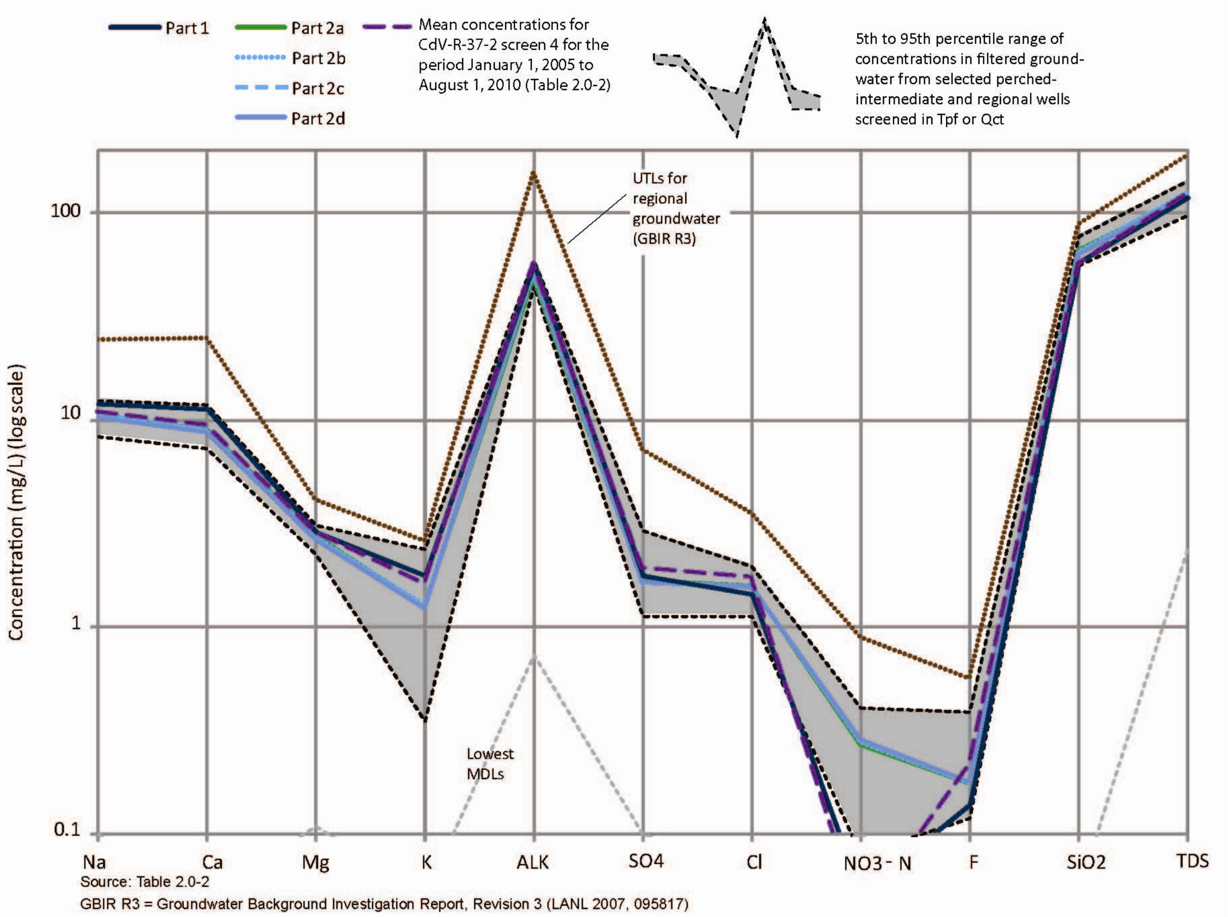
- 3a) Midpoint
- 3b) End

Part 4. Sampling after high-velocity jetting while pumping

Observations about major-ion trends, comparing post-development samples to no-purge sample:

Calcium shows greatest decrease from no-purge
All other major ions generally decrease except for Chloride which shows a slight increase

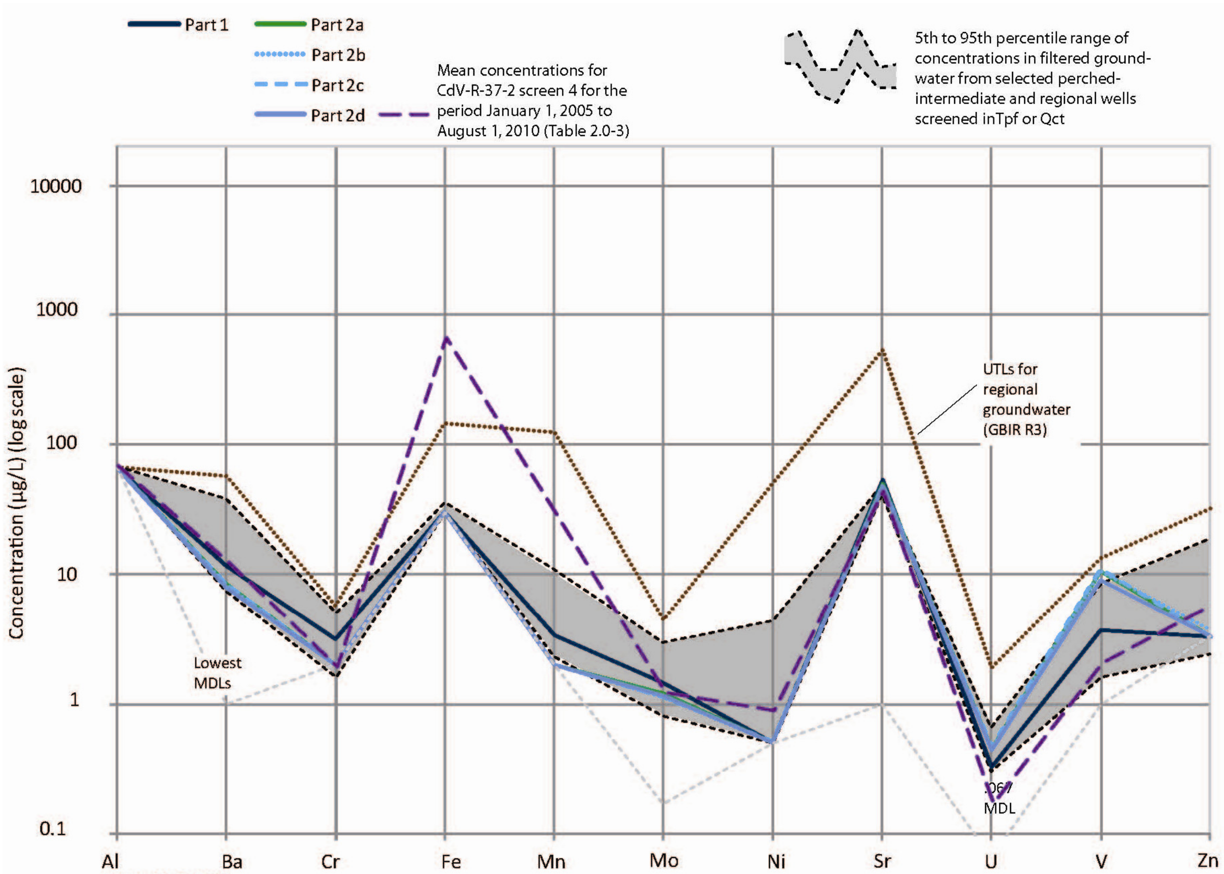
Figure 4.4-1 **Time-series plots of field parameters monitored during purging of CdV-R-37-2 screen 4**



Source: Table 2.0-2

GBIR R3 = Groundwater Background Investigation Report, Revision 3 (LANL 2007, 095817)

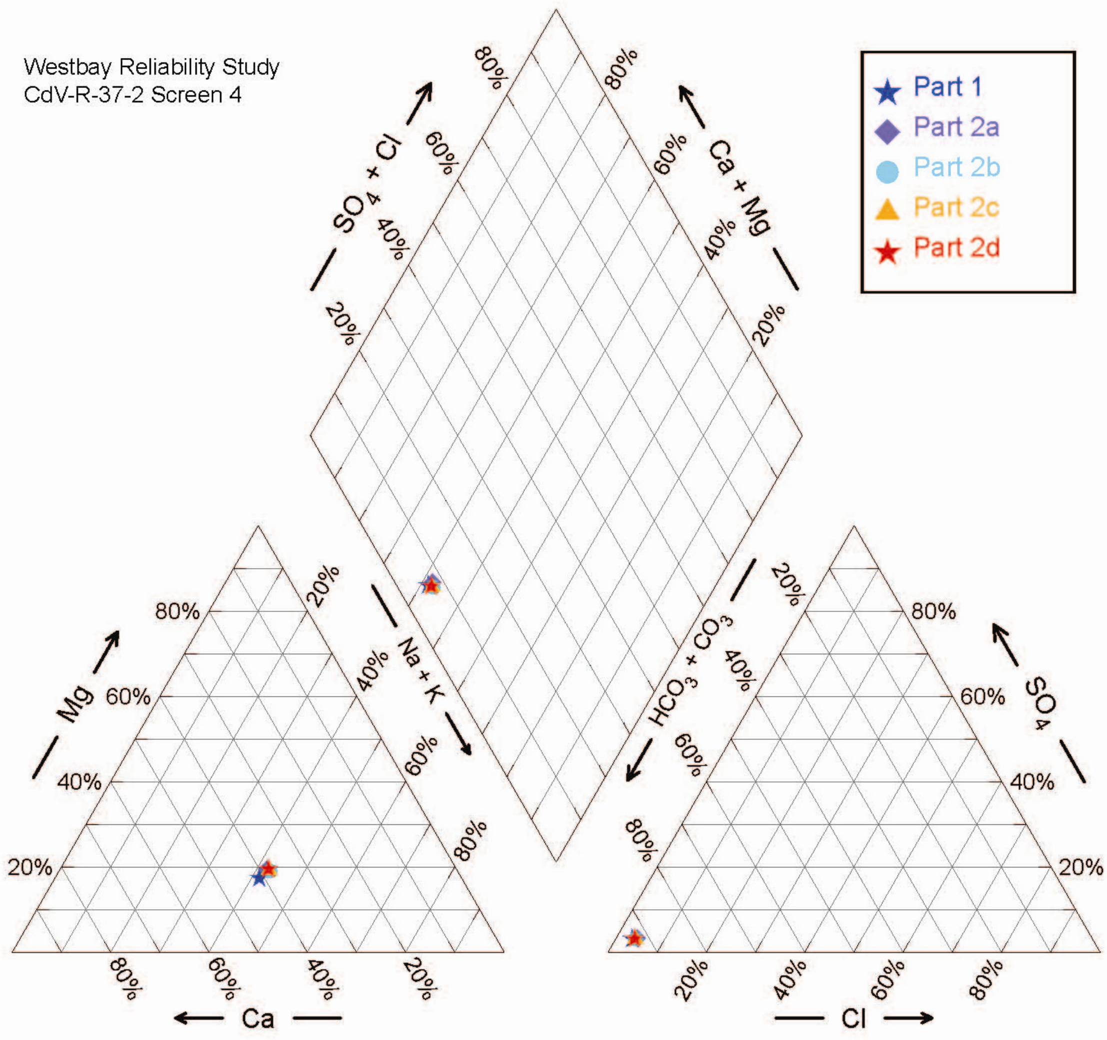
Figure 4.4-2 **Schoeller plot of major ions, silica, selected anions, and TDS in filtered groundwater from CdV-R-37-2 screen 4**



Source: Table 2.0-3

GBIR R3 = Groundwater Background Investigation Report, Revision 3 (LANL 2007, 095817)

Figure 4.4-3 Schoeller plot of trace metals in filtered groundwater from CdV-R-37-2 screen 4



Westbay Reliability Study Sampling Sequence

Part 1. No-purge sample

Part 2. Sampling during initial purge
  2a) After cross flow, when field parameters are stable
  2b) After 3CV
  2c) After 6 CV
  2d After 10 CV

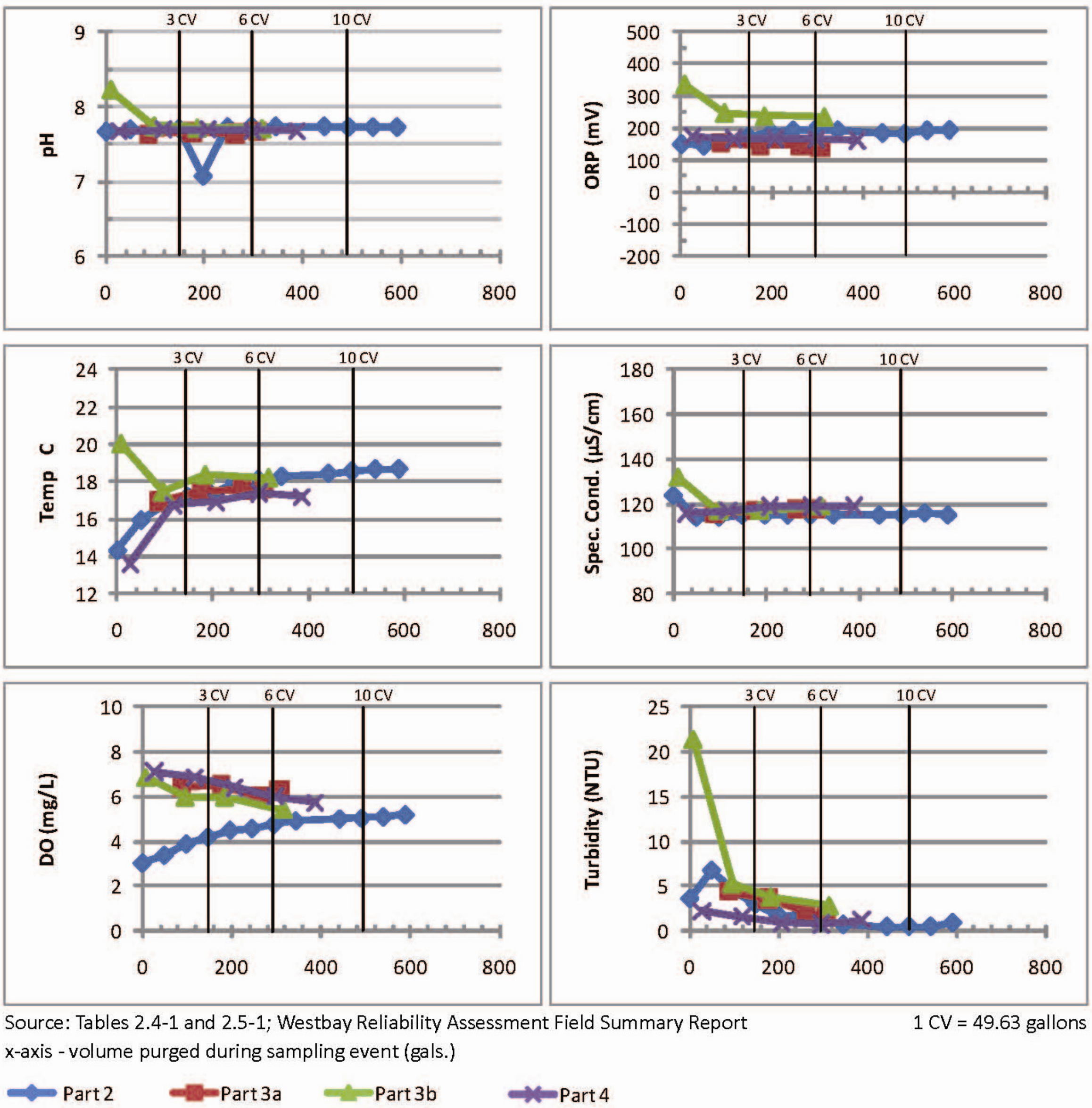
Part 3. Sampling during swabbing and bailing
  3a) Midpoint
  3b) End

Part 4. Sampling after high-velocity jetting while pumping

Observations about major-ion trends, comparing post-development samples to no-purge sample:

Calcium shows greatest decrease from no-purge
All other major ions generally decrease except for Chloride which shows a slight increase

Figure 4.4-4 Trilinear (Piper) plot showing major ion chemistry of CdV-R-37-2 screen 4



Source: Tables 2.4-1 and 2.5-1; Westbay Reliability Assessment Field Summary Report

1 CV = 49.63 gallons

x-axis - volume purged during sampling event (gals.)

Part 2 - Initial purging and sampling (Part 2a) at 3 CV (Part 2b), 6 CV(Part 2c) and 10 CV(Part 2d)

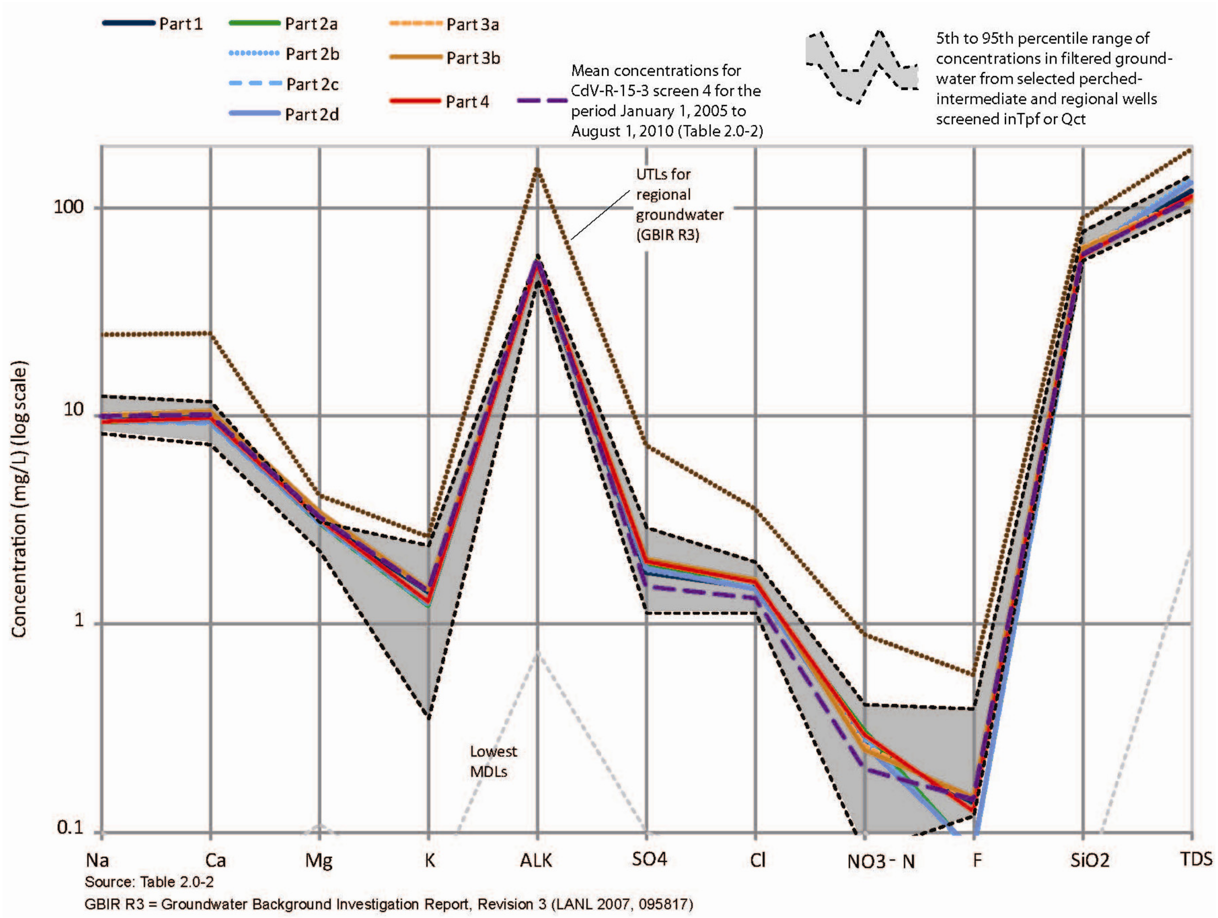
Redevelopment Steps

Part 3a - Midpoint of swabbing and bailing

Part 3b - End of swabbing and bailing

Part 4 - After high-velocity jetting while pumping

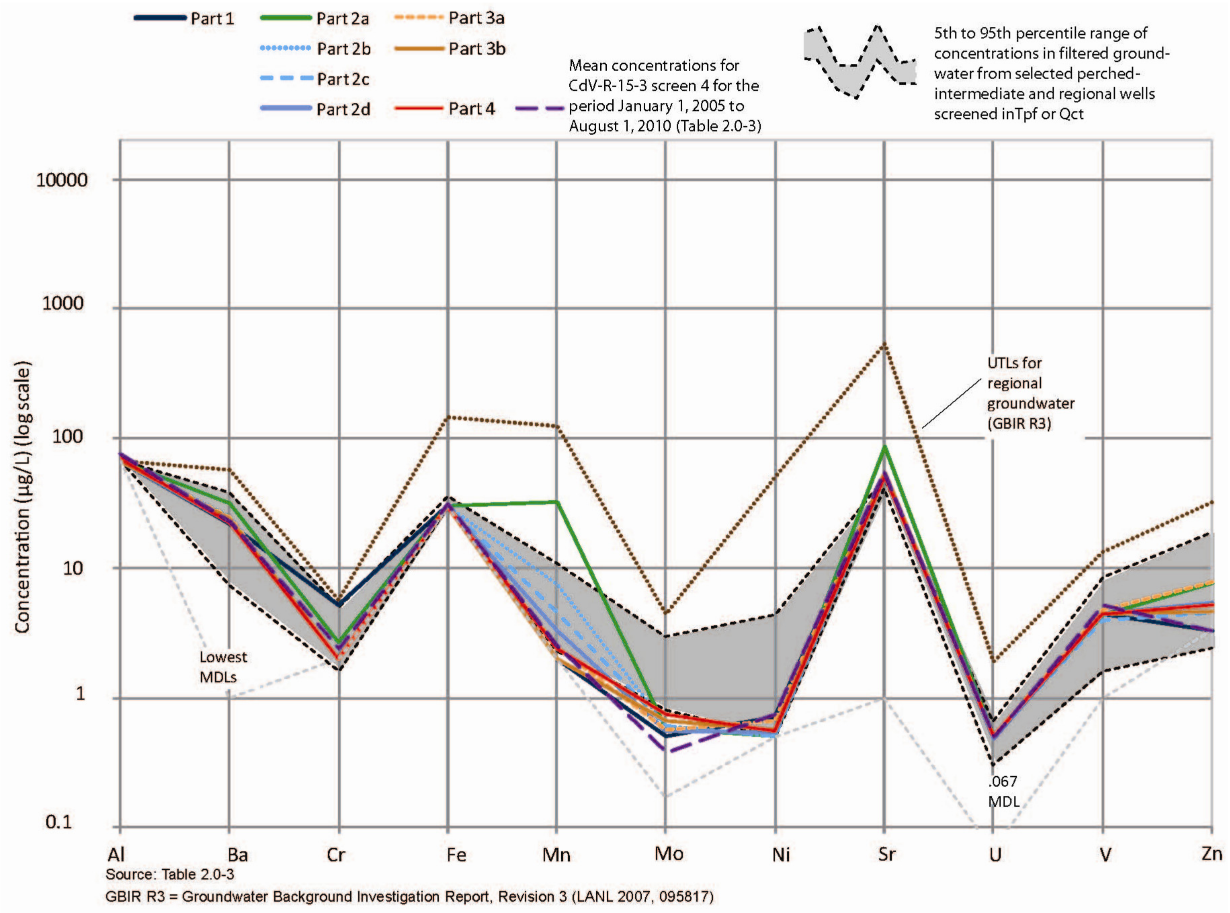
Figure 4.5-1 Time-series plots of field parameters monitored during purging and redevelopment of CdV-R-15-3 screen 4



Source: Table 2.0-2

GBIR R3 = Groundwater Background Investigation Report, Revision 3 (LANL 2007, 095817)

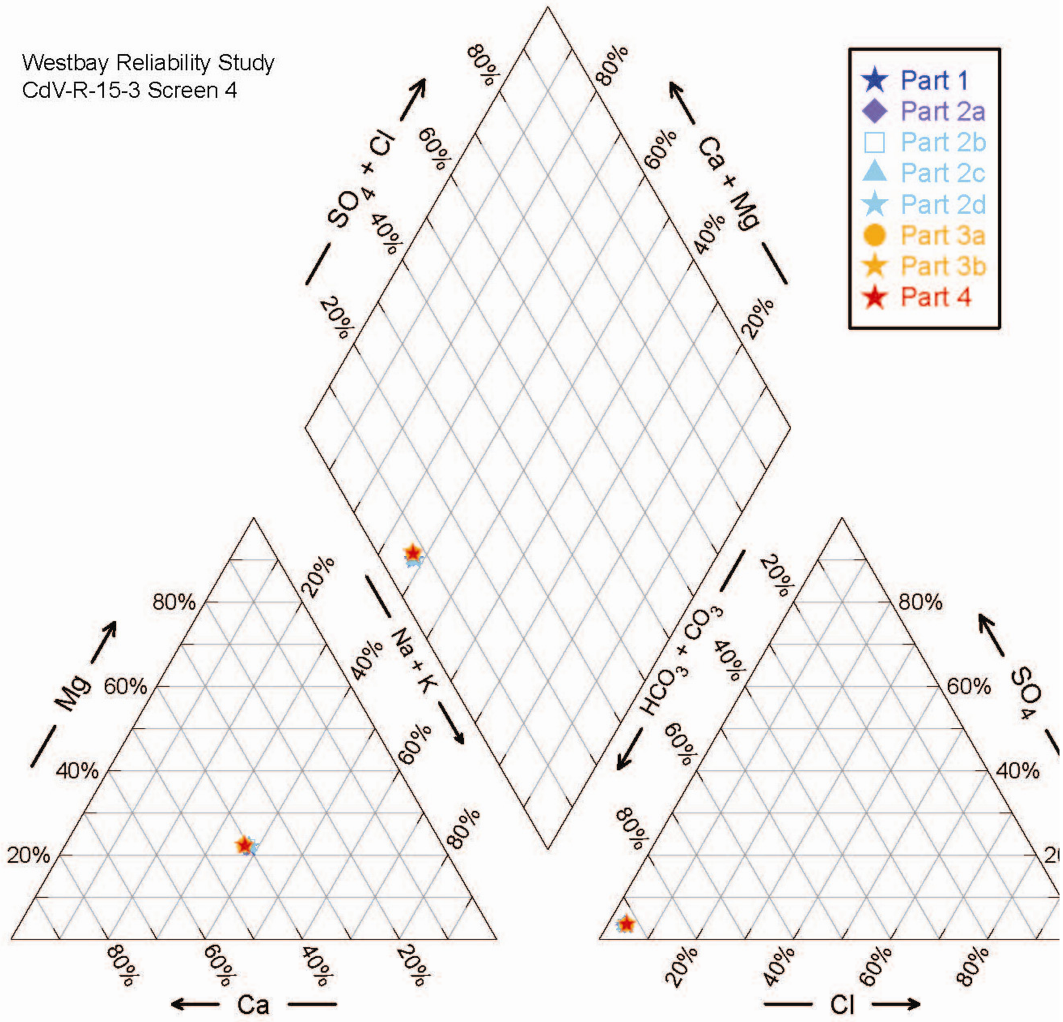
Figure 4.5-2 **Schoeller plot of major ions, silica, selected anions, and TDS in filtered groundwater from CdV-R-15-3 screen 4**



Source: Table 2.0-3

GBIR R3 = Groundwater Background Investigation Report, Revision 3 (LANL 2007, 095817)

Figure 4.5-3 Schoeller plot of trace metals in filtered groundwater from CdV-R-15-3 screen 4



Westbay Reliability Study Sampling Sequence

Part 1. No-purge sample

Part 2. Sampling during initial purge
  2a) After cross flow, when field parameters are stable
  2b) After 3CV
  2c) After 6 CV
  2d After 10 CV

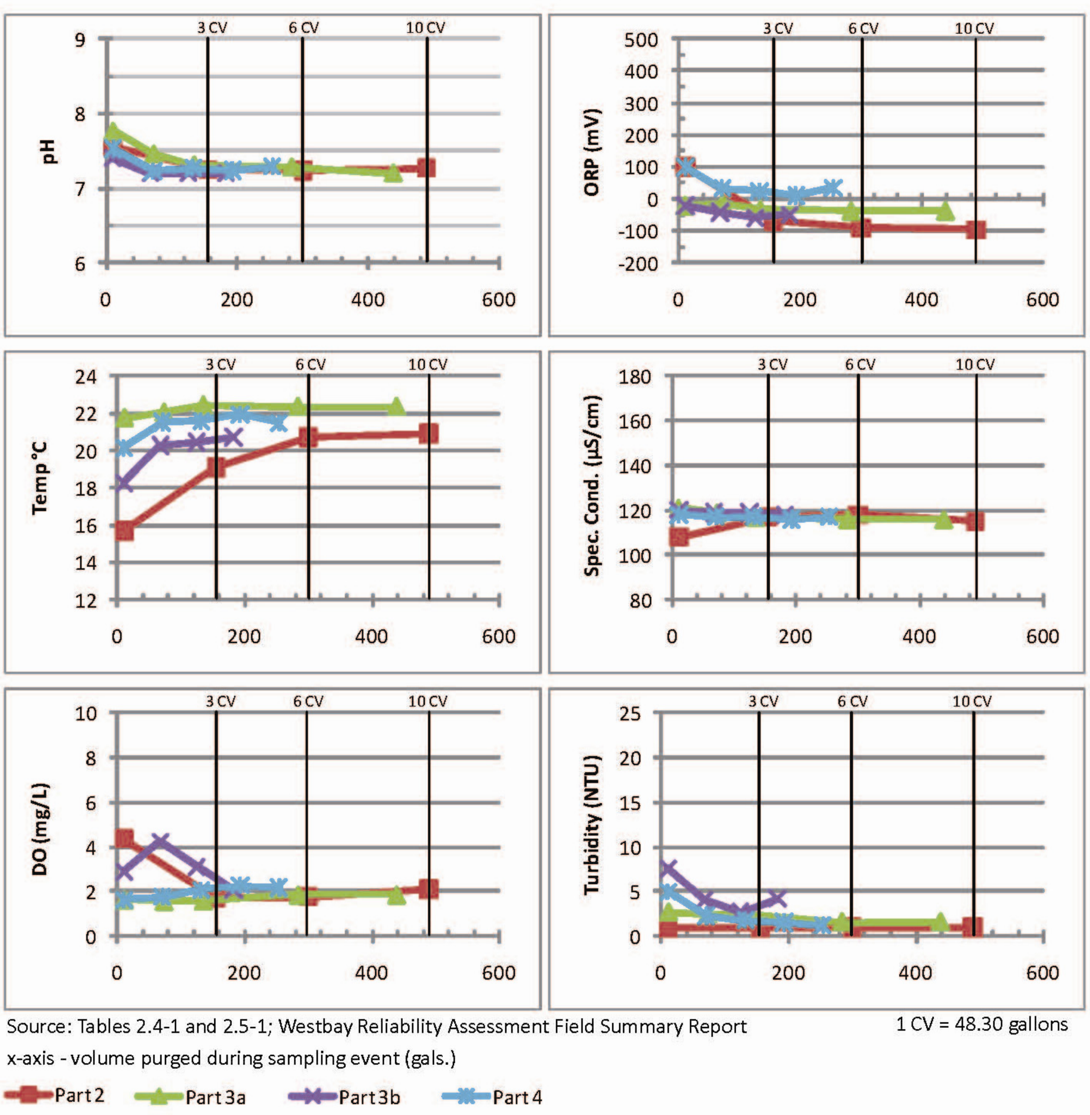
Part 3. Sampling during swabbing and bailing
  3a) Midpoint
  3b) End

Part 4. Sampling after high-velocity jetting while pumping

Observations about major-ion trends, compa
post-development samples to no-purge samp

No change in relative proportions of major io

Figure 4.5-4 Trilinear (Piper) plot showing major ion chemistry of CdV-R-15-3 screen 4



Source: Tables 2.4-1 and 2.5-1; Westbay Reliability Assessment Field Summary Report

1 CV = 48.30 gallons

x-axis - volume purged during sampling event (gals.)

Part 2 - Initial purging and sampling (Part 2a) at 3 CV (Part 2b), 6 CV(Part 2c) and 10 CV(Part 2d)
<u>Redevelopment Steps</u>
Part 3a - Midpoint of swabbing and bailing
Part 3b - End of swabbing and bailing
Part 4 - After high-velocity jetting while pumping

Figure 4.6-1 **Time-series plots of field parameters monitored during purging and redevelopment of CdV-R-37-2 screen 2**

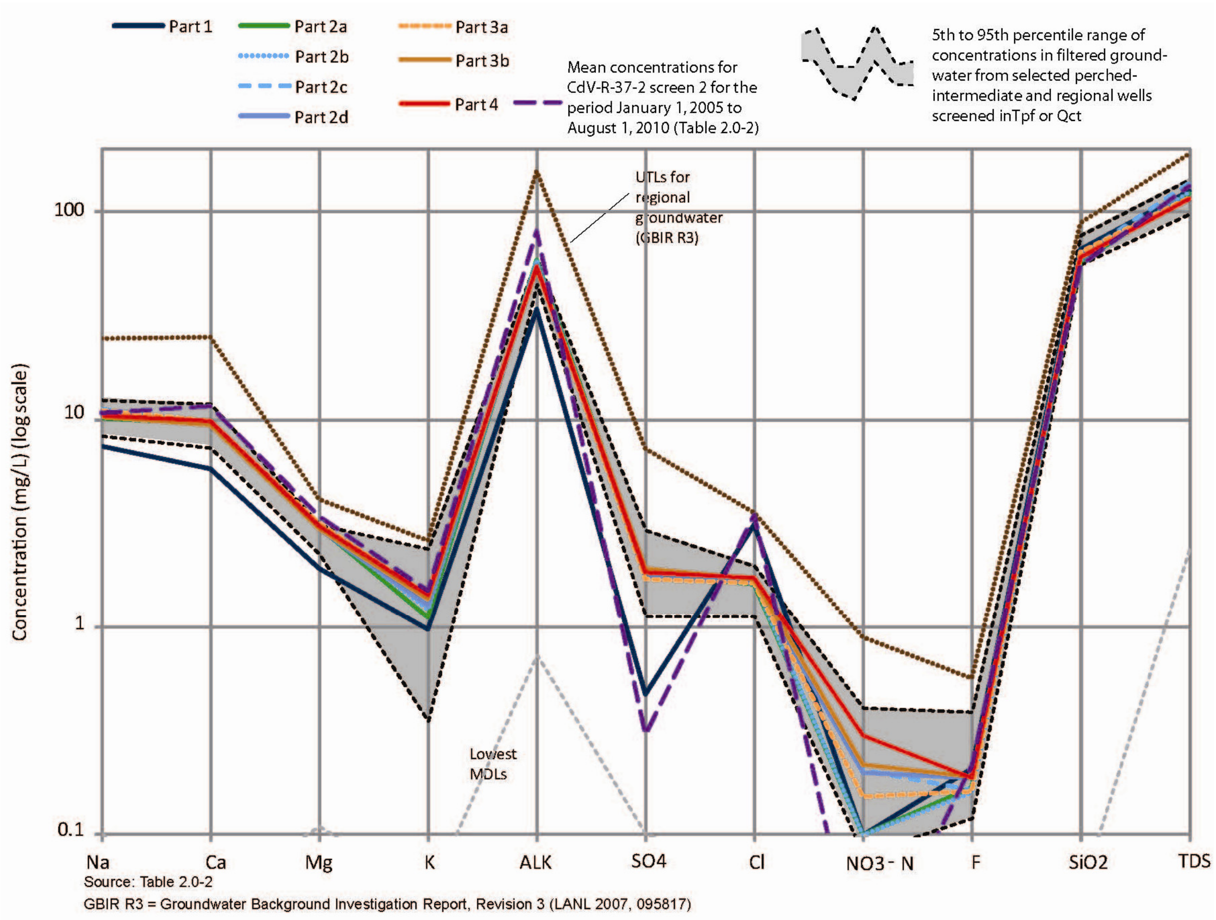
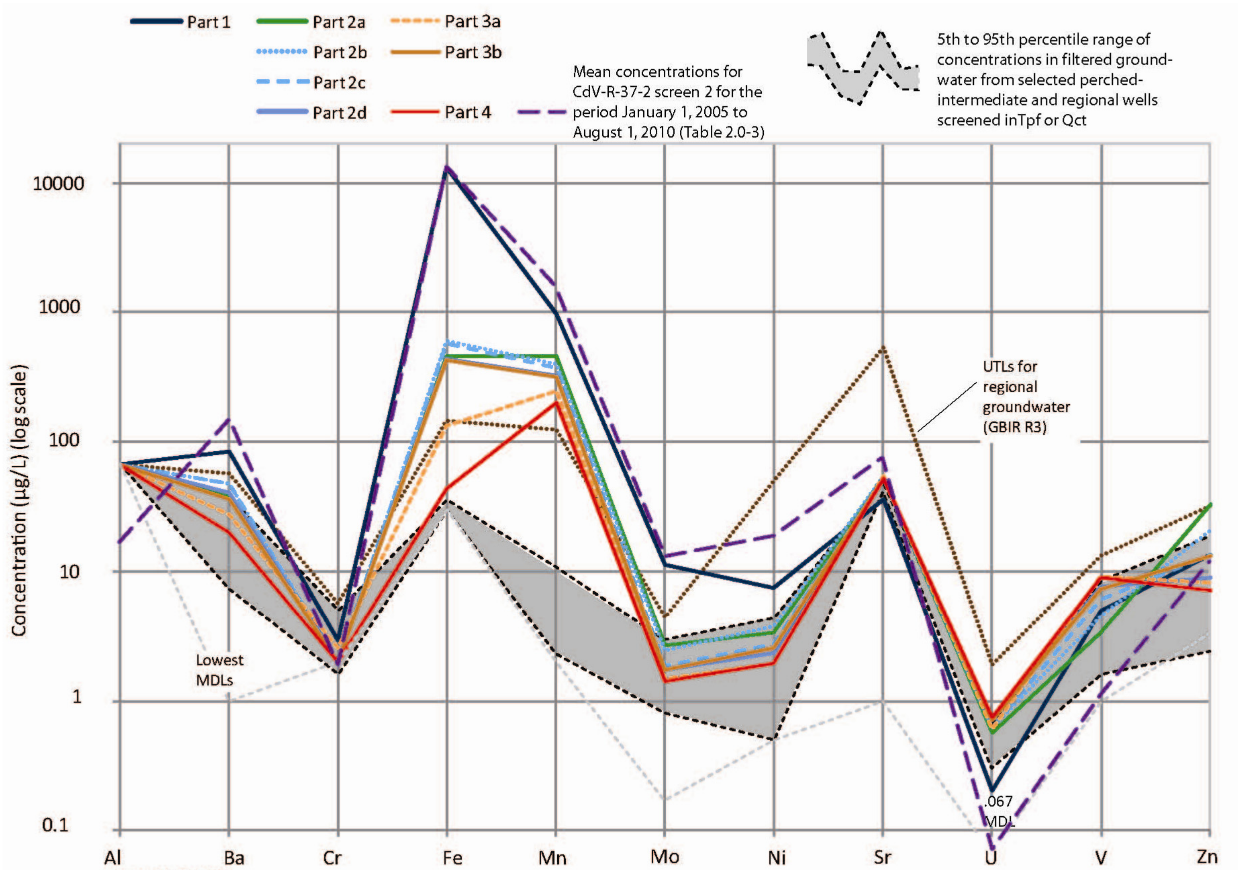


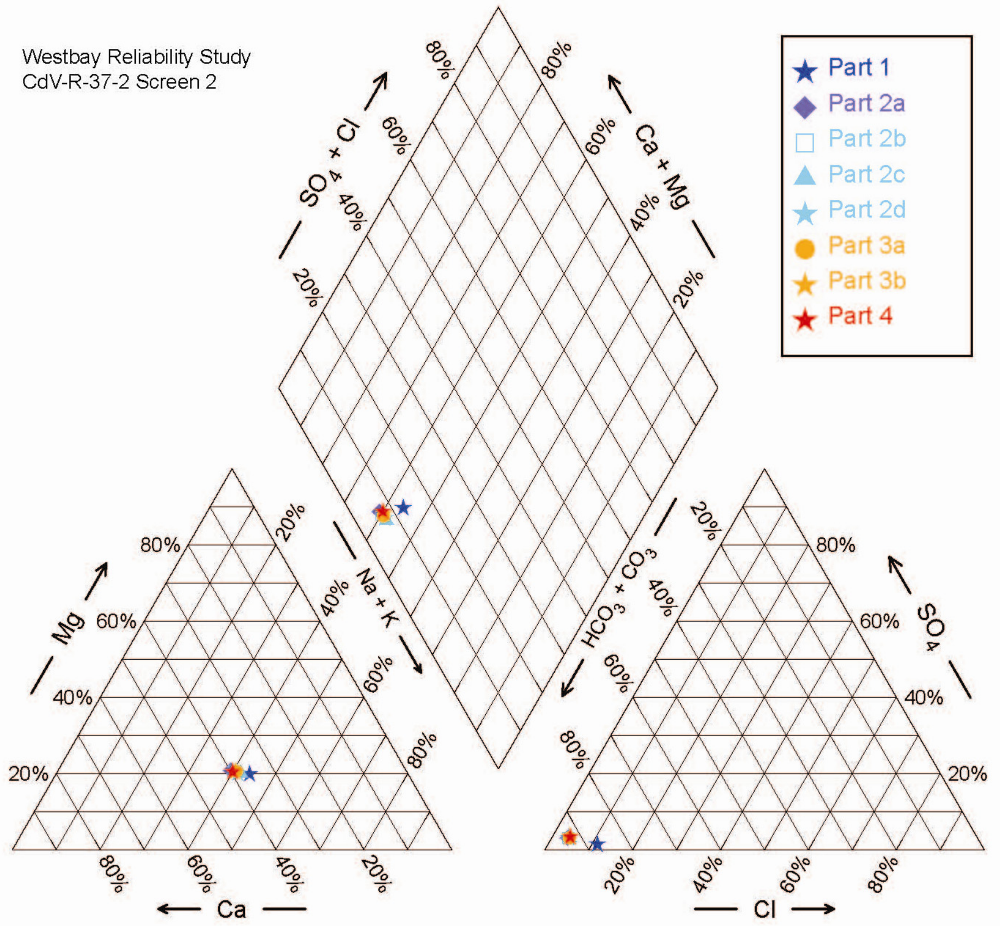
Figure 4.6-2 Schoeller plot of major ions, silica, selected anions, and TDS in filtered groundwater from CdV-R-37-2 screen 2



Source: Table 2.0-3

GBIR R3 = Groundwater Background Investigation Report, Revision 3 (LANL 2007, 095817)

Figure 4.6-3 Schoeller plot of trace metals in filtered groundwater from CdV-R-37-2 screen 2



Westbay Reliability Study Sampling Sequence

Part 1. No-purge sample

Part 2. Sampling during initial purge
  - 2a) After cross flow, when field parameters are stable
  - 2b) After 3CV
  - 2c) After 6 CV
  - 2d After 10 CV

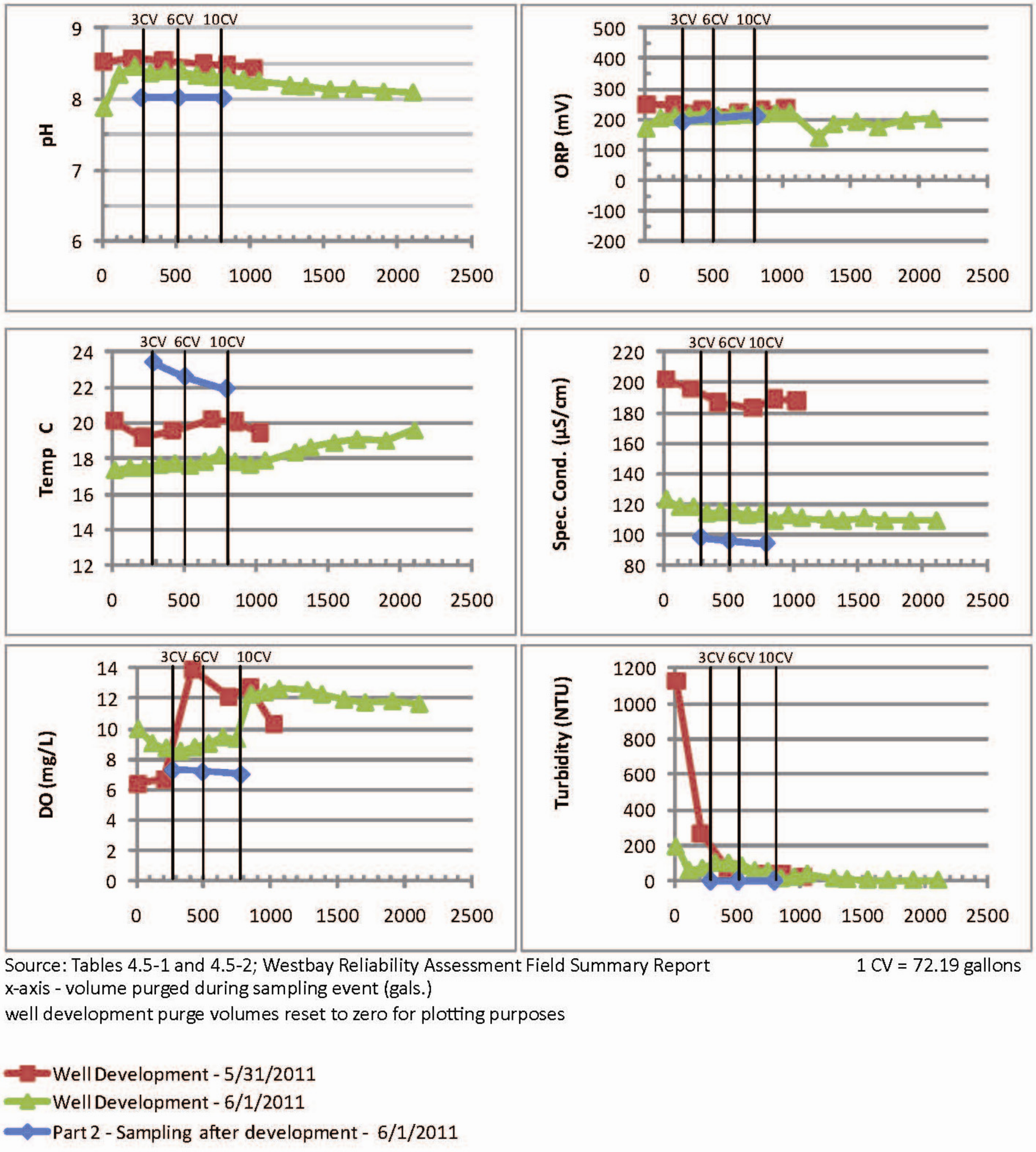
Part 3. Sampling during swabbing and bailing
  - 3a) Midpoint
  - 3b) End

Part 4. Sampling after high-velocity jetting while pumping

Observations about major-ion trends, comparing post-development samples to no-purge sample:

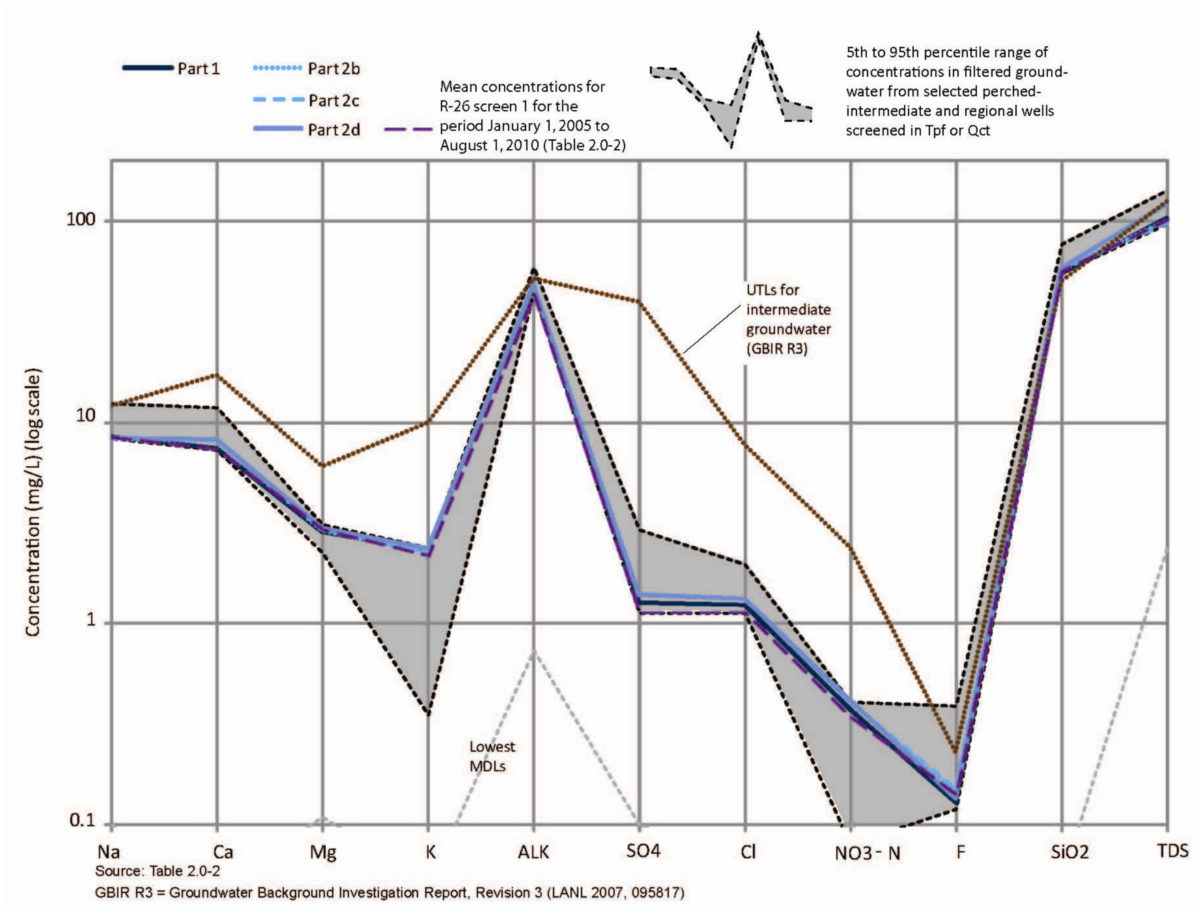
a) Cations: lower proportion of Sodium and Potassium relative to Calciium and Magnesium
b) Anions: lower porportion of Chloride relative to Sulfate and carbonate alkalinity
c) Relative proportions of major ions remain stable after purge (Part 2a)

Figure 4.6-4 Trilinear (Piper) plot showing major ion chemistry of CdV-R-37-2 screen 2



Source: Tables 4.5-1 and 4.5-2; Westbay Reliability Assessment Field Summary Report 1 CV = 72.19 gallons
x-axis - volume purged during sampling event (gals.)
well development purge volumes reset to zero for plotting purposes

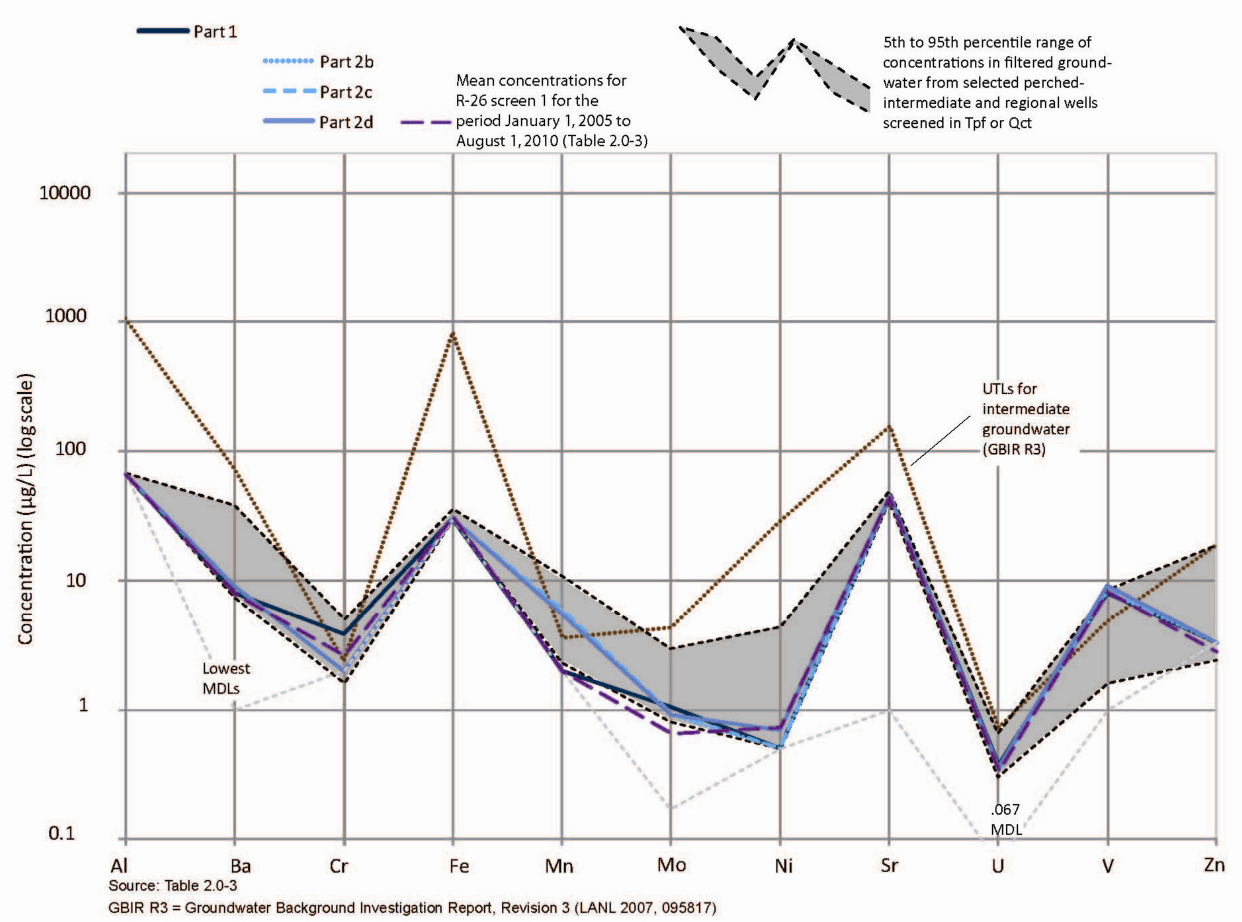
Figure 4.7-1 Time-series plots of field parameters monitored during development and purging of R-26 screen 1



Source: Table 2.0-2

GBIR R3 = Groundwater Background Investigation Report, Revision 3 (LANL 2007, 095817)

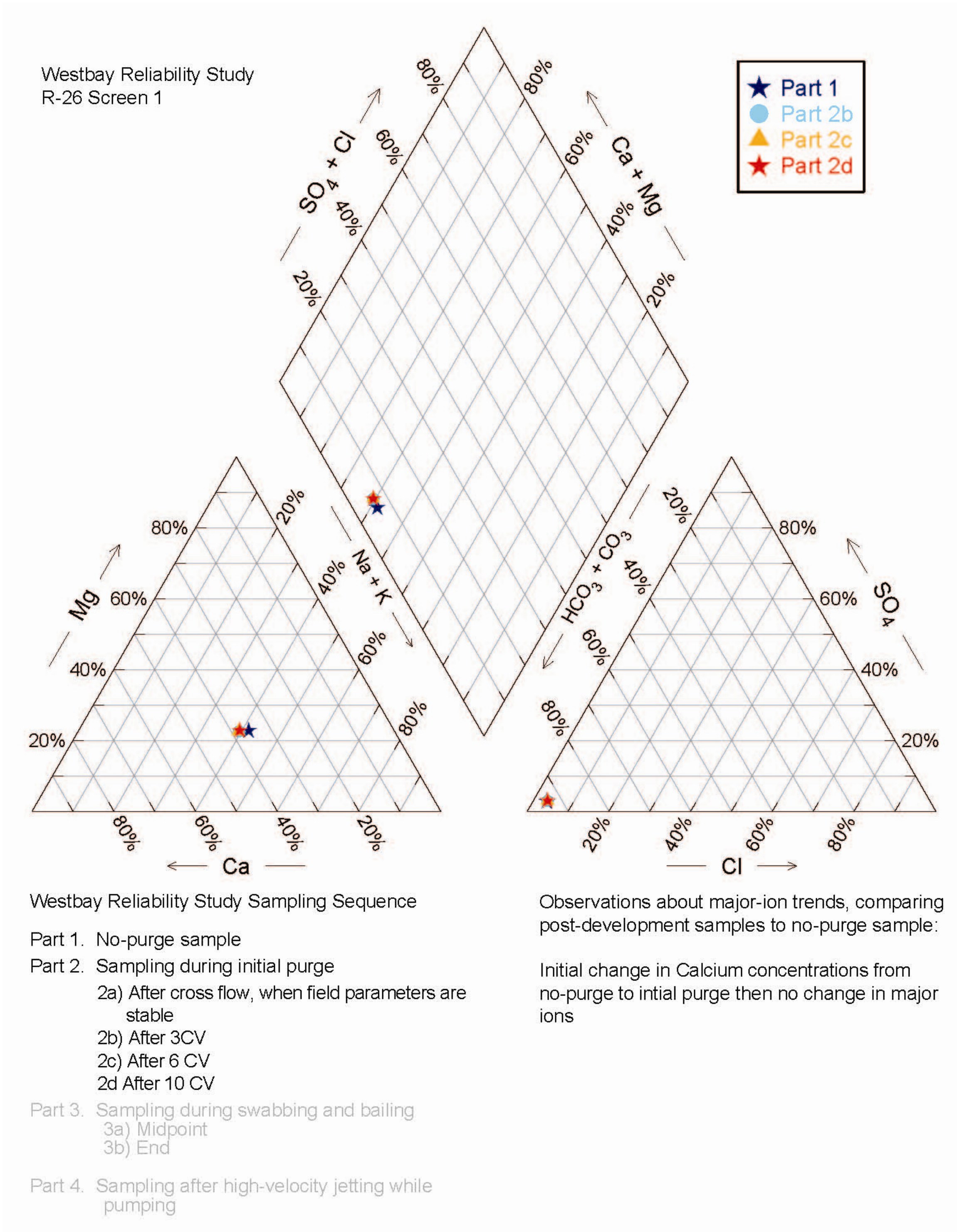
Figure 4.7-2 **Concentrations of major ions, silica, selected anions, and TDS in filtered groundwater from R-26 screen 1**



Source: Table 2.0-3

GBIR R3 = Groundwater Background Investigation Report, Revision 3 (LANL 2007, 095817)

Figure 4.7-3 Concentrations of trace metals in filtered groundwater from R-26 screen 1



Westbay Reliability Study Sampling Sequence

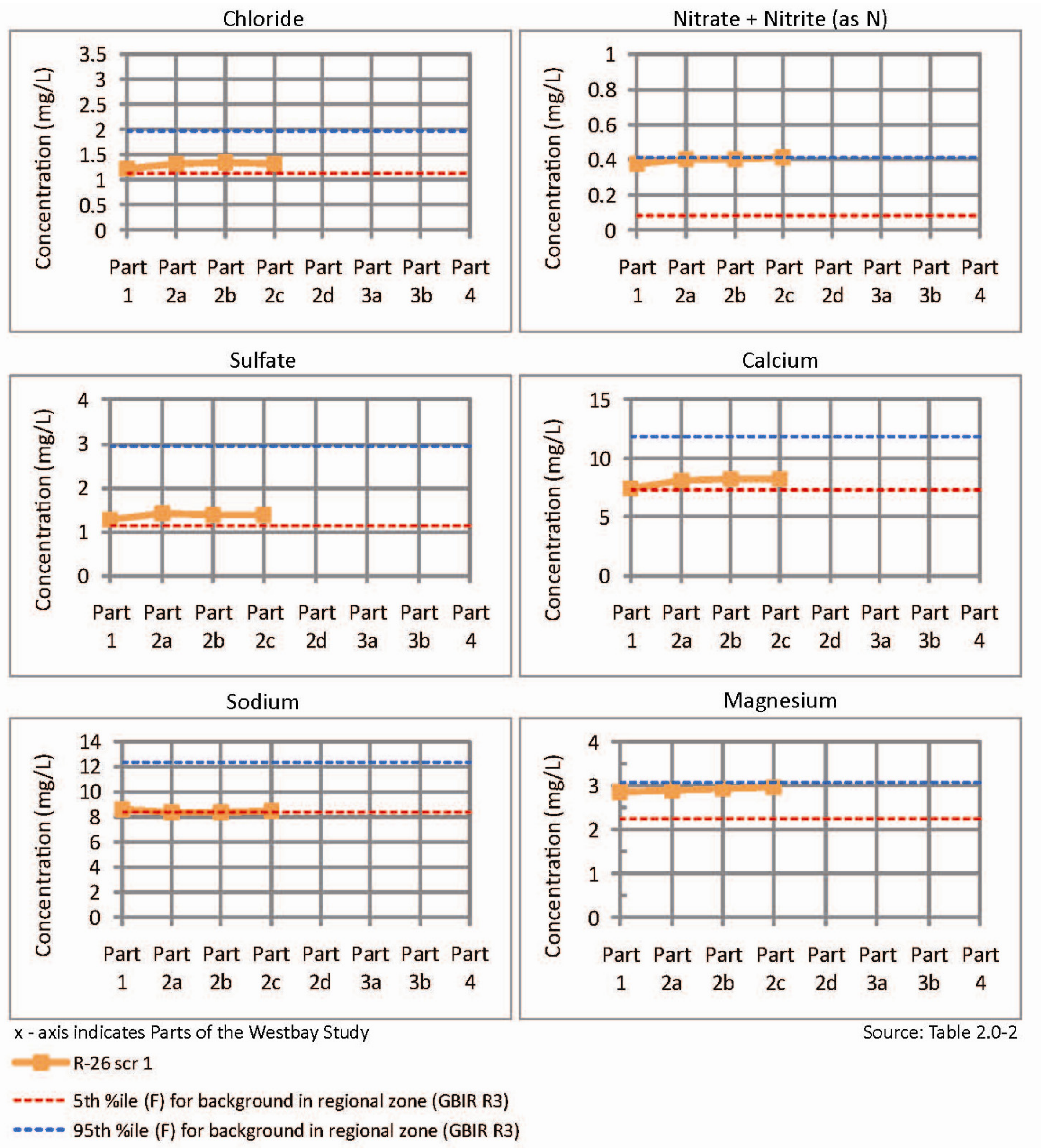
Part 1. No-purge sample
Part 2. Sampling during initial purge
  2a) After cross flow, when field parameters are stable
  2b) After 3CV
  2c) After 6 CV
  2d After 10 CV
Part 3. Sampling during swabbing and bailing
  3a) Midpoint
  3b) End

Part 4. Sampling after high-velocity jetting while pumping

Observations about major-ion trends, comparing post-development samples to no-purge sample:

Initial change in Calcium concentrations from no-purge to intial purge then no change in major ions

Figure 4.7-4 Trilinear (Piper) plot showing major ion chemistry of R-26 screen 1



GBIR R3 = Groundwater Background Investigation Report Revision 3 (LANL 2007, 095817)

Part 1 - No Purge
Part 2a - After x-flow purge (field parameters stable)
Part 2b - Purge at 3CV
Part 2c - Purge at 6 CV
Part 2d - Purge at 10 CV
Part 3a - Midpoint of swabbing and bailing
Part 3b - End of swabbing and bailing
Part 4 - After high-velocity jetting while pumping

Figure 4.7-5 Time-series plots for selected major ion species for R-26 screen 1

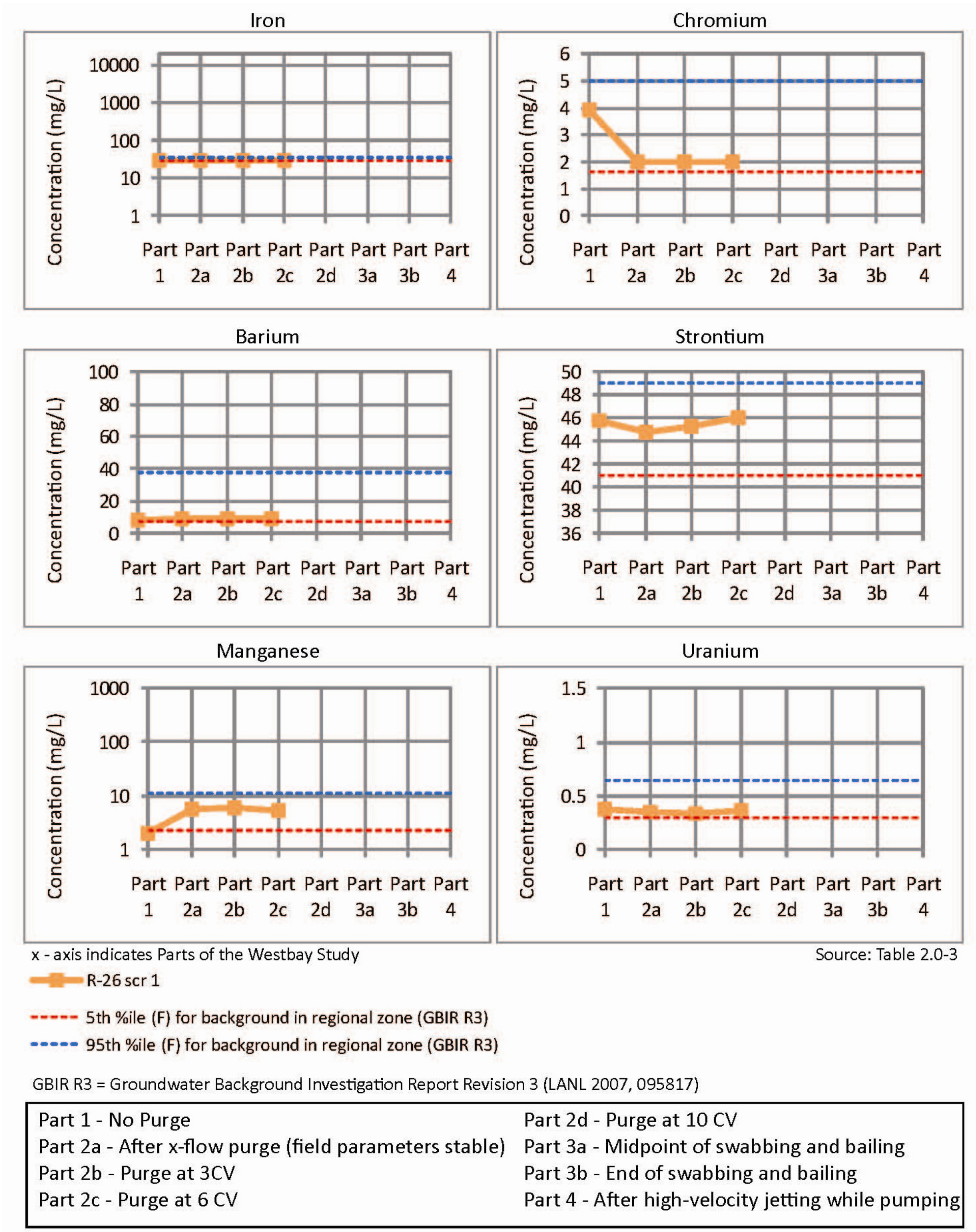


Figure 4.7-6 Time-series plots for selected trace metals for R-26 screen 1

Table 2.0-1
Final Field Parameters

Location	Port	Date and Time	Part	Event Description	Dissolved Oxygen (mg/L)	ORP (mV)	pH	Specific Conductance (µS/cm)	Temperature °C	Turbidity (NTU)
CdV-R-15-3	MP5A	8/4/10 9:12 AM	1	No-purge sample	3.32	—*	7.3	145	22.13	1.39
CdV-R-15-3	MP5A	5/4/11 3:35 PM	2a	After x-flow purge when FP stable	2.45	55	7.71	133	19.96	5.21
CdV-R-15-3	MP5A	5/4/11 4:00 PM	2b	3 CV	2.13	15.4	7.54	124	19.12	6.68
CdV-R-15-3	MP5A	5/4/11 4:25 PM	2c	6 CV	2.14	15	7.59	125	19.58	1.73
CdV-R-15-3	MP5A	5/4/11 5:00 PM	2d	10 CV	2.27	27.8	7.59	123	19.6	1.61
CdV-R-15-3	MP6A	8/4/10 12:00 PM	1	No-purge sample	10.96	—	7.53	129	23.22	1.91
CdV-R-15-3	MP6A	5/3/11 7:46 AM	2a	After x-flow purge when FP stable	2.95	217.5	7.56	112	17.22	3.28
CdV-R-15-3	MP6A	5/3/11 8:44 AM	2b	3 CV	2.41	264.1	7.45	114	18.17	4.72
CdV-R-15-3	MP6A	5/3/11 10:02 AM	2c	6 CV	2.92	250.5	7.51	113	18.35	2.73
CdV-R-15-3	MP6A	5/3/11 11:48 AM	2d	10 CV	2.96	191.4	7.56	113	19.33	2.34
CdV-R-37-2	MP3A	8/10/10 2:30 PM	1	No-purge sample	5.78	—	8.09	120	22.6	0.88
CdV-R-37-2	MP3A	4/12/11 4:23 PM	2a	After x-flow purge when FP stable	4.81	19.9	7.53	116	19.19	13.3
CdV-R-37-2	MP3A	4/12/11 4:37 PM	2b	3 CV	6.94	96.1	7.72	108	20.54	42.3
CdV-R-37-2	MP3A	4/12/11 4:52 PM	2c	6 CV	8.11	120.2	7.71	98	21.02	1.6
CdV-R-37-2	MP3A	4/12/11 5:12 PM	2d	10 CV	7.53	131.8	7.71	94	21.1	0
CdV-R-37-2	MP4A	8/10/10 8:35 AM	1	No-purge sample	6.91	—	8.5	127	22.86	1.45
CdV-R-37-2	MP4A	4/16/11 1:30 PM	2a	After x-flow purge when FP stable	6.38	82.3	7.64	111	21.96	—
CdV-R-37-2	MP4A	4/16/11 1:45 PM	2b	3 CV	6.32	163.3	7.64	107	22.03	—
CdV-R-37-2	MP4A	4/16/11 2:00 PM	2c	6 CV	6.3	111.3	7.64	102	22.04	—
CdV-R-37-2	MP4A	4/16/11 2:20 PM	2d	10 CV	6.94	116.2	7.64	98	22.03	—
CdV-R-15-3	MP4A	8/5/10 10:45 AM	1	No-purge sample	6.86	—	8.06	120	18.97	0.99
CdV-R-15-3	MP4A	5/5/11 7:56 AM	2a	After x-flow purge when FP stable	3.04	150.5	7.66	124	14.32	3.58
CdV-R-15-3	MP4A	5/5/11 8:26 AM	2b	3 CV	4.21	173.8	7.7	115	17.17	3.03
CdV-R-15-3	MP4A	5/5/11 8:56 AM	2c	6 CV	4.79	194.4	7.73	115	18.09	1.04
CdV-R-15-3	MP4A	5/5/11 9:36 AM	2d	10 CV	5.07	183	7.72	115	18.54	0.45
CdV-R-15-3	MP4A	5/7/11 8:17 AM	3a	Midpoint swabbing & bailing	7.47	185.5	7.76	122	13.87	2.85
CdV-R-15-3	MP4A	5/7/11 8:34 AM	3a	Midpoint swabbing & bailing	6.51	146	7.66	117	17.5	3.56

Table 2.0-1 (continued)

Location	Port	Date and Time	Part	Event Description	Dissolved Oxygen (mg/L)	ORP (mV)	pH	Specific Conductance (µS/cm)	Temperature (°C)	Turbidity (NTU)
CdV-R-15-3	MP4A	5/7/11 8:49 AM	3a	Midpoint swabbing & bailing	6.34	140.7	7.68	118	17.67	1.58
CdV-R-15-3	MP4A	5/8/11 11:27 AM	3b	End of swabbing & bailing	6.86	334.7	8.23	132	19.99	21.3
CdV-R-15-3	MP4A	5/8/11 11:44 AM	3b	End of swabbing & bailing	5.97	237.9	7.72	117	18.35	3.84
CdV-R-15-3	MP4A	5/8/11 12:00 PM	3b	End of swabbing & bailing	5.41	235.7	7.71	119	18.2	2.81
CdV-R-15-3	MP4A	5/11/11 12:40 PM	4	After high-velocity jetting while pumping	7.12	173.1	7.67	116	13.61	2.17
CdV-R-15-3	MP4A	5/11/11 12:57 PM	4	After high-velocity jetting while pumping	6.41	166.3	7.69	119	16.92	1.56
CdV-R-15-3	MP4A	5/11/11 1:13 PM	4	After high-velocity jetting while pumping	6.02	165.9	7.68	119	17.38	0.75
CdV-R-37-2	MP2A	8/11/10 12:41 PM	1	No-purge sample	3.93	—	6.33	122	24.2	1.92
CdV-R-37-2	MP2A	4/17/11 9:35 AM	2a	After x-flow purge when FP stable	4.37	99.3	7.54	108	15.68	—
CdV-R-37-2	MP2A	4/17/11 9:58 AM	2b	3 CV	1.71	-69.7	7.25	117	19.11	—
CdV-R-37-2	MP2A	4/17/11 10:21 AM	2c	6 CV	1.75	-90.7	7.24	118	20.71	—
CdV-R-37-2	MP2A	4/17/11 10:51 AM	2d	10 CV	2.1	-95.6	7.27	115	20.89	—
CdV-R-37-2	MP2A	4/20/11 1:16 PM	3a	Midpoint swabbing & bailing	1.64	-20.5	7.77	121	21.74	2.7
CdV-R-37-2	MP2A	4/20/11 1:40 PM	3a	Midpoint swabbing & bailing	1.85	-36.3	7.2	116	22.33	1.61
CdV-R-37-2	MP2A	4/20/11 2:05 PM	3a	Midpoint swabbing & bailing	1.85	-36.3	7.28	116	22.33	1.61
CdV-R-37-2	MP2A	4/22/11 8:18 AM	3b	End of swabbing & bailing	2.9	-20.5	7.4	120	18.27	7.55
CdV-R-37-2	MP2A	4/22/11 8:40 AM	3b	End of swabbing & bailing	4.03	-49.5	7.19	119	20.24	5.89
CdV-R-37-2	MP2A	4/22/11 8:59 AM	3b	End of swabbing & bailing	2.15	-42.5	7.22	118	20.92	3.16
CdV-R-37-2	MP2A	4/24/11 1:45 PM	4	After high-velocity jetting while pumping	1.64	99.8	7.53	118	20.13	5.03
CdV-R-37-2	MP2A	4/24/11 2:08 PM	4	After high-velocity jetting while pumping	2.44	20.6	7.22	118	21.87	1.72
CdV-R-37-2	MP2A	4/24/11 2:23 PM	4	After high-velocity jetting while pumping	2.33	19.7	7.24	116	21.81	1.46

Table 2.0-1 (continued)

Location	Port	Date and Time	Part	Event Description	Dissolved Oxygen (mg/L)	ORP (mV)	pH	Specific Conductance (µS/cm)	Temperature (°C)	Turbidity (NTU)
R-26	MP1A	8/13/10 10:51 AM	1	No-purge sample	5.88	—	8.13	98	19.77	0.54
R-26	MP1A	6/1/11 3:48 PM	2b	3 CV	7.32	192.6	8.03	98	23.41	2.3
R-26	MP1A	6/1/11 4:42 PM	2c	6 CV	7.2	204.3	8.02	96	22.61	2.1
R-26	MP1A	6/1/11 5:51 PM	2d	10 CV	7.03	212.2	8.01	94	21.92	2.1

Notes: Mean background values for intermediate groundwater: pH = 7.62; specific conductance = 137.85 µg/cm (GBIR R3). Mean background values for regional groundwater: pH = 7.83; specific conductance = 153.98 µg/cm (GBIR R3). FP = Field parameter; x-flow = cross-flow.

* — = No data.

Table 2.0-2
General Inorganic Constituents in Filtered Samples

Location	Port	Date	Time	Part	Event Description	Na (mg/L)	K (mg/L)	Ca (mg/L)	Mg (mg/L)	SO4 (mg/L)	Cl (mg/L)	F (mg/L)	NO3-N (mg/L)	ClO4 (µg/L)	SiO2 (mg/L)	TDS (mg/L)	TOC (mg/L)	ALK (mg/L as $CaCO_3$)	pH
Historical Data - for the period January 1, 2005, to August 1, 2010																			
CdV-R-15-3	MP5A				Sample Count	12	12	12	12	12	12	12	7	7	12	4	9	8	4
CdV-R-15-3	MP5A				Mean	12.06	1.65	14.79	2.11	4.39	2.33	0.46	0.07	0.05	59.99	139.00	2.80	69.66	7.28
CdV-R-15-3	MP5A				Standard Deviation	2.18	0.18	2.05	0.21	3.73	1.01	0.24	0.13	0.00	10.27	6.58	1.73	10.97	0.10
Westbay Data																			
CdV-R-15-3	MP5A	8/4/2010	9:12	1	No-purge sample	11.3	1.62	13.4	2.4	3.7	1.84	0.34	<0.25	<0.2	63.2	141	2.21	61.5	7.49
CdV-R-15-3	MP5A	5/4/2011	15:35	2a	After x-flow[a] purge when FP[b] stable	11.4	1.47	12.5	2.08	2.37	1.67	0.296	0.196	0.182	59.1	131	1.37	60.1	7.79
CdV-R-15-3	MP5A	5/4/2011	16:00	2b	3 CV	11.5	1.48	12.6	2.08	2.33	1.66	0.279	0.215	0.189	60	133	1.4	60.1	7.84
CdV-R-15-3	MP5A	5/4/2011	16:28	2c	6 CV	11.2	1.42	11.6	1.98	2.36	1.7	0.274	0.9	0.215	57.7	128	1.34	59.1	7.87
CdV-R-15-3	MP5A	5/4/2011	17:00	2d	10 CV	11.4	1.41	11.5	2.01	2.18	1.63	0.266	0.227	0.207	58.1	126	1.33	59.1	7.87
Historical Data - for the period January 1, 2005, to August 1, 2010																			
CdV-R-15-3	MP6A				Sample Count	12	12	12	12	12	12	12	9	7	12	6	11	9	6
CdV-R-15-3	MP6A				Mean	11.71	1.86	9.74	2.95	1.63	1.59	0.18	0.05	0.09	63.84	127.50	0.60	58.74	7.69
CdV-R-15-3	MP6A				Standard Deviation	0.70	0.09	0.74	0.12	0.41	0.28	0.06	0.08	0.11	10.98	13.11	0.31	2.89	0.22
Westbay Data																			
CdV-R-15-3	MP6A	8/4/2010	12:00	1	No-purge sample	12	1.91	9.93	3	1.85	1.5	0.175	0.05	<0.2	68.5	138	0.539	59.5	8.02
CdV-R-15-3	MP6A	5/3/2011	7:46	2a	After x-flow purge when FP stable	10.7	1.72	8.79	2.71	2.95	1.41	0.174	0.103	0.255	63.3	127	0.651	51.4	8.31
CdV-R-15-3	MP6A	5/3/2011	8:44	2b	3 CV	11.2	1.82	9.18	2.8	2.37	1.42	0.195	0.152	0.228	66.3	131	0.506	43.6	7.81
CdV-R-15-3	MP6A	5/3/2011	10:02	2c	6 CV	11.1	1.86	8.97	2.74	2.15	1.4	0.166	0.157	0.25	66.4	135	0.449	49.3	7.76
CdV-R-15-3	MP6A	5/3/2011	11:48	2d	10 CV	11.2	1.86	9.23	2.81	1.99	1.38	0.152	0.174	0.23	68.2	131	0.979	50.3	7.79
Historical Data - for the period January 1, 2005, to August 1, 2010																			
CdV-R-37-2	MP3A				Sample Count	13	13	13	13	13	13	13	13	8	13	10	13	13	10
CdV-R-37-2	MP3A				Mean	11.20	1.34	9.96	2.97	2.16	1.68	0.21	0.35	0.23	62.62	129.40	0.42	57.35	7.99
CdV-R-37-2	MP3A				Standard Deviation	0.28	0.07	0.26	0.09	2.07	0.19	0.07	0.07	0.08	9.80	21.58	0.12	10.48	0.18
Westbay Data																			
CdV-R-37-2	MP3A	8/10/2010	14:30	1	No-purge sample	11.6	1.49	10.4	3.16	1.68	1.88	0.236	0.374	0.297	66.4	111	<1	39.5	7.80
CdV-R-37-2	MP3A	4/12/2011	16:23	2a	After x-flow purge when FP stable	11.2	1.37	9.81	2.96	2.2166	2.958	0.3763	0.509	NM[c]	69.47	NM	<1	54.4	7.60
CdV-R-37-2	MP3A	4/12/2011	16:37	2b	3 CV	11.1	1.34	9.64	2.89	2.2148	2.8601	0.3106	0.4761	NM	69.40	NM	<1	52.9	7.44
CdV-R-37-2	MP3A	4/12/2011	16:52	2c	6 CV	10.6	1.26	9.2	2.74	2.1874	2.8534	0.2613	0.4837	NM	68.86	NM	<1	52.4	7.48
CdV-R-37-2	MP3A	4/12/2011	17:12	2d	10 CV	10.5	1.25	9.12	2.8	2.1527	2.7484	0.3001	0.479	NM	70.57	NM	<1	52.4	7.54

Table 2.0-2 (continued)

Location	Port	Date	Time	Part	Event Description	Na (mg/L)	K (mg/L)	Ca (mg/L)	Mg (mg/L)	SO4 (mg/L)	Cl (mg/L)	F (mg/L)	NO3-N (mg/L)	ClO4 (µg/L)	SiO2 (mg/L)	TDS (mg/L)	TOC (mg/L)	ALK (mg/L as $CaCO_3$)	pH
Historical Data - for the period January 1, 2005, to August 1, 2010																			
CdV-R-37-2	MP4A				Sample Count	12	12	12	12	12	12	12	9	7	12	6	10	10	7
CdV-R-37-2	MP4A				Mean	10.93	1.59	9.45	2.83	1.91	1.73	0.21	0.04	0.05	57.00	123.67	0.83	56.87	7.65
CdV-R-37-2	MP4A				Standard Deviation	0.47	0.07	0.90	0.12	0.29	0.34	0.08	0.04	0.00	9.70	9.69	0.36	8.51	0.49
Westbay Data																			
CdV-R-37-2	MP4A	8/10/2010	8:35	1	No-purge sample	11.9	1.74	11.2	2.84	1.75	1.43	0.135	0.0505	<0.2	58.1	119	1.13	57	8.62
CdV-R-37-2	MP4A	4/16/2011	13:30	2a	After x-flow purge when FP stable	10.6	1.26	9.1	2.78	1.68	1.58	0.176	0.27	0.246	65.8	121	0.411	49.3	7.64
CdV-R-37-2	MP4A	4/16/2011	13:45	2b	3 CV	10.8	1.29	9.01	2.73	1.65	1.6	0.176	0.281	0.257	65.5	126	0.419	52.4	7.59
CdV-R-37-2	MP4A	4/16/2011	14:00	2c	6 CV	10.6	1.26	8.86	2.71	1.64	1.57	0.181	0.282	0.257	64.5	122	0.367	52.4	7.6
CdV-R-37-2	MP4A	4/16/2011	14:20	2d	10 CV	10.3	1.24	8.73	2.67	1.65	1.57	0.181	0.29	0.246	63.2	121	0.398	53.4	7.62
Historical Data - for the period January 1, 2005, to August 1, 2010																			
CdV-R-15-3	MP4A				Sample Count	13	13	13	13	13	13	13	13	8	13	10	12	13	10
CdV-R-15-3	MP4A				Mean	10.05	1.45	10.18	3.29	1.52	1.34	0.14	0.20	0.25	60.36	110.80	0.58	58.17	8.27
CdV-R-15-3	MP4A				Standard Deviation	0.38	0.05	0.46	0.14	0.38	0.35	0.06	0.08	0.02	9.84	15.29	0.30	6.42	0.23
Westbay Data																			
CdV-R-15-3	MP4A	8/5/2010	10:45	1	No-purge sample	9.77	1.43	9.77	3.21	1.78	1.5	0.14	0.264	0.266	59.9	121	0.393	54.5	8.2
CdV-R-15-3	MP4A	5/5/2011	7:56	2a	After x-flow purge when FP stable	9.36	1.22	9.5	3.08	1.93	1.47	0.08	0.308	0.269	59	133	0.775	56	7.86
CdV-R-15-3	MP4A	5/5/2011	8:26	2b	3 CV	9.5	1.28	9.5	3.17	1.83	1.49	0.0793	0.287	0.259	59.8	138	0.606	55.5	7.92
CdV-R-15-3	MP4A	5/5/2011	8:56	2c	6 CV	9.34	1.24	9.25	3.09	1.85	1.49	0.0789	0.288	0.251	58	133	0.543	55.5	7.94
CdV-R-15-3	MP4A	5/5/2011	9:36	2d	10 CV	9.6	1.27	9.42	3.14	1.84	1.48	0.0832	0.266	0.276	59.4	133	0.525	54.9	7.92
CdV-R-15-3	MP4A	5/7/2011	8:34	3a	Midpoint swabbing & bailing	10.1	1.46	10.6	3.49	2.03	1.62	0.145	0.26	0.249	64.1	112	0.714	55.5	7.99
CdV-R-15-3	MP4A	5/8/2011	11:44	3b	End of swabbing & bailing	10	1.47	10.6	3.48	2.06	1.63	0.148	0.251	0.25	63.5	109	1.12	55.5	7.92
CdV-R-15-3	MP4A	5/11/2011	12:57	4	After high-velocity jetting while pumping	9.43	1.29	9.76	3.22	2	1.59	0.128	0.296	0.26	58.9	113	0.405	54.9	7.92
Historical Data - for the period January 1, 2005, to August 1, 2010																			
CdV-R-37-2	MP2A				Sample Count	12	12	12	12	12	12	12	7	7	12	4	10	8	5
CdV-R-37-2	MP2A				Mean	10.83	1.51	11.78	3.44	0.30	3.51	0.21	0.02	0.05	56.42	136.75	5.35	82.50	6.64
CdV-R-37-2	MP2A				Standard Deviation	2.63	0.44	4.50	1.33	0.14	1.39	0.06	0.01	0.00	11.69	26.99	4.41	21.44	0.43
Westbay Data																			
CdV-R-37-2	MP2A	8/11/2010	12:41	1	No-purge sample	7.52	0.984	5.78	1.93	0.473	3.12	0.207	<0.25	<0.2	66.5	126	3.02	34	6.49
CdV-R-37-2	MP2A	4/17/2011	9:35	2a	After x-flow purge when FP stable	10.1	1.12	9.58	3.02	1.83	1.62	0.17	<0.5	0.0781	58.1	122	0.986	59.1	7.29
CdV-R-37-2	MP2A	4/17/2011	9:58	2b	3 CV	10.6	1.22	9.72	3.08	1.77	1.65	0.16	<0.5	0.139	59	124	1.4	58	7.23
CdV-R-37-2	MP2A	4/17/2011	10:21	2c	6 CV	11.3	1.25	9.55	3.05	1.81	1.74	0.164	0.206	0.172	61.8	138	1.5	57	7.54
CdV-R-37-2	MP2A	4/17/2011	10:51	2d	10 CV	10.9	1.28	9.52	2.99	1.8	1.64	0.187	0.199	0.19	63.6	116	0.94	55.5	7.62
CdV-R-37-2	MP2A	4/20/2011	13:40	3a	Midpoint swabbing & bailing	11.1	1.43	9.93	3.19	1.71	1.64	0.161	0.153	0.228	64.1	117	0.866	53.9	7.58

Table 2.0-2 (continued)

Location	Port	Date	Time	Part	Event Description	Na (mg/L)	K (mg/L)	Ca (mg/L)	Mg (mg/L)	SO4 (mg/L)	Cl (mg/L)	F (mg/L)	NO3-N (mg/L)	ClO4 (µg/L)	SiO2 (mg/L)	TDS (mg/L)	TOC (mg/L)	ALK (mg/L as $CaCO_3$)	pH
CdV-R-37-2	MP2A	4/22/2011	8:40	3b	End of swabbing & bailing	10.4	1.37	9.39	2.98	1.93	1.71	0.19	0.217	0.195	60.2	116	1.12	54.9	7.48
CdV-R-37-2	MP2A	4/24/2011	14:08	4	After high-velocity jetting while pumping	10.5	1.44	9.81	3.07	1.85	1.73	0.188	0.301	0.236	60.6	116	0.84	54.4	7.61
Historical Data - for the period January 1, 2005, to August 1, 2010																			
R-26	MP1A				Sample Count	12	12	12	12	12	12	12	12	8	12	9	11	12	9
R-26	MP1A				Mean	8.49	2.19	7.41	2.91	1.13	1.12	0.14	0.34	0.23	57.08	103.89	0.41	44.17	7.78
R-26	MP1A				Standard Deviation	0.23	0.06	0.16	0.08	0.22	0.15	0.06	0.06	0.01	1.33	11.06	0.24	5.64	0.21
Westbay Data																			
R-26	MP1A	8/13/2010	10:51	1	No-purge sample	8.56	2.34	7.42	2.86	1.28	1.23	0.13	0.377	0.226	55.4	104	0.454	47.5	7.88
R-26	MP1A	6/1/2011	12:00	2a	Not collected	—[d]	—	—	—	—	—	—	—	—	—	—	—	—	—
R-26	MP1A	6/1/2011	15:48	2b	3 CV	8.32	2.27	8.13	2.9	1.41	1.33	0.149	0.407	0.262	57.9	101	NM	49.2	7.79
R-26	MP1A	6/1/2011	16:42	2c	6 CV	8.41	2.25	8.28	2.94	1.39	1.34	0.15	0.408	0.23	58.2	99	NM	49.2	7.91
R-26	MP1A	6/1/2011	17:51	2d	10 CV	8.43	2.35	8.24	2.98	1.39	1.33	0.136	0.415	0.24	59	123	NM	48.7	7.85
MDL						0.1	0.05	0.11	0.05	0.73	0.1	0.066	0.1	0.033	0.053	2.4			
Intermediate groundwater UTL						12.19	17.3	6.12	10	52	40	7.78	2.41	0.23	50.7	127			
Regional groundwater UTL						24.5	24.88	4.15	2.63	156.6	7.2	3.57	0.89	0.57	88.5	192			

Note: Data are for filtered samples only.

[a] x-flow = Cross-flow.

[b] FP = Field parameters.

[c] NM = Not measured.

[d] — =No data.

Table 2.0-3
Trace Metals in Filtered Samples

Location	Port	Date	Time	Part	Event Description	Al (µg/L)	Ba (µg/L)	Cr (µg/L)	Fe (µg/L)	Mn (µg/L)	Mo (µg/L)	Ni (µg/L)	Sr (µg/L)	U (µg/L)	V (µg/L)	Zn (µg/L)
Historical Data - for the period January 1, 2005 to August 1, 2010																
CdV-R-15-3	MP5A				Sample Count	12	12	12	12	12	12	12	12	12	12	12
CdV-R-15-3	MP5A				Mean	53.50	100.04	2.30	141.03	238.17	0.43	1.65	452.96	0.066	1.11	12.62
CdV-R-15-3	MP5A				Standard Deviation	27.60	12.44	0.70	27.06	67.67	0.49	2.33	247.29	0.004	0.34	16.94
Westbay Data																
CdV-R-15-3	MP5A	8/4/2010	9:12	1	No-purge sample	<200	82.6	<10	133	313	1.05	0.515	315	<0.2	<5	<10
CdV-R-15-3	MP5A	5/4/2011	15:35	2a	After x-flow[a] purge when FP[b] stable	<200	63.3	<10	39.1	145	2.28	0.829	401	0.849	3.49	4.46
CdV-R-15-3	MP5A	5/4/2011	16:00	2b	3 CV	<200	63.6	<10	41.8	151	2.33	0.869	401	0.907	3.64	7.21
CdV-R-15-3	MP5A	5/4/2011	16:28	2c	6 CV	<200	58.3	<10	<100	144	2.18	0.725	361	1.02	3.62	3.73
CdV-R-15-3	MP5A	5/4/2011	17:00	2d	10 CV	<200	58	<10	<100	149	2.11	0.685	352	0.991	3.96	<10
Historical Data - for the period January 1, 2005 to August 1, 2010																
CdV-R-15-3	MP6A				Sample Count	12	12	12	12	12	12	12	12	12	12	12
CdV-R-15-3	MP6A				Mean	58.39	20.65	2.09	100.22	86.18	0.80	0.74	55.31	0.214	1.83	5.97
CdV-R-15-3	MP6A				Standard Deviation	22.46	1.28	0.31	53.22	55.20	0.56	0.36	2.15	0.068	0.87	4.36
Westbay Data																
CdV-R-15-3	MP6A	8/4/2010	12:00	1	No-purge sample	<200	20.7	<10	56	53.8	1.59	0.722	57.8	0.248	<5	6.52
CdV-R-15-3	MP6A	5/3/2011	7:46	2a	After x-flow purge when FP stable	83.9	38.3	<10	<100	223	1.34	2.53	51.6	0.72	5.83	16.9
CdV-R-15-3	MP6A	5/3/2011	8:44	2b	3 CV	78.7	37.8	<10	<100	213	1.3	2.18	52	0.865	5.45	8.56
CdV-R-15-3	MP6A	5/3/2011	10:02	2c	6 CV	<200	37.8	<10	<100	207	1.22	2.13	51.7	0.801	5.78	6.9
CdV-R-15-3	MP6A	5/3/2011	11:48	2d	10 CV	92.1	38.5	<10	43	206	1.15	1.97	52.3	0.69	5.75	6.73
Historical Data - for the period January 1, 2005 to August 1, 2010																
CdV-R-37-2	MP3A				Sample Count	13	13	13	13	13	13	13	13	13	13	13
CdV-R-37-2	MP3A				Mean	74.46	10.39	2.46	34.55	2.57	1.16	0.57	55.79	0.446	9.25	4.39
CdV-R-37-2	MP3A				Standard Deviation	23.30	2.18	0.63	18.08	0.77	0.69	0.20	1.14	0.039	0.69	2.29
Westbay Data																
CdV-R-37-2	MP3A	8/10/2010	14:30	1	No-purge sample	<200	11.2	4.97	<100	<10	1.27	0.551	58.8	0.501	9.3	<10
CdV-R-37-2	MP3A	4/12/2011	16:23	2a	After x-flow purge when FP stable	<200	16.1	<10	<100	41.5	1.14	1.11	51.8	0.557	8.97	6.66
CdV-R-37-2	MP3A	4/12/2011	16:37	2b	3 CV	<200	11.6	<10	<100	8.53	1.12	0.715	50.8	0.53	8.83	<10
CdV-R-37-2	MP3A	4/12/2011	16:52	2c	6 CV	<200	9.7	<10	<100	4.19	1.07	0.559	48.8	0.495	8.51	<10
CdV-R-37-2	MP3A	4/12/2011	17:12	2d	10 CV	<200	8.83	<10	<100	2.63	1.11	1.03	48.1	0.488	8.86	<10
Historical Data - for the period January 1, 2005 to August 1, 2010																
CdV-R-37-2	MP4A				Sample Count	12	12	12	12	12	12	12	12	12	12	12
CdV-R-37-2	MP4A				Mean	69.50	12.36	1.90	682.89	30.56	1.22	0.87	43.83	0.167	2.05	5.79
CdV-R-37-2	MP4A				Standard Deviation	48.18	1.27	0.28	606.60	18.48	0.75	0.37	3.64	0.091	0.99	3.62

Table 2.0-3 (continued)

Location	Port	Date	Time	Part	Event Description	Al (µg/L)	Ba (µg/L)	Cr (µg/L)	Fe (µg/L)	Mn (µg/L)	Mo (µg/L)	Ni (µg/L)	Sr (µg/L)	U (µg/L)	V (µg/L)	Zn (µg/L)
Westbay Data																
CdV-R-37-2	MP4A	8/10/2010	8:35	1	No-purge sample	<200	11.6	3.12	<100	3.33	1.45	<2	53.3	0.325	3.72	<10
CdV-R-37-2	MP4A	4/16/2011	13:30	2a	After x-flow purge when FP stable	<200	8.37	<10	<100	<10	1.2	<2	49.4	0.454	10.6	<10
CdV-R-37-2	MP4A	4/16/2011	13:45	2b	3 CV	<200	8.28	<10	<100	<10	1.12	<2	48.9	0.454	10.5	3.66
CdV-R-37-2	MP4A	4/16/2011	14:00	2c	6 CV	<200	8.33	<10	<100	<10	1.12	0.513	48.6	0.471	11.1	<10
CdV-R-37-2	MP4A	4/16/2011	14:20	2d	10 CV	<200	7.92	<10	<100	<10	1.15	<2	47.4	0.443	9.02	<10
Historical Data - for the period January 1, 2005 to August 1, 2010																
CdV-R-15-3	MP4A				Sample Count	13	13	13	13	13	13	13	13	13	13	13
CdV-R-15-3	MP4A				Mean	74.54	22.05	2.32	30.82	2.44	0.36	0.71	54.59	0.472	5.04	3.19
CdV-R-15-3	MP4A				Standard Deviation	23.57	1.43	0.87	6.36	1.72	0.16	0.30	2.16	0.037	0.47	0.79
Westbay Data																
CdV-R-15-3	MP4A	8/5/2010	10:45	1	No-purge sample	<200	22	5.22	<100	<10	0.5	0.715	54	0.484	4.4	<10
CdV-R-15-3	MP4A	5/5/2011	7:56	2a	After x-flow purge when FP stable	<200	31.4	2.68	<100	32.4	0.582	<2	85.5	0.501	4.3	7.63
CdV-R-15-3	MP4A	5/5/2011	8:26	2b	3 CV	<200	24.9	<10	<100	7.49	0.603	<2	52.7	0.495	4.28	5.25
CdV-R-15-3	MP4A	5/5/2011	8:56	2c	6 CV	<200	22.6	<10	<100	4.49	0.611	<2	49.9	0.501	3.97	4.54
CdV-R-15-3	MP4A	5/5/2011	9:36	2d	10 CV	<200	22.3	<10	<100	3.3	0.557	0.546	50.7	0.481	4.42	5.46
CdV-R-15-3	MP4A	5/7/2011	8:34	3a	Midpoint swabbing & bailing	<200	24.5	<10	<100	2.42	0.564	0.667	55.3	0.501	4.73	7.93
CdV-R-15-3	MP4A	5/8/2011	11:44	3b	End of swabbing & bailing	<200	23.9	<10	<100	<10	0.667	0.571	54.4	0.508	4.42	4.63
CdV-R-15-3	MP4A	5/11/2011	12:57	4	After high-velocity jetting while pumping	69.6	22.6	<10	<100	2.41	<0.743	0.55	51.2	0.507	4.43	5.19
Historical Data - for the period January 1, 2005 to August 1, 2010																
CdV-R-37-2	MP2A				Sample Count	12	12	12	12	12	12	12	12	12	12	12
CdV-R-37-2	MP2A				Mean	16.52	147.54	1.83	13626.09	1608.32	12.84	18.28	74.59	0.067	1.08	11.81
CdV-R-37-2	MP2A				Standard Deviation	16.95	49.48	0.59	1442.42	490.48	3.43	8.82	34.96	0.000	0.20	9.36
Westbay Data																
CdV-R-37-2	MP2A	8/11/2010	12:41	1	No-purge sample	<200	84.7	2.95	13100	967	11.3	7.54	36	<0.2	<5	13.6
CdV-R-37-2	MP2A	4/17/2011	9:35	2a	After x-flow purge when FP stable	<200	39.1	<10	457	462	2.66	3.4	53.4	0.57	3.37	32.9
CdV-R-37-2	MP2A	4/17/2011	9:58	2b	3 CV	<200	47.5	<10	609	398	2.43	3.73	54.2	0.625	4.56	20.9
CdV-R-37-2	MP2A	4/17/2011	10:21	2c	6 CV	<200	47.6	<10	577	374	1.85	2.76	52.5	0.62	6.1	13.6
CdV-R-37-2	MP2A	4/17/2011	10:51	2d	10 CV	<200	41.1	<10	443	324	1.75	2.34	51.9	0.744	7.61	9
CdV-R-37-2	MP2A	4/20/2011	13:40	3a	Midpoint swabbing & bailing	<200	27.7	2.55	135	246	1.48	1.95	54.9	0.602	9.25	8.16
CdV-R-37-2	MP2A	4/22/2011	8:40	3b	End of swabbing & bailing	<200	36	<10	432	318	1.73	2.57	51.7	0.709	7.25	13.4
CdV-R-37-2	MP2A	4/24/2011	14:08	4	After high-velocity jetting while pumping	<200	20	<10	44	201	1.41	1.96	52.6	0.745	9.01	7.2

Table 2.0-3 (continued)

Location	Port	Date	Time	Part	Event Description	Al (µg/L)	Ba (µg/L)	Cr (µg/L)	Fe (µg/L)	Mn (µg/L)	Mo (µg/L)	Ni (µg/L)	Sr (µg/L)	U (µg/L)	V (µg/L)	Zn (µg/L)
Historical Data - for the period January 1, 2005 to August 1, 2010																
R-26	MP1A				Sample Count	12	12	12	12	12	12	12	12	12	12	12
R-26	MP1A				Mean	68.00	7.89	2.63	32.13	2.00	0.66	0.74	44.80	0.335	8.34	2.82
R-26	MP1A				Standard Deviation	0	0.38	1.34	7.36	0.21	0.36	0.51	1.10	0.014	0.60	0.71
Westbay Data																
R-26	MP1A	8/13/2010	10:51	1	No-purge sample	<200	7.96	3.9	<100	<10	1.06	<2	45.8	0.375	7.97	<10
R-26	MP1A	6/1/2011	12:00	2a	Not collected	—[c]	—	—	—	—	—	—	—	—	—	—
R-26	MP1A	6/1/2011	15:48	2b	3 CV	<200	8.94	<10	<100	5.78	0.909	<2	44.7	0.355	8.2	<10
R-26	MP1A	6/1/2011	16:42	2c	6 CV	<200	8.92	<10	<100	5.9	0.926	<2	45.2	0.344	8.67	<10
R-26	MP1A	6/1/2011	17:51	2d	10 CV	<200	8.95	<10	<100	5.41	0.92	0.69	46	0.361	9.2	<10
MDL						68	1	2	30	2	0.17	0.5	1	0.067	1	3.3
Intermediate groundwater UTL						1066	72	2.4	840	3.6	4.3	29	155	0.72	4.9	19
Regional groundwater UTL						68	57	5.75	147	124	4.4	50	540	1.9	13.4	32

Note: Data are for filtered samples only.

[a] x-flow = Cross-flow.

[b] FP = Field parameters.

[c] — = No data.

Table 2.0-4
Major Cations and Trace Metals in Unfiltered Samples

						Major Cations (Unfiltered)				Trace Metals (Unfiltered)										
Location	Port	Date	Time	Part	Event Description	Na (mg/L)	K (mg/L)	Ca (mg/L)	Mg (mg/L)	Al (µg/L)	Ba (µg/L)	Cr (µg/L)	Fe (µg/L)	Mn (µg/L)	Mo (µg/L)	Ni (µg/L)	Sr (µg/L)	U (µg/L)	V (µg/L)	Zn (µg/L)
CdV-R-15-3	MP5A	8/4/2010	9:12	1	No-purge sample	11.3	1.67	13	2.4	<200	82.1	2.67	148	306	1.21	1.39	307	<0.2	<5	7.21
CdV-R-15-3	MP5A	5/4/2011	15:35	2a	After x-flow[a] purge when FP[b] stable	11.3	1.49	12.8	2.14	409	70.6	<10	229	146	2.25	1.12	408	0.957	3.61	8.98
CdV-R-15-3	MP5A	5/4/2011	16:00	2b	3 CV	11.4	1.48	12.1	2.1	98.8	61.6	<10	73.1	147	2.14	0.822	377	0.913	3.7	4.55
CdV-R-15-3	MP5A	5/4/2011	16:28	2c	6 CV	11.2	1.43	11.6	2.01	75.1	58.6	<10	51.9	146	2.14	0.725	359	1.01	4.1	3.78
CdV-R-15-3	MP5A	5/4/2011	17:00	2d	10 CV	11.2	1.42	11.4	2.01	<200	57	<10	41.6	148	2.09	0.802	348	1.02	4.01	3.53
CdV-R-15-3	MP6A	8/4/2010	12:00	1	No-purge sample	12	1.91	10	3.09	<200	21.6	<10	77.3	57.4	1.51	1.06	58.4	0.238	<5	15.1
CdV-R-15-3	MP6A	5/3/2011	7:46	2a	After x-flow purge when FP stable	11	1.86	9.7	2.93	496	46.7	<10	351	234	1.47	3.53	54.9	1.04	6.19	29.8
CdV-R-15-3	MP6A	5/3/2011	8:44	2b	3 CV	11	1.85	9.09	2.79	147	38.8	<10	86	213	1.31	2.31	51.7	0.911	5.81	10.2
CdV-R-15-3	MP6A	5/3/2011	10:02	2c	6 CV	10.7	1.78	8.74	2.73	216	38.5	<10	84.4	202	1.2	2.03	50.4	0.8	5.58	8.06
CdV-R-15-3	MP6A	5/3/2011	11:48	2d	10 CV	10.6	1.76	8.69	2.7	154	38.1	<10	62.5	196	1.2	1.93	50.1	0.765	5.72	7.04
CdV-R-37-2	MP3A	8/10/2010	14:30	1	No-purge sample	11.6	1.53	10.4	3.16	<200	9.93	5.91	<100	<10	1.34	<2	59.2	0.523	9.45	<10

Table 2.0-4 (continued)

Location	Port	Date	Time	Part	Event Description	Major Cations (Unfiltered)				Trace Metals (Unfiltered)										
						Na (mg/L)	K (mg/L)	Ca (mg/L)	Mg (mg/L)	Al (µg/L)	Ba (µg/L)	Cr (µg/L)	Fe (µg/L)	Mn (µg/L)	Mo (µg/L)	Ni (µg/L)	Sr (µg/L)	U (µg/L)	V (µg/L)	Zn (µg/L)
CdV-R-37-2	MP3A	4/12/2011	16:23	2a	After x-flow purge when FP stable	11.2	1.31	10.1	2.97	<200	15	4.3	124	22.3	1.16	2.38	51.9	0.56	8.91	9.93
CdV-R-37-2	MP3A	4/12/2011	16:37	2b	3 CV	11.1	1.36	9.72	2.95	<200	11.5	2.05	32.9	6.91	1.1	0.96	51.3	0.509	9.07	4.45
CdV-R-37-2	MP3A	4/12/2011	16:52	2c	6 CV	10.8	1.29	9.29	2.87	<200	9.9	<10	<100	4.34	1.11	0.609	49.2	0.519	8.44	<10
CdV-R-37-2	MP3A	4/12/2011	17:12	2d	10 CV	10.5	1.22	9.54	2.76	<200	9.18	<10	<100	2.72	1.16	1.25	48.8	0.556	8.73	7.44
CdV-R-37-2	MP4A	8/10/2010	8:35	1	No-purge sample	11.6	1.74	11	2.78	<200	11	3.93	30.3	2.75	1.51	0.501	52.3	0.345	3.6	<10
CdV-R-37-2	MP4A	4/16/2011	13:30	2a	After x-flow purge when FP stable	10.5	1.25	8.94	2.73	<200	8.12	<10	<100	<10	1.2	0.667	48.2	0.476	10.9	<10
CdV-R-37-2	MP4A	4/16/2011	13:45	2b	3 CV	10.9	1.26	9.05	2.8	<200	8.51	<10	<100	<10	1.15	0.533	49.2	0.451	10.1	<10
CdV-R-37-2	MP4A	4/16/2011	14:00	2c	6 CV	10.8	1.31	9.11	2.82	<200	8.39	<10	<100	<10	1.1	0.504	49.6	0.45	9.69	<10
CdV-R-37-2	MP4A	4/16/2011	14:20	2d	10 CV	8.94	1.24	8.94	2.77	<200	8.33	<10	<100	<10	1.24	0.693	48.9	0.466	10.9	<10
CdV-R-15-3	MP4A	8/5/2010	10:45	1	No-purge sample	9.79	1.45	9.83	3.22	<200	22.4	<10	<100	<10	0.5	0.543	53.6	0.497	4.52	<10
CdV-R-15-3	MP4A	5/5/2011	7:56	2a	After x-flow purge when FP stable	9.17	1.22	9.54	3.1	196	38.7	8.93	<100	43.2	0.718	5.4	80.6	0.659	4.49	17.8
CdV-R-15-3	MP4A	5/5/2011	8:26	2b	3 CV	9.44	1.27	9.43	3.13	<200	24.5	2.03	<100	7.03	0.576	1.45	51.7	0.508	4.4	5.74
CdV-R-15-3	MP4A	5/5/2011	8:56	2c	6 CV	9.35	1.22	9.22	3.03	<200	22.6	<10	<100	3.94	0.553	0.5	49.9	0.477	4.06	5.33
CdV-R-15-3	MP4A	5/5/2011	9:36	2d	10 CV	9.57	1.27	9.445	3.17	<200	22	<10	<100	2.48	0.539	0.556	50.3	0.469	4.47	4.08
CdV-R-15-3	MP4A	5/7/2011	8:34	3a	Midpoint swabbing & bailing	10.7	1.58	12.6	3.75	127	26.9	5.28	<100	6.446	0.695	3.54	59.2	0.538	4.63	11.1
CdV-R-15-3	MP4A	5/8/2011	11:44	3b	End of swabbing & bailing	10.2	1.48	10.6	3.42	116	24.7	<10	<100	2.63	0.667	0.788	55.4	0.508	4.71	5.55
CdV-R-15-3	MP4A	5/11/2011	12:57	4	After high-velocity jetting while pumping	9.3	1.23	9.7	3.14	<200	22.2	<10	<100	2.44	0.746	0.752	50.5	0.498	4.1	5.5
CdV-R-37-2	MP2A	8/11/2010	12:41	1	No-purge sample	7.24	1.01	5.57	1.87	<200	84.4	3.49	12800	937	10.8	7.82	34.6	<0.2	<5	4.57
CdV-R-37-2	MP2A	4/17/2011	9:35	2a	After x-flow purge when FP stable	10.2	1.1	9.7	3.03	<200	44.4	<10	659	425	2.46	3.19	53.4	0.606	5.11	25.2
CdV-R-37-2	MP2A	4/17/2011	9:58	2b	3 CV	10.3	1.37	9.11	2.93	259	48.6	<10	794	381	2.28	4.51	50.7	0.693	3.93	18.4
CdV-R-37-2	MP2A	4/17/2011	10:21	2c	6 CV	11.2	1.28	9.44	2.99	86	46.6	<10	677	362	1.88	2.9	51.8	0.665	6.06	12.8
CdV-R-37-2	MP2A	4/17/2011	10:51	2d	10 CV	10.6	1.24	9.23	2.92	<200	38.1	<10	431	293	1.8	2.51	50.5	0.839	7.84	7.92
CdV-R-37-2	MP2A	4/20/2011	13:40	3a	Midpoint swabbing & bailing	11.1	1.33	10.6	3.15	<200	28.2	6.49	314	245	1.49	3.85	55.8	0.618	9.79	13.9
CdV-R-37-2	MP2A	4/22/2011	8:40	3b	End of swabbing & bailing	10	1.32	9.37	2.92	95	30.5	4.99	383	256	1.83	5.09	50.7	0.876	7.63	12.1
CdV-R-37-2	MP2A	4/24/2011	14:08	4	After high-velocity jetting while pumping	10.2	1.43	9.67	3	90.2	20.6	<10	92.1	200	1.41	2.42	51.9	0.748	9.87	7.5
R-26	MP1A	8/13/2010	10:51	1	No-purge sample	8.22	2.23	7.14	2.81	<200	9.26	5.07	<100	<10	1.23	0.859	44.7	0.4	8.19	<10
R-26	MP1A	6/1/2011	12:00	2a	Not collected	—[c]	—	—	—	—	—	—	—	—	—	—	—	—	—	—
R-26	MP1A	6/1/2011	15:48	2b	3 CV	8.3	2.33	8.18	2.89	<200	9.11	<10	58.4	6.28	0.921	0.578	45.1	0.344	8.99	<10
R-26	MP1A	6/1/2011	16:42	2c	6 CV	8.11	2.24	7.94	2.83	<200	8.85	<10	76.6	6.13	0.94	0.712	43.6	0.352	8.02	<10
R-26	MP1A	6/1/2011	17:51	2d	10 CV	8.35	2.31	8.2	2.95	<200	9.04	<10	84.6	6.08	0.941	0.727	45	0.353	8.34	<10

[a] x-flow = Cross-flow.

[b] FP = Field parameters.

[c] — = No data.

Table 2.0-5
Detected Organic Constituents

Location	Port	Date and Time	Part	Event Description	Acetone (µg/L)	Bis(2-ethylhexyl) phthalate (µg/L)	Diethylphthalate (µg/L)	Isopropylbenzene (µg/L)	Isopropyltoluene[4-] (µg/L)	Toluene (µg/L)
Historical Data										
CdV-R-15-3	MP5A			Number of detects	4	—[a]	—	—	—	—
CdV-R-15-3	MP5A			Mean Jan 1, 2005–Aug 1, 2010	8.95	—	—	—	—	—
CdV-R-15-3	MP5A			Standard deviation	5.48	—	—	—	—	—
CdV-R-15-3	MP5A			Last detected	May-07	—	—	—	—	—
Westbay Study										
CdV-R-15-3	MP5A	8/4/10 9:12 AM	1	No-purge sample	—	—	—	—	—	—[d]
CdV-R-15-3	MP5A	5/4/11 3:35 PM	2a	After x-flow[b] purge when FP[c] stable	—	—	—	—	—	4.64
CdV-R-15-3	MP5A	5/4/11 4:00 PM	2b	3 CV	—	—	—	—	—	2.57
CdV-R-15-3	MP5A	5/4/11 4:25 PM	2c	6 CV	—	—	—	—	—	3.94
CdV-R-15-3	MP5A	5/4/11 5:00 PM	2d	10 CV	—	—	—	—	—	3.02
Historical Data										
CdV-R-15-3	MP6A			Number of detects	—	—	—	—	—	—
CdV-R-15-3	MP6A			Mean Jan 1, 2005–Aug 1, 2010	—	—	—	—	—	—
CdV-R-15-3	MP6A			Standard deviation	—	—	—	—	—	—
Westbay Study										
CdV-R-15-3	MP6A	8/4/10 12:00 PM	1	No-purge sample	—	—	—[e]	—	—	—
CdV-R-15-3	MP6A	5/3/11 7:46 AM	2a	After x-flow purge when FP stable	—	—	—	—	—	1.28
CdV-R-15-3	MP6A	5/3/11 8:44 AM	2b	3 CV	—	—	—	—	—	0.88
CdV-R-15-3	MP6A	5/3/11 10:02 AM	2c	6 CV	—	—	—	—	—	0.7
CdV-R-15-3	MP6A	5/3/11 11:48 AM	2d	10 CV	—	—	—	—	—	0.54

Table 2.0-5 (continued)

Location	Port	Date and Time	Part	Event Description	Acetone (µg/L)	Bis(2-ethylhexyl) phthalate (µg/L)	Diethylphthalate (µg/L)	Isopropylbenzene (µg/L)	Isopropyltoluene[4-] (µg/L)	Toluene (µg/L)
Historical Data										
CdV-R-37-2	MP3A			Number of detects	3	1	—	—	—	—
CdV-R-37-2	MP3A			Mean Jan 1, 2005–Aug 1, 2010	1.41	0.764	—	—	—	—
CdV-R-37-2	MP3A			Standard deviation	0.14	—	—	—	—	—
CdV-R-37-2	MP3A			Last detected	May-07	May-07	—	—	—	—
Westbay Study										
CdV-R-37-2	MP3A	8/10/10 2:30 PM	1	No-purge sample	—	—	12.6	—	—	
CdV-R-37-2	MP3A	4/12/11 4:23 PM	2a	After x-flow purge when FP stable	—	—	—	—	—	3.45
CdV-R-37-2	MP3A	4/12/11 4:37 PM	2b	3 CV	—	—	—	—	—	4.21
CdV-R-37-2	MP3A	4/12/11 4:52 PM	2c	6 CV	—	—	—	—	—	4.02
CdV-R-37-2	MP3A	4/12/11 5:12 PM	2d	10 CV	—	—	4.26	—	—	4.18
Historical Data										
CdV-R-37-2	MP4A			Number of detects	—	1	—	—	—	—
CdV-R-37-2	MP4A			Mean Jan 1, 2005–Aug 1, 2010	—	2.1	—	—	—	—
CdV-R-37-2	MP4A			Standard deviation	—	—	—	—	—	—
CdV-R-37-2	MP4A			Last detected	—	Jan-06	—	—	—	—
Westbay Study										
CdV-R-37-2	MP4A	8/10/10 8:35 AM	1	No-purge sample	—	—	3.53	—	—	
CdV-R-37-2	MP4A	4/16/11 1:30 PM	2a	After x-flow purge when FP stable	—	—	—	—	—	0.5
CdV-R-37-2	MP4A	4/16/11 1:45 PM	2b	3C V	—	—	—	—	—	0.51
CdV-R-37-2	MP4A	4/16/11 2:00 PM	2c	6 CV	—	—	—	—	—	0.5
CdV-R-37-2	MP4A	4/16/11 2:20 PM	2d	10 CV	—	—	—	—	—	0.47

Table 2.0-5 (continued)

Location	Port	Date and Time	Part	Event Description	Acetone (µg/L)	Bis(2-ethylhexyl) phthalate (µg/L)	Diethylphthalate (µg/L)	Isopropylbenzene (µg/L)	Isopropyltoluene[4-] (µg/L)	Toluene (µg/L)
Historical Data										
CdV-R-15-3	MP4A			Number of detects	—	—	—	—	—	—
CdV-R-15-3	MP4A			Mean Jan 1, 2005–Aug 1, 2010	—	—	—	—	—	—
CdV-R-15-3	MP4A			Standard deviation	—	—	—	—	—	—
Westbay Study										
CdV-R-15-3	MP4A	8/5/10 10:45 AM	1	No-purge sample	—	—	—	—	—	—
CdV-R-15-3	MP4A	5/5/11 7:56 AM	2a	After x-flow purge when FP stable	—[f]	—[f]	—	—	—	17.6
CdV-R-15-3	MP4A	5/5/11 8:26 AM	2b	3 CV	—	—	—	—	—	10.7
CdV-R-15-3	MP4A	5/5/11 8:56 AM	2c	6 CV	—	—	—	—	—	10.9
CdV-R-15-3	MP4A	5/5/11 9:36 AM	2d	10 CV	—	—	—	—	—	9.54
CdV-R-15-3	MP4A	5/7/11 8:34 AM	3a	Midpoint swabbing & bailing	—	—	—	—	—	8.05
CdV-R-15-3	MP4A	5/8/11 11:44 AM	3b	End of swabbing & bailing	38	—	—	—	—	6.52
CdV-R-15-3	MP4A	5/11/11 12:57 PM	4	After high-velocity jetting while pumping	—	—	—	—	—	10.8
Historical Data										
CdV-R-37-2	MP2A			Number of detects	1	—	—	6	—	—
CdV-R-37-2	MP2A			Mean Jan 1, 2005–Aug 1, 2010	5.09	—	—	0.53	—	—
CdV-R-37-2	MP2A			Standard deviation	—	—	—	0.09	—	—
CdV-R-37-2	MP2A			Last detected	Jan-06	—	—	May-07	—	—

Table 2.0-5 (continued)

Location	Port	Date and Time	Part	Event Description	Acetone (µg/L)	Bis(2-ethylhexyl) phthalate (µg/L)	Diethylphthalate (µg/L)	Isopropylbenzene (µg/L)	Isopropyltoluene[4-] (µg/L)	Toluene (µg/L)
Westbay Study										
CdV-R-37-2	MP2A	8/11/10 12:41 PM	1	No-purge sample	—	—[g]	31.2	0.32	0.35	—
CdV-R-37-2	MP2A	4/17/11 9:35 AM	2a	After x-flow purge when FP stable	—	—	—	—	—	1.88
CdV-R-37-2	MP2A	4/17/11 9:58 AM	2b	3 CV	—	—	—	—	—	3.47
CdV-R-37-2	MP2A	4/17/11 10:21 AM	2c	6 CV	—	—	—	—	—	1.97
CdV-R-37-2	MP2A	4/17/11 10:51 AM	2d	10 CV	—	—	—	—	—	1.66
CdV-R-37-2	MP2A	4/20/11 1:40 PM	3a	Midpoint swabbing & bailing	—	—	—	—	—	6.68
CdV-R-37-2	MP2A	4/22/11 8:40 AM	3b	End of swabbing & bailing	8.97	—	—	—	—	18.7
CdV-R-37-2	MP2A	4/24/11 2:08 PM	4	After high-velocity jetting while pumping	7.7	2.95	—	—	—	6.54
Historical Data										
R-26	MP1A			Number of detects	—	—	—	—	—	—
R-26	MP1A			Mean Jan 1, 2005–Aug 1, 2010	—	—	—	—	—	—
R-26	MP1A			Standard deviation	—	—	—	—	—	—
R-26	MP1A			Last detected	—	—	—	—	—	—

Table 2.0-5 (continued)

Location	Port	Date and Time	Part	Event Description	Acetone (µg/L)	Bis(2-ethylhexyl) phthalate (µg/L)	Diethylphthalate (µg/L)	Isopropylbenzene (µg/L)	Isopropyltoluene[4-] (µg/L)	Toluene (µg/L)
Westbay Study										
R-26	MP1A	8/13/10 10:51 AM	1	No-purge sample	—	—	—	—	—	—
R-26	MP1A	6/1/11 3:48 PM	2b	3 CV	—	—	—	—	—	—
R-26	MP1A	6/1/11 4:42 PM	2c	6 CV	—	—	—	—	—	—
R-26	MP1A	6/1/11 5:51 PM	2d	10 CV	—	—	—	—	—	—

[a] — = No detections.

[b] x-flow = Cross-flow.

[c] FP = Field parameters.

[d] Toluene (0.28 µg/L) was detected in the corresponding equipment blank (EQB).

[e] Diethylphthalate (4.03 µg/L) was detected in the corresponding EQB.

[f] Acetone (5.37 µg/L) and bis(2-ethylhexyl)phthalate (3.45 µg/L) were detected in the corresponding EQB.

[g] Bis(2-ethylhexyl)phthalate (113 µg/L and 2.85 µg/L) and di-n-octylphthalate (3.45 µg/L) were detected in the corresponding EQB.

Table 2.0-6
Stable Isotopes

Location	Port	Date and Time	Part	Event Description	δ18O	δD	δ15N
CdV-R-15-3	MP5A	8/4/2010 9:12	1	No-purge sample	—[a]	—	—
CdV-R-15-3	MP5A	5/4/2011 15:35	2a	After x-flow[b] purge when FP[c] stable	-11.59	-82.69	5.43
CdV-R-15-3	MP5A	5/4/2011 16:00	2b	3 CV	-11.57	-83.58	6.21
CdV-R-15-3	MP5A	5/4/2011 16:25	2c	6 CV	-11.78	-80.81	—
CdV-R-15-3	MP5A	5/4/2011 17:00	2d	10 CV	-11.44	—	4.41
CdV-R-15-3	MP6A	8/4/10 12:00 PM	1	No-purge sample	—	—	—
CdV-R-15-3	MP6A	5/3/2011 7:46	2a	After x-flow purge when FP stable	-11.92	-82.81	7.28
CdV-R-15-3	MP6A	5/3/2011 8:44	2b	3 CV	-11.69	-83.84	5.25
CdV-R-15-3	MP6A	5/3/2011 10:02	2c	6 CV	-11.97	-83.92	5.68
CdV-R-15-3	MP6A	5/3/2011 11:48	2d	10 CV	-11.42	-80.28	5.04
CdV-R-37-2	MP3A	8/10/2010 14:30	1	No-purge sample	-11.53	-82.05	3.78
CdV-R-37-2	MP3A	4/12/2011 16:23	2a	After x-flow purge when FP stable	-11.63	-78.87	4.67
CdV-R-37-2	MP3A	4/12/2011 16:37	2b	3 CV	-11.53	-80.339	4.53
CdV-R-37-2	MP3A	4/12/2011 16:52	2c	6 CV	-11.37	-79.433	4.47
CdV-R-37-2	MP3A	4/12/2011 17:12	2d	10 CV	-11.3	-79.519	4.4
CdV-R-37-2	MP4A	8/10/2010 8:35	1	No-purge sample	-11.66	-81.84	INS
CdV-R-37-2	MP4A	4/16/2011 13:30	2a	After x-flow purge when FP stable	-11.47	-81.516	4.14
CdV-R-37-2	MP4A	4/16/2011 13:45	2b	3 CV	-11.41	-83.342	4.04
CdV-R-37-2	MP4A	4/16/2011 14:00	2c	6 CV	-11.48	-81.904	—
CdV-R-37-2	MP4A	4/16/2011 14:20	2d	10 CV	-11.63	-81.243	4.1
CdV-R-15-3	MP4A	8/5/2010 10:45	1	No-purge sample	-11.37	-82.9	3.26
CdV-R-15-3	MP4A	5/5/2011 7:56	2a	After x-flow purge when FP stable	-11.6	-84.14	5.04
CdV-R-15-3	MP4A	5/5/2011 8:26	2b	3 CV	-11.62	-81.71	4.7
CdV-R-15-3	MP4A	5/5/2011 8:56	2c	6CV	-11.66	-85.17	5.16
CdV-R-15-3	MP4A	5/5/2011 9:36	2d	10 CV	-11.74	-84.85	4.55
CdV-R-15-3	MP4A	5/7/2011 8:34	3a	Midpoint swabbing & bailing	-11.58	-81.52	5.34

Table 2.0-6 (continued)

Location	Port	Date and Time	Part	Event Description	δ18O	δD	δ15N
CdV-R-15-3	MP4A	5/8/2011 11:44	3b	End of swabbing & bailing	-11.82	-81.69	5.25
CdV-R-15-3	MP4A	5/11/2011 12:57	4	After high-velocity jetting while pumping	-11.73	-82.77	—
CdV-R-37-2	MP2A	8/11/10 12:41 PM	1	No-purge sample	—	—	—
CdV-R-37-2	MP2A	4/17/2011 9:35	2a	After x-flow purge when FP stable	-11.53	—	INS
CdV-R-37-2	MP2A	4/17/2011 9:58	2b	3 CV	-11.42	—	—
CdV-R-37-2	MP2A	4/17/2011 10:21	2c	6 CV	-11.42	—	6.89
CdV-R-37-2	MP2A	4/17/2011 10:51	2d	10 CV	-11.28	-82.4	6.16
CdV-R-37-2	MP2A	4/20/2011 13:40	3a	Midpoint swabbing & bailing	-11.36	-81.08	6.94
CdV-R-37-2	MP2A	4/22/2011 8:40	3b	End of swabbing & bailing	-11.57	-80.58	6.77
CdV-R-37-2	MP2A	4/24/2011 14:08	4	After high-velocity jetting while pumping	-11.57	-81.37	7.5
R-26	MP1A	8/13/2010 10:51	1	No-purge sample	-12.19	-82.88	3.91
R-26	MP1A	6/1/2011 12:00	2b	3 CV	—	-84.97	—
R-26	MP1A	6/1/2011 12:00	2c	6 CV	—	-84.48	—
R-26	MP1A	6/1/2011 12:00	2d	10CV	—	-83.87	—

Note: All units are permil.

[a] — = No data.

[b] x-flow = Cross-flow.

[c] FP = Field parameters.

Table 5.0-1
Summary Assessment of Westbay Screens

Well Screen & Lithology	Volume of 1 CV	Number of CV Purged before Sample Collected for Part 2a	Observations
CdV-R-15-3 Screen 5 Puye Formation	68.39	11.8	• Time-series field parameters–Stable • Purge/prepurge ❖ Major Ions: K, Ca, Mg, SO_4, Cl, F, SiO_2, TDS, TOC, ALK decreased; pH increased ❖ Trace Metals: Prepurge/purge Ba, Fe, Mn, decreased; Mo increased but remained in background; Sr increaseed then decreased; U, V, and Zn increased ❖ Organics: Toluene detected with purging • Purge/historical ❖ Major Ions: Na, K, Ca, Mg, SO_4, Cl, F, SiO_2, TDS, TOC, ALK: decreased; pH increased ❖ Trace Metals: Ba, Fe, Mn, Ni, Sr, Zn decreased; Mo increased but remained in background; U, V, and Zn increased ❖ Organics: Acetone in historical sample, not in purge; Toluene in purge sample; not in historical
CdV-R-15-3 Screen 6 Puye Formation	229.91	48	• Time-series field parameters–Turbidity started high but dropped below 5 • Purge/prepurge ❖ Major Ions: Na, K, Ca, Mg, Cl, F, SiO_2, TDS, ALK, pH decreased; SO_4 increased from no purge (Part 1) to initial purge (Part 2a) but subsequently fell again; stays within background; NO_3, ClO_4, TOC increased ❖ Trace Metals: Al, Ba, Mn, Ni, U, V, Zn increased; Fe, Mo, Sr, decreased ❖ Organics: Toluene detected at initial purge, lower concentrations than in screen 5 • Purge/historical ❖ Major Ions: Na, Ca, Mg, Cl; ALK decreased; SO_4, NO_3, ClO_4, SiO_2, TDS, pH increase ❖ Trace Metals: Al, Ba, Mn, Mo, Ni, U, V, Zn increased; Fe, Sr, decreased ❖ Organics: No toluene in historical samples

Table 5.0-1 (continued)

Well Screen & Lithology	Volume of 1 CV	Number of CV Purged before Sample Collected for Part 2a	Observations
CdV-R-37-2 Screen 3 Puye Formation	64.63 gal.	1.4 CV	• Time-series field parameters–Turbidity high to 260 gal. (>40 NTU) • Purge/prepurge ❖ Major Ions: Na, K, Ca, Mg, pH decreased; SO_4, Cl, F, NO_3, SiO_2, ALK increased ❖ Trace Metals: Cr, Mo, Sr, V decreased; Ba , Mn, U, Zn increased then decreased ❖ Organics: Toluene detected with purge; diethylphthalate, Parts 1, 2d • Purge/historical ❖ Major Ions: Cl, F, NO_3, SiO_2 increased; ALK, pH decreased; others had similar values ❖ Trace Metals: Cr, Fe, Sr, V, Zn decreased; B, Mn, Zn increased then decreased; U increased slightly ❖ Organics: Acetone and bis(2-ethylhexyl)phthalate in historical samples; none in study samples. No toluene or diethylphthalate in historical samples
CdV-R-37-2 Screen 4 Tschicoma Lavas	64.63 gal	390.8 CV	• Time-series field parameters–DO increased at end, T a little high (22°) throughout; turbidity good • Purge/prepurge ❖ Major Ions: Na, IK, Ca, Mg, SO_4, TOC, ALK, pH decreased; Cl, F, NO_3, SiO_2, TDS increased ❖ Trace Metals: Ba, Cr, Mn, Mo, Sr decreased; U, V increased ❖ Organics: Diethylphthalate in prepurge sample; none in purge samples; toluene (low) post-purge (Parts 2a-d) • Purge/historical ❖ Major Ions: Na, K, Ca, Mg, SO_4, Cl, F, TOC, ALK decreased; NO_3, ClO_4, SiO_2 increased ❖ Trace Metals: Al, Ba, Cr, Fe, Mn, Mo, Ni, Zn decreased; Sr, U, V increased ❖ Organics: bis(2-ethylhexyl)phthalate in historical samples; not detected in study samples

Table 5.0-1 (continued)

Well Screen & Lithology	Volume of 1 CV	Number of CV Purged before Sample Collected for Part 2a	Observations
CdV-R-15-3 Screen 4 Tschicoma Lavas	49.63 gal.	2.5 CV	• Time-series field parameters–DO of 3 mg/L at beginning of 10 CV purge; stabilized at 5 to 6 mg/L thereafter • Purge/prepurge ❖ Major Ions: Na, K, Ca, Mg, F decreased; SO_4, NO_3, ClO_4, TDS, TOC increased ❖ Trace Metals: Ba, Mn, Sr, U increased then decreased; Cr, Ni decreased; Mo, Zn increased ❖ Organics–none detected in prepurge; toluene beginning in Part 2a • Purge/historical ❖ Major Ions: Na, K, Ca, Mg, F, SiO2 decrease; SO_4, NO_3, TDS increased, TOC increased then decreased ❖ Trace Metals: Al, Cr, Fe, Ni, V decreased; Ba, Sr increased then decreased; Mn, Mo, Zn increased ❖ Organics: No historical detects of organics; toluene detected in Part 2a • Development/prepurge ❖ Major Ions: Na, K, Ca, Mg, SO_4, Cl, SiO_2 increased; TDS decreased; TOC increased then decreased ❖ Trace Metals: Ba, Mn, Sr, Zn increased during initial purge (Part 2a) but decreased within background ranges during subsequent purging (Parts 2b–d) ❖ Organics: Toluene concentrations detected throughout development; none in prepurge or historical samples • Development/historical ❖ Major Ions: Na, K, Ca, Mg, SiO_2, TOC increased then decreased; SO_4, Cl, F, NO_3 increased ❖ Trace Metals: Al, U, Zn increased; Ba, Mo, Sr increased then decreased; Cr, Fe, Ni, V decreased

Table 5.0-1 (continued)

Well Screen & Lithology	Volume of 1 CV	Number of CV Purged before Sample Collected for Part 2a	Observations
CdV-R-37-2 Screen 2 Tschicoma Lavas	48.30 gal.	3.9 CV	• Time-series field parameters–Temp high (22°C) Part 3a; Turb >5 Part 3b • Purge/prepurge ❖ Major Ions: Na, K, Ca, Mg, SO_4, NO_3 increased; Cl, F, ClO_4, SiO_2, TDS, TOC decreased ❖ Trace Metals: Ba, Cr, Fe, Mn, Mo, Ni, decreased; Sr, U, V increased; Zn increased then decreased ❖ Organics: Diethylphthalate, isopropylbenzene, isopropyltoluene[4-] present prepurge (Part 1); toluene (Parts 2a–4) • Purge/historical ❖ Major Ions: K, Ca, Mg, Cl, F, TDS, TOC decreased; SO_4, NO_3, ClO_4, SiO_2, pH increased ❖ Trace Metals: Al, Ba, Cr, Fe, Mn, Mo, Ni, Sr decreased; U, V increased; Zn increased then decreased ❖ Organics: Acetone and isopropylbenzene detected in historical data • Development/prepurge ❖ Major Ions: Na, K, Ca, Mg, SO_4, NO_3, ClO_4, pH increased; Cl, F, SiO_2, TDS, TOC decreased ❖ Trace Metals: Ba, Cr, Fe, Mn, Mo, Ni decreased; Sr, U, V increased ❖ Organics: Acetone (Part 3b, 4); bis(2-ethylhexyl)phthalate (Part 4); toluene present Part 4 • Development/historical ❖ Major Ions: K, Ca, Mg, Cl, TDS, TOC decreased; SO_4, NO_3, ClO_4, SiO_2, pH increased ❖ Trace Metals: Ba, Fe, Mn, Mo, Ni, Sr decreased; Cr increased then decreased; U, V increased ❖ Organics: Acetone (Parts 3b, 4) also detected in historical sample but not in prepurge; bis(2-ethylthexyl)phthalate (Part 4) not present in historical samples; toluene (Parts 2a–4) not present in historical samples

Table 5.0-1 (continued)

Well Screen & Lithology	Volume of 1 CV	Number of CV Purged before Sample Collected for Part 2a	Observations
R-26 Screen 1 Cerro Toledo Formation	72.19 gal.	178 CV	• Time-series field parameters–DO high during well development; Temp high (24°–22°C) during Part 2 • Purge/prepurge ❖ Major Ions: SO_4, Cl, SiO_2 increased; others remained similar ❖ Trace Metals: Ba, Mn, V increased; Cr decreased; others remained similar ❖ Organics: None detected • Purge/historical ❖ Major Ions: K, Ca, SO_4, Cl, F, NO_3, SiO_2 increased; others remained similar ❖ Trace Metals: Ba, Mn, Mo, V increased; Cr, Fe, Sr decreased; others remained similar ❖ Organics: None detected in historical samples

Attachment 1

Westbay Reliability Assessment Field Summary Report

Westbay Reliability Assessment
Field Summary Report

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APPENDIXES

Appendix A	Retrieval Report for Westbay System Wells R-26, CDV-R-37-2 and CDV-R-15-3, Los Alamos National Laboratory
Appendix B	Video Logs of CdV-R-15-3, CdV-R-37-2, and R-26 after Westbay Sampling System Removal (on DVDs included with this report)
Appendix C	Well Development, Specific Capacity Testing and Cross-flow Calculations

Acronyms and Abbreviations

amsl	above mean sea level
bgs	below ground surface
Consent Order	Compliance Order on Consent
DO	dissolved oxygen
FTL	field team leader
gpm	gallons per minute
HE	high explosives
hp	horsepower
I.D.	inside diameter
LANL	Los Alamos National Laboratory
NMED	New Mexico Environment Department
NTU	nephelometric turbidity unit
O.D.	outside diameter
ORP	oxidation-reduction potential
PVC	polyvinyl chloride
RPF	Records Processing Facility
SOP	standard operating procedure
SVOC	semivolatile organic compound
TA	technical area
TD	total depth
TOC	total organic carbon
VOC	volatile organic compound
WCSF	waste characterization strategy form

1.0 INTRODUCTION

This report provides a summary of field activities associated with a reliability assessment of multiscreened Westbay wells at Los Alamos National Laboratory (LANL). The report is written in accordance with the requirements in Section IV.A.3.e.iv of the March 1, 2005 (revised 2008), Compliance Order on Consent (the Consent Order). Plans for the reliability assessment were presented in the "Work Plan to Conduct Reliability Assessment of Multiscreened Westbay Wells" (LANL 2010) that was approved by the New Mexico Environment Department (NMED) on June 15, 2010 (NMED 2010).

The primary objective of the reliability assessment was to evaluate whether analytical data collected historically with Westbay low purge volume sampling systems in three multi-screened wells are comparable with analytical data collected using conventional purging and sampling techniques in those same wells.

This report summarizes the field portion of the reliability assessment and presents the field techniques used to remove the Westbay system from three wells, redevelop select screens from each well, conduct specific capacity testing, and purge/sample each screen interval. A separate data assessment report compares the analytical data from samples collected during the field work described herein with historical data from the Westbay sampling systems.

The reliability assessment focused on three wells in the Technical Area 16 (TA-16) 260 Outfall area [Solid Waste Management Unit 16-021(c)-99] that used Westbay sample systems: CdV-R-15-3, CdV-R-37-2, and R-26 (Figure 1.0-1). After well installation, these wells were configured with Westbay low-purge sampling systems to enable monitoring in multiple zones. Some screen intervals in the wells have not yielded groundwater, either because of absence of groundwater after installation or because of drilling, well construction, and/or well development problems.

Field activities for the reliability assessment of the three wells with Westbay sampling systems occurred between March 24 and June 17, 2011. The field activities performed as part of the Westbay reliability assessment included

- removal of the Westbay sampling systems
- video logging
- specific capacity testing
- high-velocity jetting
- redevelopment of select screens
- purging and sampling.

Groundwater samples collected throughout the field activities from each well were analyzed for general inorganic compounds, metals, semivolatile organic compounds (SVOCs), volatile organic compounds (VOCs) and high explosive (HE) compounds (Table 1.0-1)

Temporary packer strings were installed at wells CdV-R-15-3 and CdV-R-37-2 after the field assessments were completed. Well R-26 was converted to a single-screen well and a dedicated sampling system was installed after the field assessment.

The information presented in this report was compiled from field reports and daily activity summaries. Records are on file at the Laboratory's Records Processing Facility (RPF).

2.0 CdV-R-15-3

CdV-R-15-3 is located east of Cañon de Valle, within TA-15 of LANL. CdV-R-15-3 was installed to investigate the extent of contamination in the deep perched and regional aquifers that are associated with effluents containing high explosives (HE) that discharged from TA-16 and possibly other nearby sites (Kopp et al. 2002). The CdV-R-15-3 borehole was primarily drilled using fluid-assisted air-rotary methods. The 5-in. outside diameter (O.D.) stainless steel well was installed on May 3, 2000, to a total depth (TD) of 1674.9 ft below ground surface (bgs). The well was constructed with six 5.50-in. O.D. pipe-based 0.010-in. slot screens (Figure 2.0-1):

- Screen 1 (6.8 ft) is set from 617.7 to 624.5 ft bgs. Screen 2 (7.0 ft) was set from 800.8 to 807.8 ft bgs. Screen 3 (16.1 ft) is set from 964.8 to 980.9 ft bgs. Screens 1, 2, and 3 were set within suspected perched water zones. After well construction, screens 1 through 3 did not yield groundwater.
- Screen 4 (43.8 ft) is set from 1235.1 to 1278.9 ft bgs and spans the top of saturation in the regional aquifer.
- Screen 5 (6.9 ft) is set from 1348.4 to 1355.3 ft bgs within the middle portion of the regional aquifer.
- Screen 6 (6.9 ft) is set from 1637.9 to 1644.8 ft bgs within the deeper part of the regional aquifer. A 30.1-ft-long sump extends below the well screen.

2.1 CdV-R-15-3 Retrieval of Westbay Sampling System

The Westbay MP55 sampling system was retrieved from CdV-R-15-3 on April 1 using a Smeal pump hoist. A Schlumberger technical representative was on-site to lead the retrieval operations. All Westbay components were successfully removed from the well. The Westbay Retrieval Report is presented in Appendix A. The Retrieval Report describes field operations in detail and documents field measurements recorded in association with the retrieval process.

2.2 CdV-R-15-3 Video Logging

Following Westbay removal, a video log of the well was recorded on April 2 to document well screen and casing conditions and to confirm the composite water level in the well. LANL’s geophysical trailer and camera were used to complete video logging from the surface to the total depth of the well. The video log is in Appendix B on the DVD included with this report.

After video logging was complete, two temporary inflatable packers were set on a string of 2-in. carbon steel drop pipe and inflated to isolate screens 4, 5, and 6.

2.3 CdV-R-15-3 Specific Capacity Testing

On April 27, the temporary packer string was removed from the well and a pump and packer assembly was installed. Short-duration specific capacity testing was conducted at each productive screen interval to determine specific capacities. The specific capacity data were used to calculate cross-flow volumes between screens and to design the high-velocity jetting tool for redevelopment. The cross-flow calculations were used to determine the volume of water to be purged before sampling.

A shrouded submersible pump with inflatable packers above and below the pump was installed in the well on 2-in. carbon steel drop pipe. The packers were inflated in order to isolate screens. Transducers were placed between the packers in the pumped zone, below the bottom packer, and above the top packer. Water-level data were collected using the down-hole pressure transducers to capture the pumping and recovery response.

Specific capacity testing was performed at screen 5 first, then screen 6, and finally screen 4 (screens 1 through 3 are dry) between April 28 and April 29. A 5-horsepower (hp) pump was used for the specific capacity tests. Approximately 749.1 gal. of groundwater was purged from screen 5 at an average flow rate of approximately 5.7 gallons per minute (gpm). Approximately 781.5 gal. of groundwater was purged from screen 6 at an average flow rate of approximately 5.9 gpm. Approximately 805.5 gal. of groundwater was purged from screen 4 at an average flow rate of approximately 5.9 gpm.

Table 2.3-1 presents a summary of volumes purged during specific capacity testing. Approximately 2336.1 gal. of groundwater was purged with the submersible pump during specific capacity testing activities. No parameters were recorded during specific capacity testing. The specific capacity testing report is presented in Appendix C.

The specific capacity of screen 4 was again measured after swabbing and bailing and after jetting (see section 2.5) to assess the effectiveness of the redevelopment. Before development, the specific capacity was approximately 9.7 gpm/ft. After swabbing and bailing, the specific capacity was approximately 11.9 gpm/ft. After jetting, the specific capacity was approximately 12.2 gpm/ft.

2.4 CdV-R-15-3 Purging and Sampling Activities

After cross-flow volume calculations were performed (Appendix C), a pumping assembly was installed in the well. On April 30, the lower packer and 25 ft of discharge pipe were accidentally dropped in the well. With a 30 ft long sump, the packer/pipe did not impact purging and sampling operations so they continued. On May 5, following the sampling of screen 4, the packer and pipe were retrieved from the bottom of the well.

Each productive well screen (screens 4, 5 and 6) was purged using a pump assembly consisting of a 5-hp pump, a stainless steel pump shroud, inflatable packers above and below the shrouded pump, and stainless steel drop pipe. Purging and sampling were performed at screen 6 first, then screen 5, and finally screen 4 between May 1 and 5.

During purging, the field team leader (FTL) monitored discharge from the pump for pH, temperature, specific conductance, oxidation-reduction potential, turbidity, and dissolved oxygen using a flow-through cell and multi-parameter meter. Approximately 16,012.3 gal. of groundwater was purged with the submersible pump during purging and sampling activities. The average flow rate increased with depth, from approximately 4.9 to 8.5 gpm. Table 2.4-1 presents a summary of volumes purged during each phase of purging and sampling as well as measured and calculated water quality parameters.

Samples were collected from each screen interval (see analytical suite in Table 1.0-1) except for XRF, which was collected only during activities at screen 4. The first samples were collected after the estimated purge volume necessary to remove the calculated cross-flow volume had been removed. Three more samples were collected after an additional 3, 6, and 10 casing volumes had been purged. Table 2.4-3 presents a summary of samples collected at CdV-R-15-3. Table 2.4-4 presents a summary of quality control samples collected at CdV-R-15-3.

2.5 CdV-R-15-3 Screen 4 Redevelopment and Sampling Activities

Redevelopment was performed on screen 4 in two stages between May 5 and 11. The first stage of redevelopment was performed by swabbing and bailing. The second stage of redevelopment was performed by high-velocity jetting while pumping.

The swabbing tool employed was a 4.25-in. O.D., 1-in. thick nylon disc attached to a weighted steel rod. The wireline conveyed tool was drawn repeatedly across the screened interval causing a surging action across the screen/filter pack. A 3.0-in. O.D. by 9.0 ft long carbon steel bailer with a total capacity of 3 gal. was used to remove water from the well. Approximately 20 gal. of groundwater was removed during bailing activities.

At the midpoint and at the end of swabbing and bailing, a 5-hp submersible pump with inflatable packers located above and below the pump was installed in the well for purging and sampling. During purging, the FTL monitored discharge from the pump for pH, temperature, specific conductance, oxidation-reduction potential, turbidity, and dissolved oxygen using a flow-through cell and multi-parameter meter. Approximately 1147.5 gal. of groundwater was purged with the submersible pump during the first stage of sampling activities at an average flow rate of approximately 8.8 gpm.

High-velocity jetting while pumping was performed during the second stage of redevelopment using a 10-hp submersible pump, jetting tool, and 2-in. carbon steel drop pipe. The jetting tool, installed just above the pump discharge, directed a portion of the pump output through the screen openings to deliver energy to the filter pack and formation. The remainder of the pump output was discharged to the surface to effect net removal of water and sediment from the well during the jetting process. Approximately 3240.0 gal. of groundwater was purged with the submersible pump during the second stage of redevelopment at an average flow rate of approximately 9.0 gpm.

One sample was collected from screen 4 after high-velocity jetting and pumping were completed. This required removing the jetting/pump assembly from the well, and installing a pump assembly consisting of a 5-hp pump, a stainless steel pump shroud, inflatable packers above and below the shrouded pump, and stainless steel drop pipe. During purging, the FTL monitored discharge from the pump for pH, temperature, specific conductance, oxidation-reduction potential, turbidity, and dissolved oxygen using a flow-through cell and multi-parameter meter. Approximately 567.0 gal. of groundwater was purged with the submersible pump during the second stage of sampling activities at an average flow rate of approximately 9.0 gpm. Table 2.5-1 presents a summary of volumes purged during each phase of redevelopment and sampling as well as measured and calculated water quality parameters.

Total groundwater purged at CdV-R-15-3 during reliability assessment field activities was 23,322.9 gal.

2.6 CdV-R-15-3 Installation of Temporary Packers

On May 12, two temporary inflatable packers were installed on a string of 2-in. carbon steel drop pipe and inflated to isolate screens 4, 5 and 6 (Figure 2.6-1). The inflatable packers are configured to ensure adequate pressurization and hydraulic isolation between water bearing screen zones while the well is in this configuration. Packer pressure will be monitored to ensure continued isolation.

Temporary packers were not set to isolate screens that appeared to be nonproductive based on historical Westbay transducer records, and confirmed by video logging.

3.0 CDV-R-37-2

CdV-R-37-2 is located on the mesa top within TA-37 of LANL. CdV-R-37-2 was also installed to investigate the extent of contamination in the deep perched and regional aquifers which are associated with effluents containing HE that discharged from TA-16 and possibly other nearby sites (Kopp et al. 2003). The CdV-R-37-2 borehole was drilled primarily with fluid-assisted air-rotary methods. The 5-in. O.D. stainless steel well was installed on August 10, 2001, to a TD of 1587.3 ft bgs. The well was constructed with four 5.56-in. O.D. pipe-based 0.010-in. slot screens (Figure 3.0-1).

- Screen 1 (25.1 ft) is set from 914.4 to 939.5 ft bgs within a suspected perched water zone. After well construction, screen 1 did not yield groundwater.
- Screen 2 (25.1 ft) is set from 1188.7 to 1213.8 ft bgs at the top of the regional aquifer.
- Screen 3 (23.4 ft) is set from 1353.7 to 1377.1 ft bgs within the regional aquifer.
- Screen 4 (6.7 ft) is set from 1549.3 to 1556.0 ft bgs within the deeper part of the regional aquifer. A 31.3-ft-long sump extends below the well screen.

3.1 CdV-R-37-2 Retrieval of Westbay Sampling System

The Westbay MP55 sampling system was retrieved from CdV-R-37-2 between April 3 and 5 using a Smeal pump hoist. A Schlumberger technical representative was on-site to lead the retrieval operations. All Westbay components were successfully removed from the well. The Westbay Retrieval Report is presented in Appendix A. The Retrieval Report describes field operations in detail and documents field measurements recorded in association with the retrieval process.

3.2 CdV-R-37-2 Video Logging

Following Westbay removal, a video log of the well was recorded on April 6 to document well screen and casing conditions and to confirm the composite water level in the well. LANL's geophysical trailer and camera were used to complete video logging from the surface to the total depth of the well. The video log is in Appendix B on the DVD included with this report.

3.3 CdV-R-37-2 Specific Capacity Testing

After video logging was complete, short-duration specific capacity testing was conducted at each productive screen interval to determine specific capacities. The specific capacity data were used to calculate cross-flow volumes between screens and design the high-velocity jetting tool for redevelopment. The cross-flow calculations determined the volume of groundwater that needed to be purged before sampling.

A shrouded submersible pump with inflatable packers above and below the pump was installed in the well on 2-in. carbon steel drop pipe. The packers were inflated in order to isolate screens. Transducers were placed between the packers in the pumped zone, below the bottom packer, and above the top packer. Water-level data were collected using the down-hole pressure transducers to capture the pumping and recovery response.

Specific capacity testing was performed at screen 3 first, then screen 4, and finally screen 2 (screen 1 is dry) on April 8 and 9. A 5-hp pump was used for the specific capacity tests. Approximately 585.7 gal. of groundwater was purged from screen 3 at an average flow rate of approximately 3.8 gpm. Approximately

486.7 gal. of groundwater were purged from screen 4 at an average flow rate of approximately 3.8 gpm. Approximately 719.0 gal. of groundwater was purged from screen 2 at an average flow rate of approximately 4.0 gpm.

Table 3.3-1 presents a summary of volumes purged during specific capacity testing. Approximately 1791.4 gal. of groundwater was purged with the submersible pump during specific capacity testing activities. No parameters were recorded during specific capacity testing. The specific capacity testing report is presented in Appendix C.

The specific capacity of screen 2 was measured again after swabbing and bailing and after jetting (see section 3.5) to assess the effectiveness of the redevelopment. Before development, the specific capacity was approximately 1.4 gpm/ft. After swabbing and bailing, the specific capacity was approximately 1.5 gpm/ft. After jetting, the specific capacity was approximately 2.2 gpm/ft.

3.4 CdV-R-37-2 Purging and Sampling Activities

After cross-flow calculations were performed (Appendix C), a pumping assembly was installed in the well. Each productive well screen was purged using a pump assembly consisting of a 5-hp pump, a stainless steel pump shroud, inflatable packers above and below the shrouded pump, and stainless steel drop pipe. Purging and sampling was performed at screen 3 first, then screen 4, and finally screen 2 between April 11 and April 17.

During purging, the FTL monitored discharge from the pump for pH, temperature, specific conductance, oxidation-reduction potential, turbidity, and dissolved oxygen using a flow-through cell and multi-parameter meter. Approximately 29,717.7 gal. of groundwater was purged with the submersible pump during purging and sampling activities. The average flow rate decreased with decreasing depth from approximately 9.6 to 6.3 gpm. Table 3.4-1 presents a summary of volumes purged during each phase of purging and sampling as well as measured and calculated water quality parameters.

Samples were collected from each screen interval (see analytical suite in Table 1.0-1) except for XRF, which was collected only during activities at screen 2. The first samples were collected after the estimated purge volume necessary to remove cross-flow had been removed. Three more samples were collected after an additional 3, 6, and 10 casing volumes had been purged. Table 3.4-2 presents a summary of samples collected at CdV-R-37-2. Table 3.4-3 presents a summary of quality control samples collected during CdV-R-37-2 sampling.

3.5 CdV-R-37-2 Screen 2 Redevelopment and Sampling Activities

Redevelopment was performed on screen 2 in two stages between April 19 and 24. The first stage of redevelopment was performed by swabbing and bailing. The second stage of redevelopment was performed by high-velocity jetting while pumping.

The swabbing tool employed was a 4.25-in. O.D., 1-in. thick nylon disc attached to a weighted steel rod. The wireline conveyed tool was drawn repeatedly across the screened interval causing a surging action across the screen/filter pack. A 3.0-in. O.D. by 9.0 ft long carbon steel bailer with a total capacity of 3 gal. was used to remove water from the well. Approximately 30 gal. of groundwater was removed during bailing activities.

At the midpoint and at the end of swabbing and bailing, a 5-hp submersible pump with inflatable packers located above and below the pump was installed in the well for purging and sampling. During purging, the FTL monitored discharge from the pump for pH, temperature, specific conductance, oxidation-reduction potential, turbidity, and dissolved oxygen using a flow-through cell and multi-parameter meter. Approximately 1152.3 gal. of groundwater was purged with the submersible pump during the first stage of sampling activities at an average flow rate of approximately 5.7 gpm.

High-velocity jetting while pumping was performed using a 10-hp submersible pump, jetting tool, and 2-in. carbon steel drop pipe. The jetting tool, installed just above the pump discharge, directed a portion of the pump output through the screen openings to deliver energy to the filter pack and formation. The remainder of the pump output was discharged to the surface to effect net removal of water and sediment from the well during the jetting process. Approximately 1170.0 gal. of groundwater was purged with the submersible pump during the second stage of redevelopment at an average flow rate of approximately 6.5 gpm.

One sample was collected from screen 2 after high-velocity jetting and pumping were completed. This required removing the jetting/pump assembly from the well, and installing a pump assembly consisting of a 5-hp pump, a stainless steel pump shroud, inflatable packers above and below the shrouded pump, and stainless steel drop pipe. During purging, the FTL monitored discharge from the pump for pH, temperature, specific conductance, oxidation-reduction potential, turbidity, and dissolved oxygen using a flow-through cell and multi-parameter meter. Approximately 517.4 gal. of groundwater was purged with the submersible pump during the second stage of sampling activities at an average flow rate of approximately 6.1 gpm. Table 3.5-1 presents a summary of volumes purged during each phase of redevelopment and sampling as well as measured and calculated water quality parameters.

Total groundwater purged at CdV-R-37-2 during reliability assessment field activities was 34,378.8 gal.

3.6 CdV-R-37-2 Installation of Temporary Packers

On April 25 and 26, two temporary inflatable packers were installed on a string of 2-in. carbon steel drop pipe and inflated to isolate screens 2, 3 and 4 (Figure 3.6-1). The inflatable packers are configured to ensure adequate pressurization and hydraulic isolation between water bearing screen zones while the well is in this configuration. Packer pressure will be monitored to ensure continued isolation.

Temporary packers were not set to isolate screens that appeared to be nonproductive based on historical Westbay transducer records, and confirmed by video logging.

4.0 R-26

R-26 is located in Cañon de Valle, just east of State Highway 4. R-26 was installed at LANL to provide background water chemistry for perched and regional groundwater upgradient of TA-16 (Kleinfelder 2005). The R-26 borehole was drilled primarily with fluid-assisted air-rotary methods. The 5-in. O.D. stainless steel well was installed on October 18, 2003, to a TD of 1479.0 ft bgs with two screened intervals (Figure 4.0-1):

- The 5.53-in. O.D. pipe-based 0.010-in. slot upper screen (18.1 ft) was set from 651.8 to 669.9 ft bgs within intermediate-depth perched groundwater.
- The 5.27-in. O.D. rod-based 0.020-in. slot lower screen (23.2) is set from 1421.8 to 1445.0 ft bgs within the regional aquifer. A 34-ft-long sump extends below the well screen.

4.1 R-26 Retrieval of Westbay Sampling System

The Westbay packers in well R-26 were successfully deflated between March 24 and 28. A Schlumberger technical representative was on-site to lead the retrieval operations. Repeated attempts were made to remove the MP55 sampling system with a Smeal pump hoist, but the system was lodged downhole. Westbay personnel determined from stretch calculations that the lowermost packer was stuck and retrieval operations were halted on March 30 when the personnel were directed to begin working on CdV-R-15-3.

On April 6, a Semco pump hoist, Weatherford recovery specialist, and Weatherford fishing tools were mobilized to R-26 to remove the system. Three attempts were made to remove the system. All but the bottom 10 ft of Westbay components were successfully removed from the well on April 7 and 8. The bottom 30 ft of Westbay casing that was removed from the well was encased in bentonite drilling mud (Figures 4.1-1 and 4.1-2).

It was determined that the lower screen in well R-26 would be abandoned due to the drilling mud that had infiltrated the well screen. In addition, bentonite was observed in the pipe-based portion of the upper screen on the video log that was run after the Westbay casing had been removed. It was decided at that point that the upper screen would be redeveloped by high-velocity jetting and pumping, followed by purging and sampling.

The Westbay Retrieval Report is presented in Appendix A. The Retrieval Report describes field operations in detail and documents field measurements recorded in association with the retrieval process.

4.2 R-26 Video Logging

Following Westbay removal a video log of the well was recorded on April 15 to document the upper screen and casing conditions and to confirm the composite water level in the well. LANL's geophysical trailer and camera were used to complete video logging from the surface to 1160 ft bgs (video was terminated at this depth due to visibility constraints).

On May 28 a video log of the well was recorded to document the upper screen and casing conditions after redevelopment activities. The video log is in Appendix B on the DVD included with this report.

4.3 R-26 Screen 1 Redevelopment Activities

Redevelopment was performed on screen 1 in three stages between May 24 and 27. The first stage of redevelopment was performed by swabbing. The second stage of redevelopment was performed by high-velocity jetting while pumping. The final stage of redevelopment was performed by pumping with a submersible pump.

The swabbing tool employed was a 4.25-in. O.D., 1-in. thick nylon disc attached to a weighted steel rod. The wireline conveyed tool was drawn repeatedly across the screened interval causing a surging action across the screen/filter pack.

High-velocity jetting while pumping was performed using a 10-hp submersible pump, jetting tool, and 2-in. carbon steel drop pipe. The jetting tool, installed just above the pump discharge, directed a portion of the pump output through the screen openings to deliver energy to the filter pack and formation. The remainder of the pump output was discharged to the surface to remove water and sediment from the well during the jetting process. In addition to jetting the well screen, the well casing 40 ft above and 40 ft below the well screen were jetted. Approximately 3959.0 gal. of groundwater was purged during jetting activities at an average flow rate of approximately 10.5 gpm.

After high-velocity jetting while pumping, the jetting/pump assembly was removed from the well. A pump assembly consisting of a 5-hp pump, a stainless steel pump shroud, and stainless steel drop pipe was installed for the pumping phase of redevelopment. Approximately 4948.6 gal. of groundwater was purged with the submersible pump at an average flow rate of approximately 7.5 gpm. Table 4.3-1 presents a summary of volumes purged during jetting and pumping. No parameters were recorded during redevelopment activities.

Total groundwater purged at R-26 during redevelopment activities was 8907.6 gal.

4.4 R-26 Screen 2 Abandonment and Well Conversion

The lower screen (screen 2) was abandoned from May 28 to 31. Details of abandonment materials and depths are presented in Figure 4.4-1. All of the backfill materials were installed with a 2-in. inside diameter (I.D.) threaded/coupled steel tremie pipe (decontaminated prior to use) using a small amount of potable water to carry the material into place and prevent plugging of the tremie pipe.

Filter-grade 10/20 silica sand was used as the primary backfill material from the bottom of the sump through to above the screened interval or from 1479.0 to 1299.1 ft bgs using 18.5 ft^3 of 10/20 silica sand. Fine sand (20/40) was installed from 1299.1 to 1294.6 ft bgs using 0.5 ft^3 of 20/40 silica sand. The finer 20/40 sand served as a transition interval to keep cement from flowing into the coarser 10/20 sand.

A Type I/II/V Portland cement seal was installed above the 20/40 sand from 1294.6 to 1197.4 ft bgs using 11.2 ft^3 of neat cement. The cement was allowed to cure overnight (approximately 18 h) before proceeding with the next sand interval.

An upper sand backfill was placed above the cement seal from 1197.4 to 698.5 ft bgs using 55.5 ft^3 of 10/20 silica sand. The upper sand pack was emplaced to help isolate the cement plug. A custom-made stainless steel and Viton figure K-packer was installed on top of the sand from 698.5 to 697.0 ft bgs.

During abandonment, 2700 gal. of potable water was added during the placement of materials. This volume plus an additional 45% (3635.5 gal.) were removed on May 31 and June 1 before sampling occurred. A summary of backfill materials and calculated volumes is listed in Table 4.4-1.

4.5 R-26 Purging and Sampling Activities

On May 31, a 5-hp stainless steel shrouded pump and stainless steel drop pipe were used to purge the well with the pump shroud intake set at 694.3 ft bgs (approximately 2.7 ft above the K-packer). Approximately 1267.9 gal. of groundwater was purged with the submersible pump at an average flow rate of approximately 10.6 gpm.

On June 1, the pump shroud intake was raised approximately 20 ft to 674.1 ft bgs. The pump was then raised in 2 ft increments across the screened interval from 674.1 ft bgs to where it was landed for sampling activities at 649.0 ft bgs. Approximately 2367.6 gal. of groundwater was purged at an average flow rate of approximately 8.9 gpm, for a total purge volume of 3635.5 gal.

During purging, the FTL monitored discharge from the pump for pH, temperature, specific conductance, oxidation-reduction potential, turbidity, and dissolved oxygen using a flow-through cell and multi-parameter meter. Table 4.5-1 presents a summary of volumes purged during purging as well as measured and calculated water quality parameters.

Following purging to remove the volume of water introduced during screen 2 abandonment, samples were collected after 3, 6, and 10 casing volumes had been removed (see constituents in Table 2.4-2). Approximately 869.5 gal. of groundwater was purged at an average flow rate of approximately 4.2 gpm. During sampling, the FTL monitored discharge from the pump for pH, temperature, specific conductance, oxidation-reduction potential, turbidity, and dissolved oxygen using a flow-through cell and multi-parameter meter. Table 4.5-2 presents a summary of volumes purged during sampling as well as measured and calculated water quality parameters.

Table 4.5-3 presents a summary of samples collected after R-26 purging. Table 4.5-4 presents a summary of quality control samples collected during R-26 assessment activities.

Total groundwater purged at R-26 before and during sampling activities was 4505.0 gal.

4.6 R-26 Dedicated Sampling System Installation

The dedicated sampling system for R-26 was installed on June 17. The pumping system utilizes an environmentally retrofitted 4-in. 2-hp Grundfos submersible pump. The mid-point of the pump's intake is set near the top of the screened interval at 650.6 ft bgs. The pump column is constructed of 1 in. threaded/coupled passivated stainless-steel pipe. A weep valve was installed at the bottom of the uppermost pipe joint to protect the pump column from freezing. To measure water levels in the well, two 1-in. I.D. schedule 80 polyvinyl chloride (PVC) pipes are installed to sufficient depth to set a dedicated transducer and to provide access for manual water-level measurements. The PVC transducer tubes are equipped with 8-in. sections of 0.010-in. slot screen with a threaded end cap on the bottom of each tube. An In-Situ Level Troll 500 30-psig transducer is installed in one of the PVC tubes to monitor the water level in the well's screened interval.

Sampling system details for R-26 are presented in Figure 4.6-1.

5.0 DEVIATIONS FROM WORK PLAN

The following actions represent deviations from the "Reliability Assessment of Multiscreened Westbay Wells Work Plan" (LANL 2010).

At the request of NMED, high-velocity jetting was used during redevelopment activities at wells CdV-R-15-3 and CdV-R-37-2. Additionally, specific capacity tests were conducted at the productive screens of all three wells in order to calculate cross-flow volumes between water-bearing zones. The Work Plan specified that samples would be collected from the Westbay sampling systems at the beginning of the project; those samples were collected in August 2010. For a discussion of the resultant data, please refer to the data assessment report to which this field summary is attached.

Problems were encountered when attempting to remove the Westbay system at R-26. Bentonite encasing the lower 30 ft of the Westbay system was the cause of the problem and necessitated deviations from the Work Plan for the R-26. It was determined that the lower screen in well R-26 would have to be abandoned due to the drilling mud that had infiltrated the well screen. In addition, bentonite was observed in the pipe-based portion of the upper screen on the video log made after the Westbay casing had been removed. As a result, the upper screen was redeveloped, something that had not been included in the Work Plan.

After redevelopment of the upper screen, the lower screen in well R-26 was abandoned. A custom-made K-packer was installed below the upper screen. The upper screen was then purged and sampled. A second video log was conducted to document removal of the bentonite from the pipe-based screen slots of the upper screen. The dedicated sampling system for R-26 was installed after purging, sampling and video logging were completed, another deviation from the Work Plan.

6.0 WASTE MANAGEMENT

Fluids (purged groundwater and decontamination water) and contact waste (Westbay components, gloves, paper towels, plastic, and/or glass sample bottles) were the primary waste streams generated during Westbay reliability assessment activities. Fluids were containerized and will be sampled per the waste characterization strategy form (WCSF). Fluids are expected to be land-applied after a review of associated analytical results in accordance with the WCSF and ENV-RCRA-QP-10.1, Land Application of Groundwater. If it is determined that fluids are nonhazardous but cannot meet the criteria for land application, they will be evaluated for treatment and disposal at one of the Laboratory's wastewater treatment facilities. If analytical data indicate that the fluids are hazardous/nonradioactive or mixed low-level waste, they will be disposed of at an authorized facility.

The decontamination water, contact waste, and any other IDW will be managed in accordance with the approved WCSF.

7.0 REFERENCES AND MAP DATA SOURCES

7.1 References

Kleinfelder, January 2005. "Final Well R-26 Completion Report, Rev. 1," report prepared for Los Alamos National Laboratory, Project No. 37151, Albuquerque, New Mexico. (Kleinfelder 2005)

Kopp, B., A. Crowder, M. Everett, D. Vaniman, D. Hickmott, W. Stone, N. Clayton, S. Pearson, and D. Larssen, April 2002. "Well CdV-R-15-3 Completion Report," Los Alamos National Laboratory report LA-13906-MS, Los Alamos, New Mexico. (Kopp et al. 2002)

Kopp, B., M. Everett, J.R. Lawrence, G. WoldeGabriel, D. Vaniman, J. Heikoop, W. Stone, S. McLin, N. Clayton, and D. Larsenn, April 2003. "Well CdV-R-37-2 Completion Report," Los Alamos National Laboratory report LA-14023-MS, Los Alamos, New Mexico. (Kopp et al. 2003)

LANL (Los Alamos National Laboratory), May 2010. "Work Plan to Conduct Reliability Assessment of Multiscreened Westbay Wells," Los Alamos National Laboratory document LA-UR-10-1422, Los Alamos National Laboratory (LANL 2010)

NMED (New Mexico Environmental Department), June 15, 2010. "Approval with Modifications Work Plan to Conduct Reliability Assessment of Multiscreened Westbay Wells Los Alamos National Laboratory," New Mexico Environment Department letter to G. Rael (LANL) and M. Graham (LANL) from J.P. Bearzi (NMED-HWB), Santa Fe, New Mexico. (NMED 2010)

7.2 Map Data Sources

Point Feature Locations of the Environmental Restoration Project Database; Los Alamos National Laboratory, Waste and Environmental Services Division, EP2008-0109; 12 April 2010.

Hypsography, 100 and 20 Foot Contour Interval; Los Alamos National Laboratory, ENV Environmental Remediation and Surveillance Program; 1991.

Surface Drainages, 1991; Los Alamos National Laboratory, ENV Environmental Remediation and Surveillance Program, ER2002-0591; 1:24,000 Scale Data; Unknown publication date.

Paved Road Arcs; Los Alamos National Laboratory, KSL Site Support Services, Planning, Locating and Mapping Section; 06 January 2004; as published 28 May 2009.

Dirt Road Arcs; Los Alamos National Laboratory, KSL Site Support Services, Planning, Locating and Mapping Section; 06 January 2004; as published 28 May 2009.

Structures; Los Alamos National Laboratory, KSL Site Support Services, Planning, Locating and Mapping Section; 06 January 2004; as published 28 May 2009.

Technical Area Boundaries; Los Alamos National Laboratory, Site Planning & Project Initiation Group, Infrastructure Planning Division; 4 December 2009.

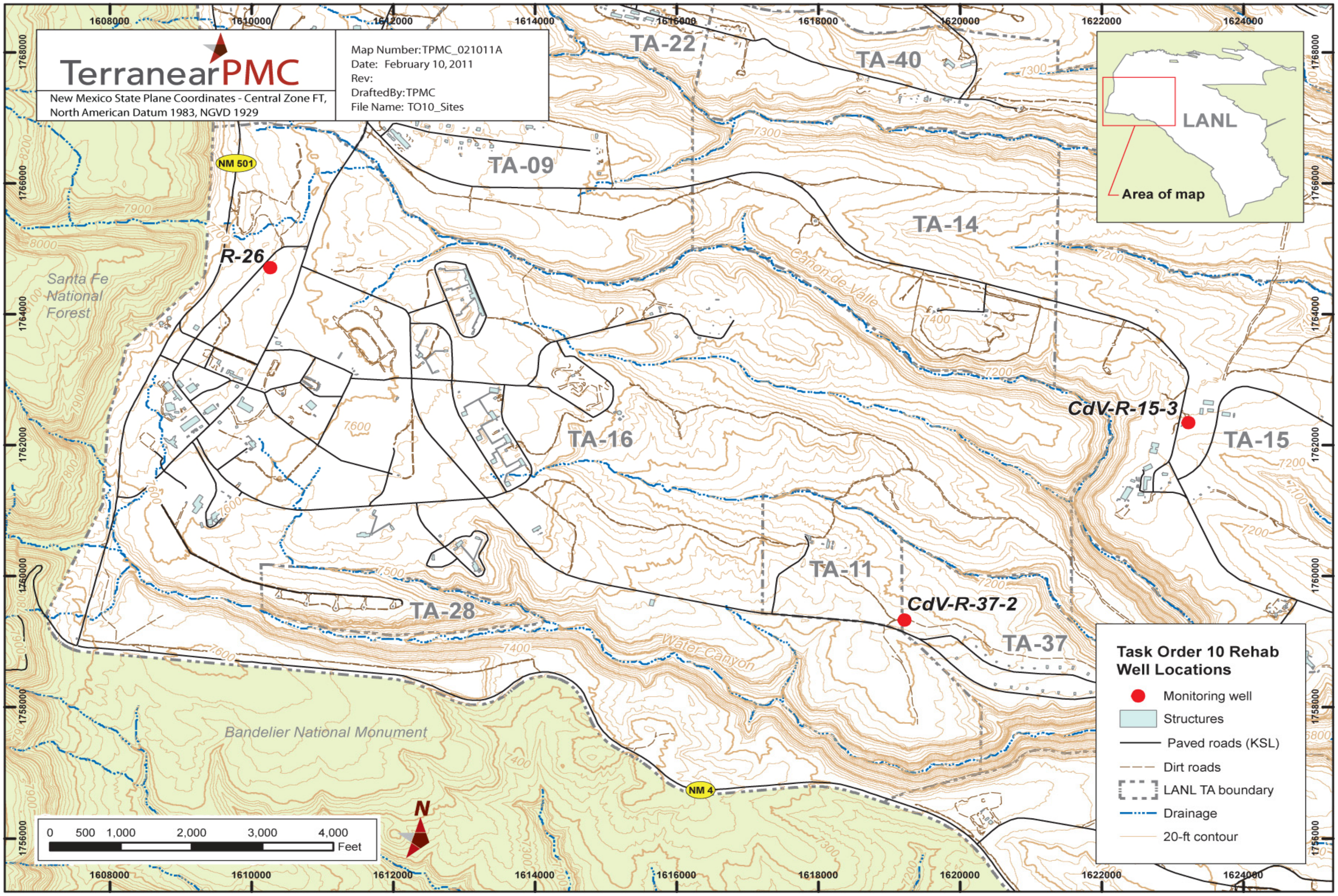
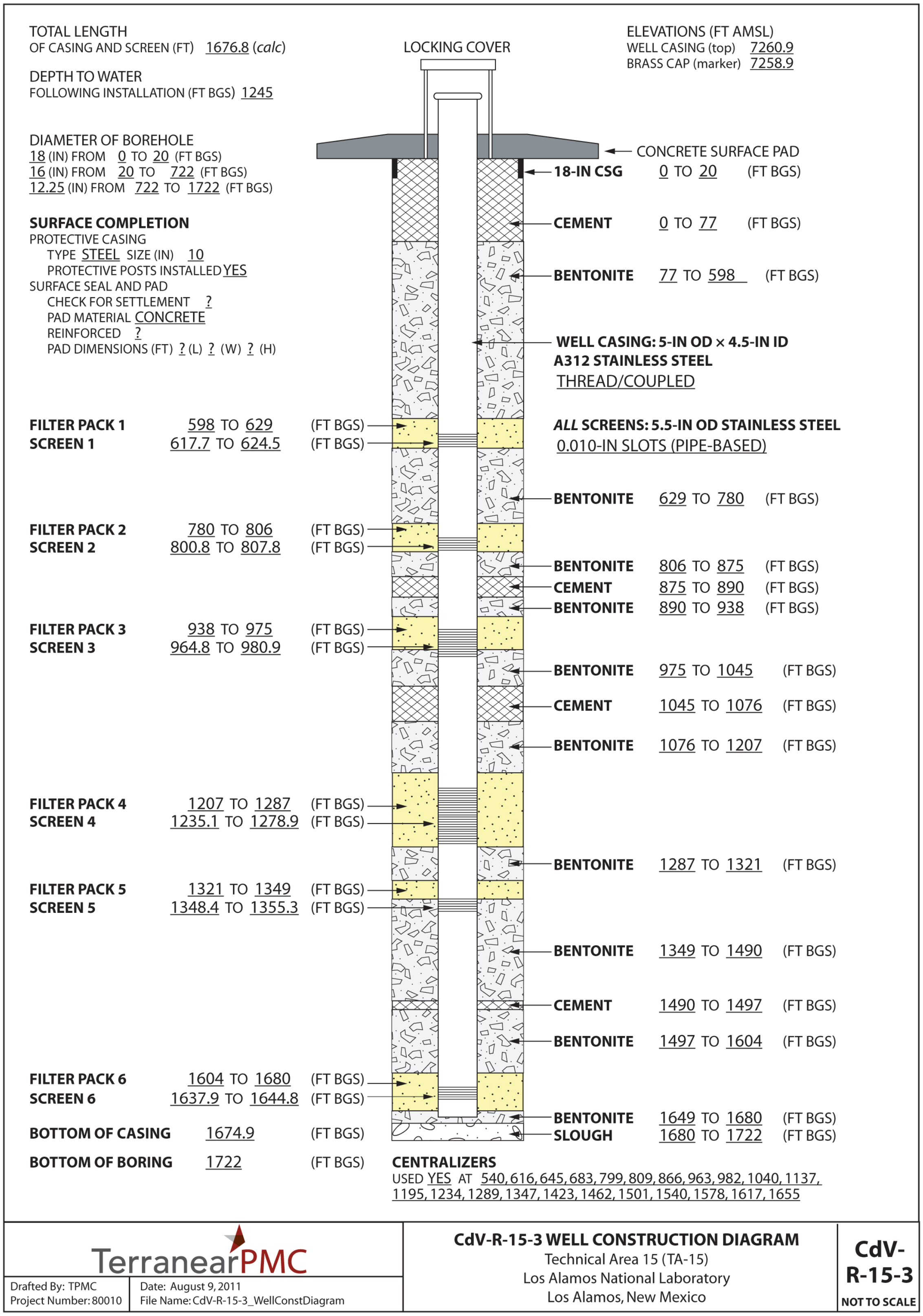


Figure 1.0-1 Westbay Reliability Assessment Well Locations R-26, CdV-R-15-3, CdV-R-37-2



TOTAL LENGTH
OF CASING AND SCREEN (FT) 1676.8 (*calc*)

DEPTH TO WATER
FOLLOWING INSTALLATION (FT BGS) 1245

DIAMETER OF BOREHOLE
18 (IN) FROM 0 TO 20 (FT BGS)
16 (IN) FROM 20 TO 722 (FT BGS)
12.25 (IN) FROM 722 TO 1722 (FT BGS)

SURFACE COMPLETION
PROTECTIVE CASING
TYPE STEEL SIZE (IN) 10
PROTECTIVE POSTS INSTALLED YES
SURFACE SEAL AND PAD
CHECK FOR SETTLEMENT ?
PAD MATERIAL CONCRETE
REINFORCED ?
PAD DIMENSIONS (FT) ? (L) ? (W) ? (H)

ELEVATIONS (FT AMSL)
WELL CASING (top) 7260.9
BRASS CAP (marker) 7258.9

18-IN CSG 0 TO 20 (FT BGS)
CEMENT 0 TO 77 (FT BGS)
BENTONITE 77 TO 598 (FT BGS)

WELL CASING: 5-IN OD × 4.5-IN ID
A312 STAINLESS STEEL
THREAD/COUPLED

***ALL* SCREENS: 5.5-IN OD STAINLESS STEEL**
0.010-IN SLOTS (PIPE-BASED)

FILTER PACK 1 598 TO 629 (FT BGS)
SCREEN 1 617.7 TO 624.5 (FT BGS)

BENTONITE 629 TO 780 (FT BGS)

FILTER PACK 2 780 TO 806 (FT BGS)
SCREEN 2 800.8 TO 807.8 (FT BGS)

BENTONITE 806 TO 875 (FT BGS)
CEMENT 875 TO 890 (FT BGS)
BENTONITE 890 TO 938 (FT BGS)

FILTER PACK 3 938 TO 975 (FT BGS)
SCREEN 3 964.8 TO 980.9 (FT BGS)

BENTONITE 975 TO 1045 (FT BGS)
CEMENT 1045 TO 1076 (FT BGS)
BENTONITE 1076 TO 1207 (FT BGS)

FILTER PACK 4 1207 TO 1287 (FT BGS)
SCREEN 4 1235.1 TO 1278.9 (FT BGS)

BENTONITE 1287 TO 1321 (FT BGS)

FILTER PACK 5 1321 TO 1349 (FT BGS)
SCREEN 5 1348.4 TO 1355.3 (FT BGS)

BENTONITE 1349 TO 1490 (FT BGS)
CEMENT 1490 TO 1497 (FT BGS)
BENTONITE 1497 TO 1604 (FT BGS)

FILTER PACK 6 1604 TO 1680 (FT BGS)
SCREEN 6 1637.9 TO 1644.8 (FT BGS)

BENTONITE 1649 TO 1680 (FT BGS)
SLOUGH 1680 TO 1722 (FT BGS)

BOTTOM OF CASING 1674.9 (FT BGS)
BOTTOM OF BORING 1722 (FT BGS)

CENTRALIZERS
USED YES AT 540, 616, 645, 683, 799, 809, 866, 963, 982, 1040, 1137, 1195, 1234, 1289, 1347, 1423, 1462, 1501, 1540, 1578, 1617, 1655

TerranearPMC
Drafted By: TPMC
Project Number: 80010
Date: August 9, 2011
File Name: CdV-R-15-3_WellConstDiagram

CdV-R-15-3 WELL CONSTRUCTION DIAGRAM
Technical Area 15 (TA-15)
Los Alamos National Laboratory
Los Alamos, New Mexico

CdV-R-15-3
NOT TO SCALE

Figure 2.0-1 Monitoring well CdV-R-15-3 as-built well construction diagram

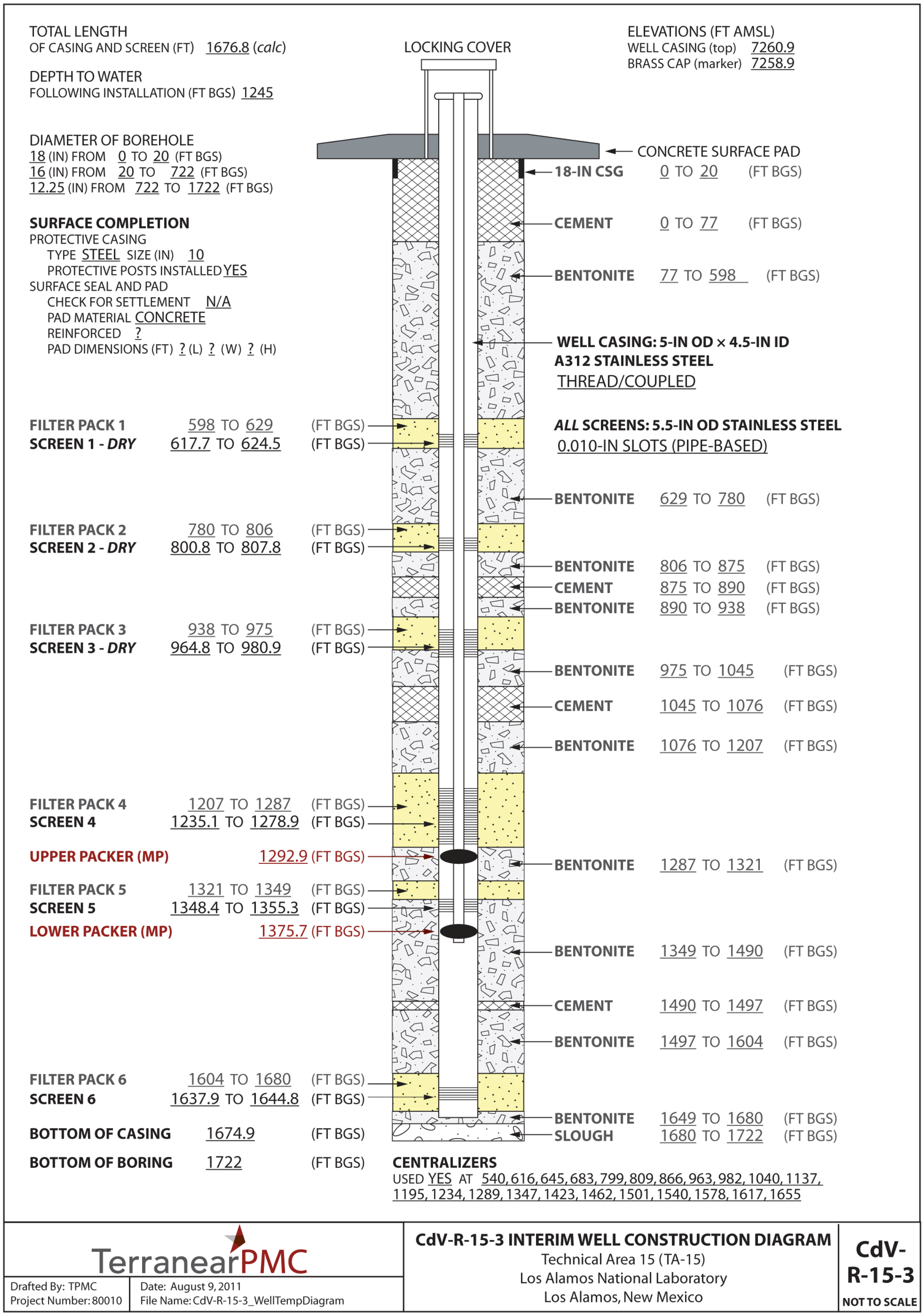


Figure 2.6-1 Monitoring well CdV-R-15-3 interim well construction diagram

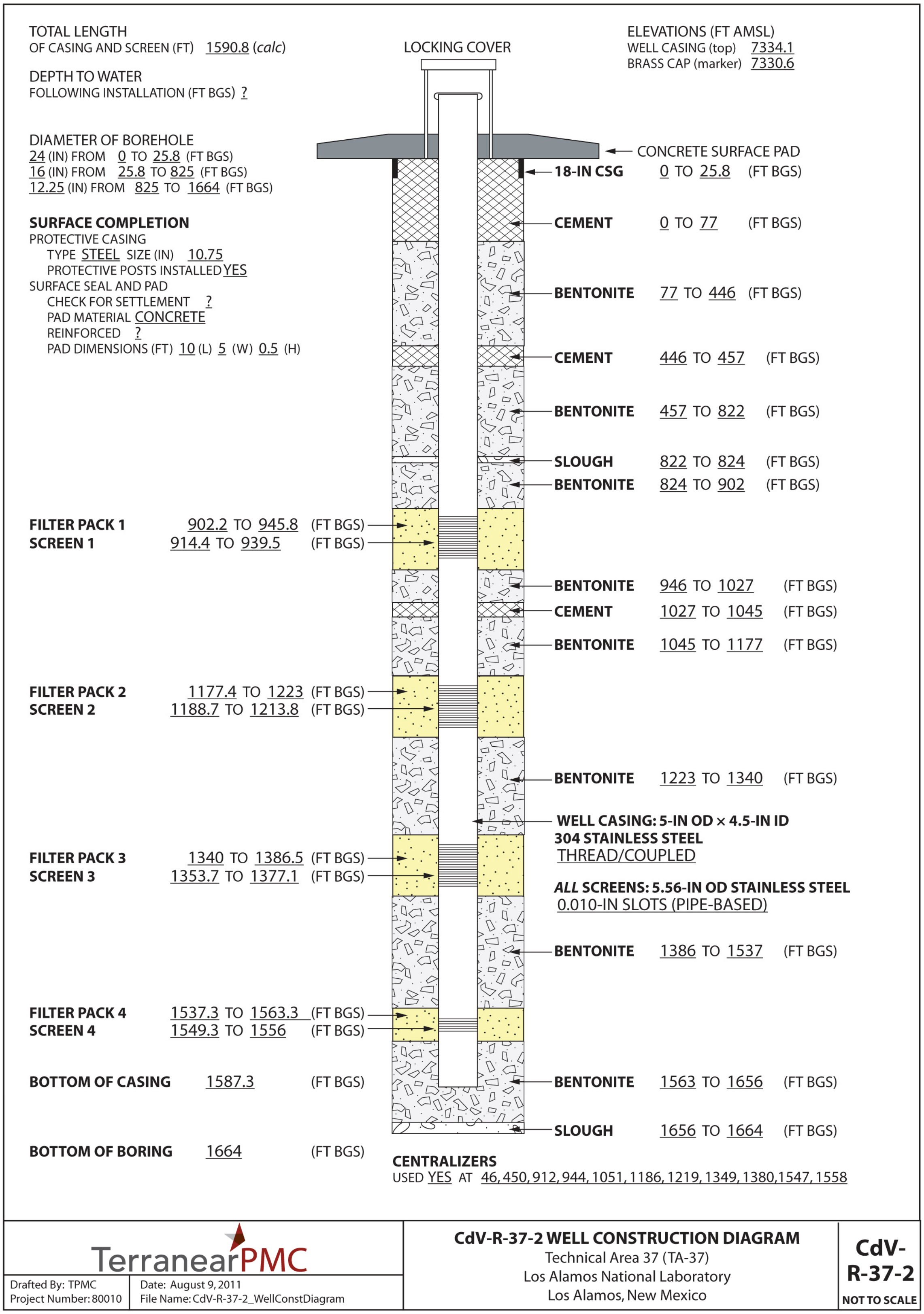
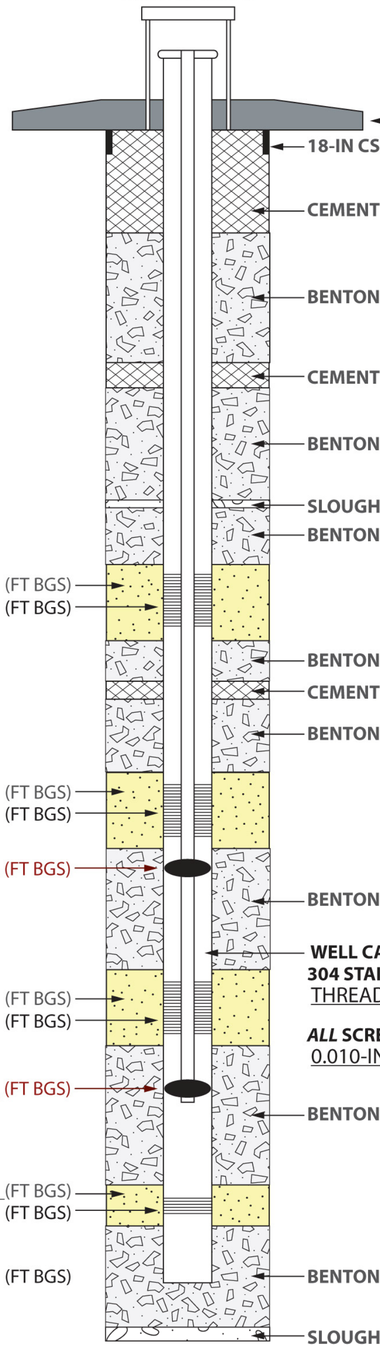


Figure 3.0-1 Monitoring well CdV-R-37-2 as-built well construction diagram



TOTAL LENGTH
OF CASING AND SCREEN (FT) 1590.8 (*calc*)

DEPTH TO WATER
FOLLOWING INSTALLATION (FT BGS) ?

DIAMETER OF BOREHOLE
24 (IN) FROM 0 TO 25.8 (FT BGS)
16 (IN) FROM 25.8 TO 825 (FT BGS)
12.25 (IN) FROM 825 TO 1664 (FT BGS)

SURFACE COMPLETION
PROTECTIVE CASING
TYPE STEEL SIZE (IN) 10.75
PROTECTIVE POSTS INSTALLED YES
SURFACE SEAL AND PAD
CHECK FOR SETTLEMENT N/A
PAD MATERIAL CONCRETE
REINFORCED ?
PAD DIMENSIONS (FT) 10 (L) 5 (W) 0.5 (H)

ELEVATIONS (FT AMSL)
WELL CASING (top) 7334.1
BRASS CAP (marker) 7330.6

CONCRETE SURFACE PAD
18-IN CSG 0 TO 25.8 (FT BGS)
CEMENT 0 TO 77 (FT BGS)
BENTONITE 77 TO 446 (FT BGS)
CEMENT 446 TO 457 (FT BGS)
BENTONITE 457 TO 822 (FT BGS)
SLOUGH 822 TO 824 (FT BGS)
BENTONITE 824 TO 902 (FT BGS)

FILTER PACK 1 902.2 TO 945.8 (FT BGS)
SCREEN 1 - *DRY* 914.4 TO 939.5 (FT BGS)

BENTONITE 946 TO 1027 (FT BGS)
CEMENT 1027 TO 1045 (FT BGS)
BENTONITE 1045 TO 1177 (FT BGS)

FILTER PACK 2 1177.4 TO 1223 (FT BGS)
SCREEN 2 1188.7 TO 1213.8 (FT BGS)

UPPER PACKER (MP) 1229.4 (FT BGS)

BENTONITE 1223 TO 1340 (FT BGS)

WELL CASING: 5-IN OD × 4.5-IN ID
304 STAINLESS STEEL
THREAD/COUPLED

FILTER PACK 3 1340 TO 1386.5 (FT BGS)
SCREEN 3 1353.7 TO 1377.1 (FT BGS)

***ALL* SCREENS: 5.56-IN OD STAINLESS STEEL**
0.010-IN SLOTS (PIPE-BASED)

LOWER PACKER (MP) 1405.5 (FT BGS)

BENTONITE 1386 TO 1537 (FT BGS)

FILTER PACK 4 1537.3 TO 1563.3 (FT BGS)
SCREEN 4 1549.3 TO 1556 (FT BGS)

BOTTOM OF CASING 1587.3 (FT BGS)

BENTONITE 1563 TO 1656 (FT BGS)
SLOUGH 1656 TO 1664 (FT BGS)

BOTTOM OF BORING 1664 (FT BGS)

CENTRALIZERS
USED YES AT 46, 450, 912, 944, 1051, 1186, 1219, 1349, 1380,1547, 1558

TerranearPMC
Drafted By: TPMC
Project Number: 80010
Date: August 9, 2011
File Name: CdV-R-37-2_WellTempDiagram

CdV-R-37-2 INTERIM WELL CONSTRUCTION DIAGRAM
Technical Area 37 (TA-37)
Los Alamos National Laboratory
Los Alamos, New Mexico

CdV-R-37-2
NOT TO SCALE

Figure 3.6-1 Monitoring well CdV-R-37-2 interim well construction diagram

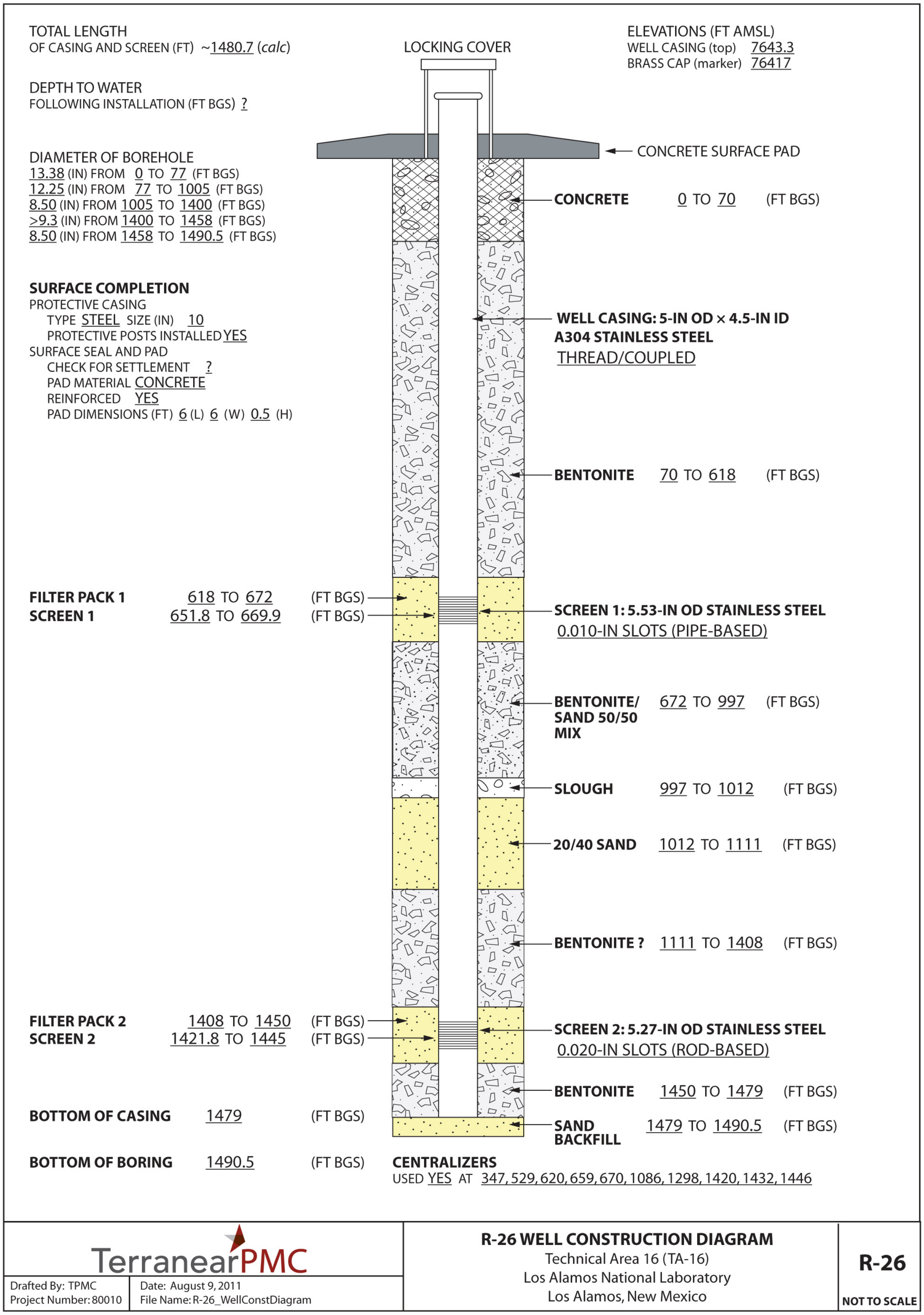


Figure 4.0-1 **Monitoring well R-26 as-built well construction diagram**

Figure 4.1-1 Photograph of Westbay sample port 2A at 1428 ft bgs encased in bentonite.

Figure 4.1-2 Photograph from approximately 1440 ft bgs showing screen 2, annular space between Westbay casing and stainless steel well casing completely occluded with bentonite.

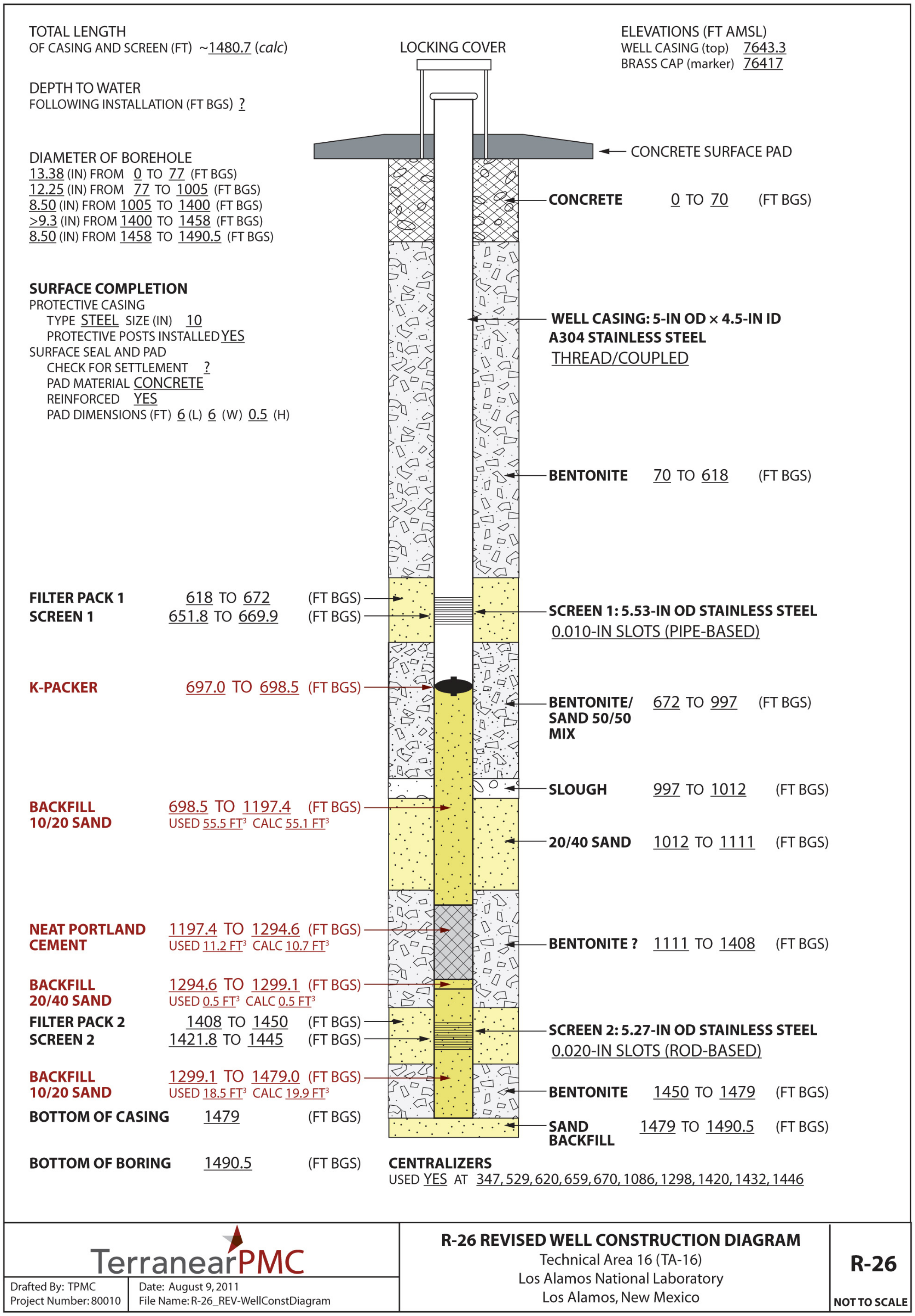
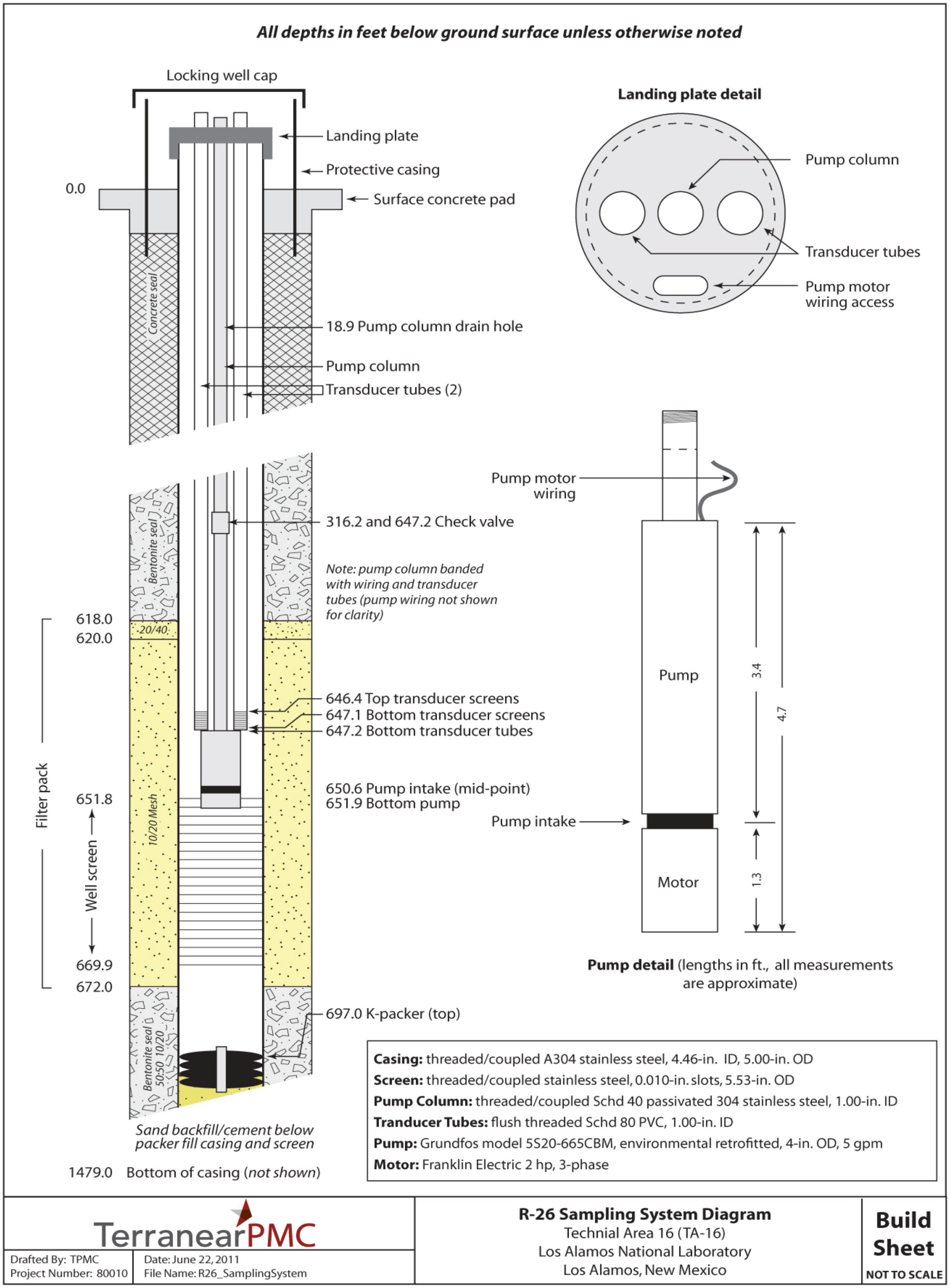


Figure 4.4-1 **Monitoring well R-26 revised well construction diagram - post Screen 2 abandonment**



Casing: threaded/coupled A304 stainless steel, 4.46-in. ID, 5.00-in. OD
Screen: threaded/coupled stainless steel, 0.010-in. slots, 5.53-in. OD
Pump Column: threaded/coupled Schd 40 passivated 304 stainless steel, 1.00-in. ID
Tranducer Tubes: flush threaded Schd 80 PVC, 1.00-in. ID
Pump: Grundfos model 5S20-665CBM, environmental retrofitted, 4-in. OD, 5 gpm
Motor: Franklin Electric 2 hp, 3-phase

TerranearPMC
Drafted By: TPMC
Project Number: 80010
Date: June 22, 2011
File Name: R26_SamplingSystem

R-26 Sampling System Diagram
Technial Area 16 (TA-16)
Los Alamos National Laboratory
Los Alamos, New Mexico

Build Sheet
NOT TO SCALE

Figure 4.6-1 Monitoring well R-26 sampling system diagram

Table 1.0-1
Analyses Conducted on Groundwater Samples

Monitoring Well	Field Parameters	General Inorganics	Metals	SVOCs	VOCs	HE	XRF
R-26 Screen 1	X	X	X	X	X	X	—[a]
CdV-R-15-3 Screen 4	X	X	X	X	X	X	X[b]
CdV-R-15-3 Screen 5	X	X	X	X	X	X	—
CdV-R-15-3 Screen 6	X	X	X	X	X	X	—
CdV-R-37-2 Screen 2	X	X	X	X	X	X	X
CdV-R-37-2 Screen 3	X	X	X	X	X	X	—
CdV-R-37-2 Screen 4	X	X	X	X	X	X	—

[a] **— =** Sample not collected.

[b] XRF analyses not conducted because solid volume was insufficient.

Table 2.3-1
CdV-R-15-3 Purge Volume during Specific Capacity Tests

Date	pH	Temp (°C)	DO (mg/L)	ORP (mV)	Eh (mV)	Specific Conductivity (mS/cm)	Turbidity (NTU)	Purge Volume between Samples (gal.)	Cumulative Purge Volume (gal.)
Screens 4, 5, and 6 Specific Capacity Tests									
4/28/11 and 4/29/11	n/r*; no parameters recorded during specific capacity testing							2336.1	2336.1

*n/r = Not recorded.

Table 2.4-1
CdV-R-15-3 Purge Volumes and Parameters Measured during Sampling

Date	pH	Temp (°C)	DO (mg/L)	ORP (mV)	Eh[a] (mV)	Specific Conductivity (mS/cm)	Turbidity (NTU)	Purge Volume between Samples (gal.)	Cumulative Purge Volume (gal.)
Screen 6 Initial Sampling									
5/1/11	n/r[b]; no parameters recorded while purging cross-flow							5476.8	5476.8
5/2/11	n/r; no parameters recorded while purging cross-flow							5254.9	10,731.7
5/3/11	7.56	17.22	2.95	217.5	426.4	0.112	3.3	391.0	11,122.7
	7.40	17.65	1.65	278.9	482.8	0.114	11.3	76.5	11,199.2
	7.36	17.81	1.26	255.4	459.3	0.115	8.0	85.0	11,284.2
	7.38	17.70	1.59	241.6	445.5	0.115	7.4	85.0	11,369.2
	7.41	17.69	1.91	236.9	440.8	0.114	6.4	85.0	11,454.2
	7.42	17.76	2.20	232.9	436.8	0.114	5.6	85.0	11,539.2
	7.45	18.17	2.41	264.1	468.0	0.114	4.7	85.0	11,624.2
	7.45	18.26	2.59	227.9	431.8	0.113	4.7	85.0	11,709.2
	7.47	18.40	2.70	227.0	430.9	0.113	4.1	85.0	11,794.2
	7.47	18.34	2.78	244.9	448.8	0.113	3.9	85.0	11,879.2
	7.48	18.05	2.59	258.3	462.2	0.114	3.3	85.0	11,964.2
	7.49	18.14	2.87	247.5	451.4	0.113	3.4	85.0	12,049.2
	7.50	18.00	2.93	245.9	449.8	0.113	3.1	170.0	12,219.2
	7.51	18.35	2.92	250.5	454.4	0.113	2.7	85.0	12,304.2
	7.50	18.35	2.92	248.3	452.2	0.113	2.7	85.0	12,389.2
	7.54	18.77	2.82	279.0	482.9	0.112	2.7	85.0	12,474.2
	7.54	19.23	2.74	257.2	461.1	0.113	2.7	170.0	12,644.2
	7.55	19.15	2.69	220.0	423.9	0.112	2.5	85.0	12,729.2
	7.54	19.12	2.97	207.3	411.2	0.113	2.4	85.0	12,814.2
	7.54	18.87	3.03	192.2	396.1	0.113	2.5	85.0	12,899.2
	7.55	19.04	3.07	188.8	392.7	0.113	2.4	85.0	12,984.2
	7.56	19.33	2.96	191.4	395.3	0.113	2.3	170.0	13,154.2
	7.56	19.23	3.17	183.4	387.3	0.112	2.4	85.0	13,239.2
	7.55	19.06	2.99	179.1	383.0	0.112	2.3	85.0	13,324.2
	n/r; no parameters recorded while purging prior to shutting off pump							212.7	13,536.9

Table 2.4-1 (continued)

Date	pH	Temp (°C)	DO (mg/L)	ORP (mV)	Eh[a] (mV)	Specific Conductivity (mS/cm)	Turbidity (NTU)	Purge Volume between Samples (gal.)	Cumulative Purge Volume (gal.)
Screen 5 Initial Sampling									
5/4/11	7.71	19.96	2.45	55.0	258.9	0.133	5.2	807.4	807.4
	7.55	19.28	2.04	24.2	228.1	0.126	4.7	73.4	880.8
	7.56	19.25	2.10	13.6	217.5	0.126	4.6	73.4	954.2
	7.54	19.12	2.13	15.4	219.3	0.124	6.7	73.4	1027.6
	7.55	19.15	2.14	18.5	222.4	0.122	6.5	73.4	1101.0
	7.59	19.58	2.14	15.0	218.9	0.124	1.7	73.4	1174.4
	7.58	19.39	2.19	11.6	215.5	0.126	3.9	73.4	1247.8
	7.58	19.70	2.22	8.7	212.6	0.123	2.3	73.4	1321.2
	7.60	19.91	2.23	16.1	220.0	0.123	1.6	73.4	1394.6
	7.59	19.60	2.27	27.8	231.7	0.123	1.6	73.4	1468.0
	7.58	19.49	2.28	23.3	227.2	0.123	1.0	73.4	1541.4
	n/r; no parameters recorded while purging prior to shutting off pump							146.8	1688.2
Screen 4 Initial Sampling									
5/5/11	7.66	14.32	3.04	150.5	359.4	0.124	3.6	123.0	123.0
	7.69	15.93	3.39	146.0	354.9	0.114	6.8	49.2	172.2
	7.70	16.75	3.91	155.9	364.8	0.114	4.5	49.2	221.4
	7.70	17.17	4.21	173.8	382.7	0.115	3.0	49.2	270.6
	7.07	17.29	4.53	187.2	396.1	0.115	1.8	49.2	319.8
	7.72	17.95	4.60	192.9	396.8	0.115	1.7	49.2	369.0
	7.73	18.09	4.79	194.4	398.3	0.115	1.0	49.2	418.2
	7.73	18.26	4.95	193.2	397.1	0.115	0.7	49.2	467.4
	7.73	18.42	5.03	184.9	388.8	0.115	0.5	98.4	565.8
	7.72	18.54	5.07	183.0	386.9	0.115	0.5	49.2	615.0
	7.72	18.65	5.13	193.2	397.1	0.116	0.5	49.2	664.2
	7.72	18.65	5.23	194.2	398.1	0.115	0.9	49.2	713.4
	n/r; no parameters recorded while purging prior to shutting off pump							73.8	787.2

[a] Eh (mV) is calculated from an Ag/AgCl saturated KCl electrode filling solution at 15ºC and 20ºC by adding temperature-sensitive correction factors of 208.9 mV and 203.9 mV, respectively, to the ORP values.

[b] n/r = Not recorded.

Table 2.4-3
Groundwater Samples Collected at CdV-R-15-3

Location ID	Sample ID	Date Collected	Collection Depth (ft bgs)
Screen 6 Initial Sampling (0 Casing Volumes Purged)			
CdV-R-15-3	CAWA-11-6870	05/03/2011	1414.2
CdV-R-15-3	CAWA-11-6871	05/03/2011	1414.2
Screen 6 Initial Sampling (3 Casing Volumes Purged)			
CdV-R-15-3	CAWA-11-6928	05/03/2011	1414.2
CdV-R-15-3	CAWA-11-6930	05/03/2011	1414.2
Screen 6 Initial Sampling (6 Casing Volumes Purged)			
CdV-R-15-3	CAWA-11-6981	05/03/2011	1414.2
CdV-R-15-3	CAWA-11-6982	05/03/2011	1414.2
Screen 6 Initial Sampling (10 Casing Volumes Purged)			
CdV-R-15-3	CAWA-11-7039	05/03/2011	1414.2
CdV-R-15-3	CAWA-11-7041	05/03/2011	1414.2
Screen 5 Initial Sampling (0 Casing Volumes Purged)			
CdV-R-15-3	CAWA-11-6861	05/04/2011	1297.4
CdV-R-15-3	CAWA-11-6862	05/04/2011	1297.4
Screen 5 Initial Sampling (3 Casing Volumes Purged)			
CdV-R-15-3	CAWA-11-6921	05/04/2011	1297.4
CdV-R-15-3	CAWA-11-6922	05/04/2011	1297.4
Screen 5 Initial Sampling (6 Casing Volumes Purged)			
CdV-R-15-3	CAWA-11-6973	05/04/2011	1297.4
CdV-R-15-3	CAWA-11-6978	05/04/2011	1297.4
Screen 5 Initial Sampling (10 Casing Volumes Purged)			
CdV-R-15-3	CAWA-11-7033	05/04/2011	1297.4
CdV-R-15-3	CAWA-11-7035	05/04/2011	1297.4
Screen 4 Initial Sampling (0 Casing Volumes Purged)			
CdV-R-15-3	CAWA-11-6854	05/05/2011	1243.8
CdV-R-15-3	CAWA-11-6855	05/05/2011	1243.8
CdV-R-15-3	CAWA-11-6860	05/05/2011	1243.8
Screen 4 Initial Sampling (3 Casing Volumes Purged)			
CdV-R-15-3	CAWA-11-6910	05/05/2011	1243.8
CdV-R-15-3	CAWA-11-6913	05/05/2011	1243.8
CdV-R-15-3	CAWA-11-6916	05/05/2011	1243.8
Screen 4 Initial Sampling (6 Casing Volumes Purged)			
CdV-R-15-3	CAWA-11-6966	05/05/2011	1243.8
CdV-R-15-3	CAWA-11-6967	05/05/2011	1243.8
CdV-R-15-3	CAWA-11-6969	05/05/2011	1243.8

Table 2.4-3 (continued)

Location ID	Sample ID	Date Collected	Collection Depth (ft bgs)
Screen 4 Initial Sampling (10 Casing Volumes Purged)			
CdV-R-15-3	CAWA-11-7022	05/05/2011	1243.8
CdV-R-15-3	CAWA-11-7026	05/05/2011	1243.8
CdV-R-15-3	CAWA-11-7028	05/05/2011	1243.8
Screen 4 Mid-point of Swabbing and Bailing			
CdV-R-15-3	CAWA-11-7247	05/07/2011	1243.8
CdV-R-15-3	CAWA-11-7248	05/07/2011	1243.8
CdV-R-15-3	CAWA-11-7249	05/07/2011	1243.8
CdV-R-15-3	CAWA-11-7252	05/07/2011	1243.8
CdV-R-15-3	CAWA-11-7253	05/07/2011	1243.8
CdV-R-15-3	CAWA-11-7265	05/07/2011	1243.8
Screen 4 Completion of Swabbing and Bailing			
CdV-R-15-3	CAWA-11-7326	05/08/2011	1243.8
CdV-R-15-3	CAWA-11-7327	05/08/2011	1243.8
CdV-R-15-3	CAWA-11-7328	05/08/2011	1243.8
CdV-R-15-3	CAWA-11-7329	05/08/2011	1243.8
CdV-R-15-3	CAWA-11-7330	05/08/2011	1243.8
CdV-R-15-3	CAWA-11-7331	05/08/2011	1243.8
Screen 4 Completion of High Velocity Jetting			
CdV-R-15-3	CAWA-11-7351	05/11/2011	1243.8
CdV-R-15-3	CAWA-11-7352	05/11/2011	1243.8
CdV-R-15-3	CAWA-11-7353	05/11/2011	1243.8
CdV-R-15-3	CAWA-11-7354	05/11/2011	1243.8
CdV-R-15-3	CAWA-11-7361	05/11/2011	1243.8
CdV-R-15-3	CAWA-11-7364	05/11/2011	1243.8

Table 2.4-4
Quality Control Samples Collected at CdV-R-15-3

Location ID	Sample ID*	Date Collected	Sample Type
CdV-R-15-3	CAWA-11-6872	05/03/2011	Field Trip Blank
CdV-R-15-3	CAWA-11-6927	05/03/2011	Field Trip Blank
CdV-R-15-3	CAWA-11-6983	05/03/2011	Field Trip Blank
CdV-R-15-3	CAWA-11-7038	05/03/2011	Field Trip Blank
CdV-R-15-3	CAWA-11-6866	05/04/2011	Field Trip Blank
CdV-R-15-3	CAWA-11-6920	05/04/2011	Field Trip Blank
CdV-R-15-3	CAWA-11-6979	05/04/2011	Field Trip Blank
CdV-R-15-3	CAWA-11-7029	05/04/2011	Field Trip Blank
CdV-R-15-3	CAWA-11-6859	05/05/2011	Field Trip Blank
CdV-R-15-3	CAWA-11-6914	05/05/2011	Field Trip Blank
CdV-R-15-3	CAWA-11-6970	05/05/2011	Field Trip Blank
CdV-R-15-3	CAWA-11-7027	05/05/2011	Field Trip Blank
CdV-R-15-3	CAWA-11-7074	05/05/2011	Equipment Blank
CdV-R-15-3	CAWA-11-7075	05/05/2011	Equipment Blank
CdV-R-15-3	CAWA-11-7076	05/05/2011	Equipment Blank
CdV-R-15-3	CAWA-11-7077	05/05/2011	Equipment Blank
CdV-R-15-3	CAWA-11-7078	05/05/2011	Equipment Blank
CdV-R-15-3	CAWA-11-7254	05/07/2011	Field Trip Blank
CdV-R-15-3	CAWA-11-7316	05/08/2011	Field Trip Blank
CdV-R-15-3	CAWA-11-7363	05/11/2011	Field Trip Blank

*Samples were analyzed for SVOCs and VOCs.

Table 2.5-1
CdV-R-15-3 Purge Volumes and Parameters Measured during Redevelopment

Date	pH	Temp (°C)	DO (mg/L)	ORP (mV)	Eh[a] (mV)	Specific Conductivity (mS/cm)	Turbidity (NTU)	Purge Volume between Samples (gal.)	Cumulative Purge Volume (gal.)
Screen 4 Bailing Sump after Swabbing									
5/5/11	n/r[b]; no parameters recorded while bailing							10.0	10.0
5/6/11	n/r; no parameters recorded while bailing							5.0	15.0
Screen 4 Mid-point of Swabbing and Bailing									
5/7/11	7.63	16.95	6.45	153.5	362.4	0.116	4.4	87.6	102.6
	7.66	17.50	6.51	146.0	349.9	0.117	3.6	87.6	190.2
	7.64	17.56	6.01	146.2	350.1	0.118	2.1	87.6	277.8
	7.68	17.67	6.34	140.7	344.6	0.118	1.6	43.8	321.6
	n/r; no parameters recorded while purging prior to shutting off pump							262.9	584.5
Screen 4 Swabbing and Bailing									
5/7/11	n/r; no parameters recorded while bailing							5.0	589.5
Screen 4 Completion of Swabbing and Bailing									
5/8/11	8.23	19.99	6.86	334.7	538.6	0.132	21.3	8.8	598.3
	7.75	17.46	5.97	248.0	456.9	0.117	5.3	87.6	685.9
	7.72	18.35	5.97	237.9	441.8	0.117	3.8	87.6	773.5
	7.71	18.20	5.41	235.7	439.6	0.119	2.8	131.4	904.9
	n/r; no parameters recorded while purging prior to shutting off pump							262.6	1167.5
Screen 4 High-velocity Jetting									
5/9/11 and 5/10/11	n/r; no parameters recorded while jetting							3240.0	4407.5
Screen 4 Completion of High-velocity Jetting									
5/11/11	7.67	13.61	7.12	173.1	382.0	0.116	2.2	27.0	4434.5
	7.69	16.75	6.85	166.3	375.2	0.117	1.6	90.0	4524.5
	7.69	16.92	6.41	166.5	375.4	0.119	0.9	90.0	4614.5
	7.68	17.38	6.02	165.9	374.8	0.119	0.8	90.0	4704.5
	7.68	17.18	5.74	162.4	371.3	0.119	1.2	90.0	4794.5
	n/r; no parameters recorded while purging prior to shutting off pump							180.0	4974.5

[a] Eh (mV) is calculated from an Ag/AgCl saturated KCl electrode filling solution at 15ºC and 20ºC by adding temperature-sensitive correction factors of 208.9 mV and 203.9 mV, respectively, to the ORP values.

[b] n/r = Not recorded.

Table 3.3-1
CdV-R-37-2 Purge Volume during Specific Capacity Testing

Date	pH	Temp (°C)	DO (mg/L)	ORP (mV)	Eh (mV)	Specific Conductivity (mS/cm)	Turbidity (NTU)	Purge Volume between Samples (gal.)	Cumulative Purge Volume (gal.)
Screens 2, 3, and 4 Specific Capacity Testing									
4/8/11 and 4/9/11	n/r*; no parameters recorded during specific capacity testing							1791.4	1791.4

*n/r = Not recorded.

Table 3.4-1
CdV-R-37-2 Purge Volumes and Parameters Measured during Sampling

Date	pH	Temp (°C)	DO (mg/L)	ORP (mV)	Eh[a] (mV)	Specific Conductivity (mS/cm)	Turbidity (NTU)	Purge Volume between Samples (gal.)	Cumulative Purge Volume (gal.)
Screen 3 Initial Sampling									
4/11/11	7.53	19.19	4.81	19.9	223.8	0.116	13.3	88.0	88.0
	7.72	20.54	6.94	96.1	300.0	0.108	42.3	123.2	211.2
	7.71	21.02	8.11	120.2	324.1	0.098	1.6	132.0	343.2
	7.71	21.10	7.53	131.8	335.7	0.094	1.0	176.0	519.2
	n/r[b]; no parameters recorded while purging prior to shutting off pump							334.0	853.2
4/12/11	n/r; water purged to allow NMED to collect samples							1633.2	2486.4
Screen 4 Initial Sampling									
4/12/11	n/r; no parameters recorded while purging cross-flow							2992.8	2992.8
4/13/11	n/r; no parameters recorded while purging cross-flow							5613.9	8606.7
4/14/11	n/r; no parameters recorded while purging cross-flow							6370.0	14,976.7
4/15/11	n/r; no parameters recorded while purging cross-flow							6536.8	21,513.5
4/16/11	7.64	21.96	6.38	82.3	286.2	0.111	1.0	3744.0	25,257.5
	7.64	22.03	6.32	103.3	307.2	0.107	1.0	144.0	25,401.5
	7.64	22.04	6.30	111.3	315.2	0.102	1.0	144.0	25,545.5
	7.64	22.03	6.94	116.2	320.1	0.098	1.0	192.0	25,737.5
	n/r; no parameters recorded while purging prior to shutting off pump							592.9	26,330.4
Screen 2Initial Sampling									
4/17/11	7.54	15.68	4.37	99.3	308.2	0.108	1.0	189.0	189.0
	7.25	19.11	1.71	-69.7	134.2	0.117	1.0	144.9	333.9
	7.24	20.71	1.75	-90.7	113.2	0.118	1.0	144.9	478.8
	7.27	20.89	2.10	-95.6	108.3	0.115	1.0	189.0	667.8
	n/r; no parameters recorded while purging prior to shutting off pump							233.1	900.9

[a] Eh (mV) is calculated from an Ag/AgCl saturated KCl electrode filling solution at 15ºC and 20ºC by adding temperature-sensitive correction factors of 208.9 mV and 203.9 mV, respectively, to the ORP values.

[b] n/r = Not recorded.

Table 3.4-2
Groundwater Samples Collected at CdV-R-37-2

Location ID	Sample ID	Date Collected	Collection Depth (ft bgs)
Screen 3 Initial Sampling (0 Casing Volumes Purged)			
CdV-R-37-2	CAWA-11-6886	04/11/2011	1395.9
CdV-R-37-2	CAWA-11-6888	04/11/2011	1395.9
Screen 3 Initial Sampling (3 Casing Volumes Purged)			
CdV-R-37-2	CAWA-11-6938	04/11/2011	1395.9
CdV-R-37-2	CAWA-11-6940	04/11/2011	1395.9
Screen 3 Initial Sampling (6 Casing Volumes Purged)			
CdV-R-37-2	CAWA-11-6996	04/11/2011	1395.9
CdV-R-37-2	CAWA-11-7000	04/11/2011	1395.9
Screen 3 Initial Sampling (10 Casing Volumes Purged)			
CdV-R-37-2	CAWA-11-7053	04/11/2011	1395.9
CdV-R-37-2	CAWA-11-7056	04/11/2011	1395.9
Screen 4 Initial Sampling (0 Casing Volumes Purged)			
CdV-R-37-2	CAWA-11-6889	04/16/2011	1540.4
CdV-R-37-2	CAWA-11-6895	04/16/2011	1540.4
CdV-R-37-2	CAWA-11-6893	04/16/2011	1540.4
Screen 4 Initial Sampling (3 Casing Volumes Purged)			
CdV-R-37-2	CAWA-11-6948	04/16/2011	1540.4
CdV-R-37-2	CAWA-11-6945	04/16/2011	1540.4
CdV-R-37-2	CAWA-11-6951	04/16/2011	1540.4
Screen 4 Initial Sampling (6 Casing Volumes Purged)			
CdV-R-37-2	CAWA-11-7005	04/16/2011	1540.4
CdV-R-37-2	CAWA-11-7002	04/16/2011	1540.4
CdV-R-37-2	CAWA-11-7006	04/16/2011	1540.4
Screen 4 Initial Sampling (10 Casing Volumes Purged)			
CdV-R-37-2	CAWA-11-7060	04/16/2011	1540.4
CdV-R-37-2	CAWA-11-7062	04/16/2011	1540.4
CdV-R-37-2	CAWA-11-7061	04/16/2011	1540.4
Screen 2 Initial Sampling (0 Casing Volumes Purged)			
CdV-R-37-2	CAWA-11-6881	04/17/2011	1235.9
CdV-R-37-2	CAWA-11-6878	04/17/2011	1235.9
CdV-R-37-2	CAWA-11-6880	04/17/2011	1235.9
Screen 2 Initial Sampling (3 Casing Volumes Purged)			
CdV-R-37-2	CAWA-11-6931	04/17/2011	1235.9
CdV-R-37-2	CAWA-11-6937	04/17/2011	1235.9
CdV-R-37-2	CAWA-11-6932	04/17/2011	1235.9

Table 3.4-2 (continued)

Location ID	Sample ID	Date Collected	Collection Depth (ft bgs)
Screen 2 Initial Sampling (6 Casing Volumes Purged)			
CdV-R-37-2	CAWA-11-6988	04/17/2011	1235.9
CdV-R-37-2	CAWA-11-6992	04/17/2011	1235.9
CdV-R-37-2	CAWA-11-6987	04/17/2011	1235.9
Screen 2 Initial Sampling (10 Casing Volumes Purged)			
CdV-R-37-2	CAWA-11-7049	04/17/2011	1235.9
CdV-R-37-2	CAWA-11-7047	04/17/2011	1235.9
CdV-R-37-2	CAWA-11-7044	04/17/2011	1235.9
Screen 2 Mid-point of Swabbing and Bailing			
CdV-R-37-2	CAWA-11-7284	04/20/2011	1236.1
CdV-R-37-2	CAWA-11-7266	04/20/2011	1236.1
CdV-R-37-2	CAWA-11-7271	04/20/2011	1236.1
CdV-R-37-2	CAWA-11-7272	04/20/2011	1236.1
CdV-R-37-2	CAWA-11-7267	04/20/2011	1236.1
CdV-R-37-2	CAWA-11-7268	04/20/2011	1236.1
Screen 2 Completion of Swabbing and Bailing			
CdV-R-37-2	CAWA-11-7332	04/22/2011	1236.1
CdV-R-37-2	CAWA-11-7345	04/22/2011	1236.1
CdV-R-37-2	CAWA-11-7349	04/22/2011	1236.1
CdV-R-37-2	CAWA-11-7347	04/22/2011	1236.1
CdV-R-37-2	CAWA-11-7333	04/22/2011	1236.1
CdV-R-37-2	CAWA-11-7268	04/22/2011	1236.1
Screen 2 Completion of High-velocity Jetting			
CdV-R-37-2	CAWA-11-7382	04/24/2011	1236.1
CdV-R-37-2	CAWA-11-7374	04/24/2011	1236.1
CdV-R-37-2	CAWA-11-7369	04/24/2011	1236.1
CdV-R-37-2	CAWA-11-7371	04/24/2011	1236.1
CdV-R-37-2	CAWA-11-7372	04/24/2011	1236.1
CdV-R-37-2	CAWA-11-7370	04/24/2011	1236.1

Table 3.4-3
Quality Control Samples Collected at CdV-R-37-2

Location ID	Sample ID*	Date Collected	Sample Type
CdV-R-37-2	CAWA-11-7064	04/10/2011	Equipment Blank
CdV-R-37-2	CAWA-11-7065	04/10/2011	Equipment Blank
CdV-R-37-2	CAWA-11-7066	04/10/2011	Equipment Blank
CdV-R-37-2	CAWA-11-7067	04/10/2011	Equipment Blank
CdV-R-37-2	CAWA-11-6885	04/11/2011	Field Trip Blank
CdV-R-37-2	CAWA-11-6939	04/11/2011	Field Trip Blank
CdV-R-37-2	CAWA-11-6999	04/11/2011	Field Trip Blank
CdV-R-37-2	CAWA-11-7052	04/11/2011	Field Trip Blank
CdV-R-37-2	CAWA-11-6894	04/16/2011	Field Trip Blank
CdV-R-37-2	CAWA-11-6949	04/16/2011	Field Trip Blank
CdV-R-37-2	CAWA-11-7007	04/16/2011	Field Trip Blank
CdV-R-37-2	CAWA-11-7063	04/16/2011	Field Trip Blank
CdV-R-37-2	CAWA-11-6879	04/17/2011	Field Trip Blank
CdV-R-37-2	CAWA-11-6936	04/17/2011	Field Trip Blank
CdV-R-37-2	CAWA-11-6993	04/17/2011	Field Trip Blank
CdV-R-37-2	CAWA-11-7043	04/17/2011	Field Trip Blank
CdV-R-37-2	CAWA-11-7273	04/20/2011	Field Trip Blank
CdV-R-37-2	CAWA-11-7348	04/22/2011	Field Trip Blank
CdV-R-37-2	CAWA-11-7381	04/24/2011	Field Trip Blank

*Samples were analyzed for SVOCs and VOCs.

Table 3.5-1
CdV-R-37-2 Purge Volumes and Parameters Measured during Redevelopment

Date	pH	Temp (°C)	DO (mg/L)	ORP (mV)	Eh[a] (mV)	Specific Conductivity (mS/cm)	Turbidity (NTU)	Purge Volume between Samples (gal.)	Cumulative Purge Volume (gal.)
Screen 2 Bailing Sump after Swabbing									
4/19/11	n/r[b]; no parameters recorded while bailing							20.0	20.0
Screen 2 Mid-point of Swabbing and Bailing									
4/20/11	7.77	21.74	1.64	-20.5	183.4	0.121	2.7	303.8	323.8
	7.46	22.03	1.57	-14.6	189.3	0.119	2.5	62.0	385.8
	7.31	22.41	1.59	-33.2	170.7	0.117	2.5	62.0	447.8
	7.28	22.33	1.85	-36.3	167.6	0.116	1.6	148.8	596.6
	7.20	22.33	1.85	-36.3	167.6	0.116	1.6	155.0	751.6
	n/r[b]; no parameters recorded while purging prior to shutting off pump							31.0	782.6
Screen 2 Swabbing and Bailing									
4/21/11	n/r; no parameters recorded while bailing							10.0	792.6
Screen 2 Completion of Swabbing and Bailing									
4/22/11	7.40	18.27	2.90	-20.5	183.4	0.120	7.6	74.5	867.1
	7.2	20.25	4.25	-42.0	161.9	0.119	4.1	57.3	924.4
	7.2	20.45	3.12	-58.8	145.1	0.119	2.7	57.3	981.7
	7.2	20.70	2.09	-48.8	155.1	0.118	4.2	57.3	1039.0
	n/r; no parameters recorded while purging prior to shutting off pump							143.3	1182.3
Screen 2 High-velocity Jetting									
4/23/11	n/r; no parameters recorded while jetting							1170.0	2352.3
Screen 2 Completion of High-velocity Jetting									
4/24/11	7.53	20.13	1.64	99.8	303.7	0.118	5.0	213.2	2565.5
	7.23	21.51	1.75	33.1	237.0	0.117	2.3	60.9	2626.4
	7.27	21.58	2.08	24.2	228.1	0.117	1.8	60.9	2687.3
	7.24	21.93	2.27	10.0	213.9	0.116	1.5	60.9	2748.2
	7.29	21.48	2.17	34.6	238.5	0.117	1.2	60.9	2809.1
	n/r[b]; no parameters recorded while purging prior to shutting off pump							60.6	2869.7

[a] Eh (mV) is calculated from an Ag/AgCl saturated KCl electrode filling solution at 20ºC by adding a temperature-sensitive correction factor of 203.9 mV to ORP values.

[b] n/r = Not recorded.

Table 4.3-1
R-26 Screen 1 Purge Volumes during Redevelopment

Date	pH	Temp (°C)	DO (mg/L)	ORP (mV)	Eh (mV)	Specific Conductivity (mS/cm)	Turbidity (NTU)	Purge Volume between Samples (gal.)	Cumulative Purge Volume (gal.)
Screen 1 High Velocity Jetting									
5/25/11 and 5/26/11	n/r*; no parameters recorded while jetting							3959.0	3959.0
Screen 1 Pumping									
5/26/11 and 5/27/11	n/r; no parameters recorded while purging							4948.6	8907.6

*n/r = Not recorded.

Table 4.4-1
R-26 Screen 2 Abandonment Materials

Material	Volume
Upper 10/20 sand backfill	55.5 ft^3
Neat cement	11.2 ft^3
20/40 silica sand backfill	0.5 ft^3
Lower 10/20 sand backfill	18.5 ft^3

Table 4.5-1
R-26 Purge Volumes and Parameters Measured before Sampling

Date	pH	Temp (°C)	DO (mg/L)	ORP (mV)	Eh[a] (mV)	Specific Conductivity (mS/cm)	Turbidity (NTU)	Purge Volume between Samples (gal.)	Cumulative Purge Volume (gal.)
Screen 1 Purging									
5/31/11	8.52	20.12	6.35	248.2	452.1	0.202	1124.4	242.7	242.7
	8.57	19.20	6.68	245.4	449.3	0.196	268.2	197.3	440.0
	8.54	19.58	13.88	229.0	432.9	0.187	69.2	209.7	649.7
	8.49	20.20	12.10	220.9	424.8	0.183	43.4	268.8	918.5
	8.47	20.07	12.70	231.6	435.5	0.189	38.8	162.7	1081.2
	8.44	19.46	10.29	237.8	441.7	0.188	24.8	177.3	1258.5
	n/r[b]; no parameters recorded while purging prior to shutting off pump							9.4	1267.9
6/1/11	7.88	17.35	9.98	171.8	380.7	0.123	196.8	156.0	1423.9
	8.34	17.47	9.02	206.5	410.4	0.118	57.7	105.0	1528.9
	8.45	17.48	8.72	211.1	420.0	0.118	71.5	105.0	1633.9
	8.36	17.65	8.52	211.8	415.7	0.114	103.3	105.0	1738.9
	8.39	17.72	8.77	211.8	415.7	0.115	102.7	105.0	1843.9
	8.39	17.59	9.01	213.7	417.6	0.115	86.9	105.0	1948.9
	8.33	17.82	9.45	216.2	420.1	0.113	59.6	105.0	2053.9
	8.31	18.18	9.31	217.2	421.1	0.114	53.4	105.0	2158.9
	8.31	17.82	12.25	219.1	423.0	0.109	13.1	105.0	2263.9
	8.27	17.65	12.41	221.3	425.2	0.113	21.5	105.0	2368.9
	8.25	17.88	12.63	222.9	426.8	0.111	39.6	105.0	2473.9
	8.19	18.35	12.55	140.5	344.4	0.110	14.3	211.0	2684.9
	8.17	18.63	12.29	186.1	390.0	0.109	7.0	107.0	2791.9
	8.13	18.88	11.94	194.1	398.0	0.111	5.1	165.3	2957.2
	8.14	19.08	11.75	175.6	379.5	0.109	3.9	159.3	3116.5
	8.10	19.01	11.84	198.4	402.3	0.109	3.6	202.7	3319.2
	8.09	19.60	11.64	202.2	406.1	0.109	3.4	199.2	3518.4
	n/r; no parameters recorded while purging prior to shutting off pump							117.1	3635.5

[a] Eh (mV) is calculated from an Ag/AgCl saturated KCl electrode filling solution at 15ºC and 20ºC by adding temperature-sensitive correction factors of 208.9 mV and 203.9 mV, respectively.

[b] n/r = Not recorded.

Table 4.5-2
R-26 Purge Volumes and Parameters Measured during Sampling

Date	pH	Temp (°C)	DO (mg/L)	ORP (mV)	Eh[a] (mV)	Specific Conductivity (mS/cm)	Turbidity (NTU)	Purge Volume between Samples (gal.)	Cumulative Purge Volume (gal.)
Screen 1 Sampling									
6/1/11	8.03	23.41	7.32	192.6	391.1	0.098	2.3	289.3	289.3
	8.02	22.61	7.20	204.3	402.8	0.096	2.1	220.6	509.9
	8.01	21.92	7.03	212.2	416.1	0.094	2.1	290.4	800.3
	n/r[b]; no parameters recorded while purging prior to shutting off pump							69.2	869.5

[a] Eh (mV) is calculated from an Ag/AgCl saturated KCl electrode filling solution at 20º and 25ºC by adding temperature-sensitive correction factors of 203.9 mV and 198.5 mV, respectively.

[b] n/r = Not recorded.

Table 4.5-3
Groundwater Samples Collected at R-26

Location ID	Sample ID	Date Collected	Collection Depth (ft bgs)
Screen 1 Initial Sampling (3 Casing Volumes Purged)			
R-26	CAWA-11-6896	06/01/2011	648.5
R-26	CAWA-11-6897	06/01/2011	648.5
Screen 1 Initial Sampling (6 Casing Volumes Purged)			
R-26	CAWA-11-6953	06/01/2011	648.5
R-26	CAWA-11-6957	06/01/2011	648.5
Screen 1 Initial Sampling (10 Casing Volumes Purged)			
R-26	CAWA-11-7011	06/01/2011	648.5
R-26	CAWA-11-7012	06/01/2011	648.5

Table 4.5-4
Quality Control Samples Collected at R-26

Location ID	Sample ID*	Date Collected	Sample Type
R-26	CAWA-11-6901	06/01/2011	Field Trip Blank
R-26	CAWA-11-6954	06/01/2011	Field Trip Blank
R-26	CAWA-11-7008	06/01/2011	Field Trip Blank
R-26	CAWA-11-7069	06/02/2011	Equipment Blank
R-26	CAWA-11-7070	06/02/2011	Equipment Blank
R-26	GW26-11-22274	06/17/2011	Equipment Blank
R-26	GW26-11-22275	06/17/2011	Equipment Blank
R-26	GW26-11-22276	06/17/2011	Equipment Blank
R-26	GW26-11-22277	06/17/2011	Equipment Blank
R-26	GW26-11-22278	06/17/2011	Equipment Blank
R-26	GW26-11-22279	06/17/2011	Equipment Blank
R-26	GW26-11-22280	06/17/2011	Equipment Blank
R-26	GW26-11-22282	06/17/2011	Field Blank
R-26	GW26-11-22283	06/17/2011	Field Trip Blank

*Samples analyzed for SVOCs and VOCs.

Appendix A

Retrival Report for Westbay System Wells R-26, CDV-R-37-2, and CDV-R-15-3, Los Alamos National Laboratory

Schlumberger Canada Ltd (Westbay)
3480 Gilmore Way, Suite 110
Burnaby, BC V5G 4Y1
Canada
Tel. (604) 430-4272
Fax (604) 430-3538

May 16, 2011
WB777

Mr. Steven White
Terranear PMC, LLC
Research Park
4200 West Jemez Road, Suite 502
Los Alamos, NM 87544
USA

Subject: Retrieval Report for Westbay System Wells R-26 , CDV-R-37-2 and CDV-, Los Alamos National Laboratory

Dear Mr. White:

This report summarizes the work carried out by Schlumberger Canada Ltd.. related to retrieval of the Westbay System casing components from LANL wells R-26, CDV-R-37-2 and CDV-R-15-3 near Los Alamos, NM. This work was carried out under Terranear PMC, LLC (TPMC) Task Order No. 1 dated February 3, 2011, under Subcontract Agreement No. SCHLUM80010.

Schlumberger technical services representative Mr. Andrew Bessant was on site for the retrieval tasks from March 17 to April 05, 2011. The Westbay MP55 System completions previously installed in CDV-R37-2 and CDV-R-15-3 were successfully retrieved. The Westbay packers in well R-26 were successfully deflated but the Westbay completion could not be retrieved. We understand that further retrieval efforts conducted at R-26 after the Schlumberger representative left the site were successful.

We look forward to working with you in the future. Please call if you have any questions or comments.

Yours truly,

Andrew Bessant

Schlumberger Canada Ltd. (Westbay)

Encl.: Retrieval Report for Westbay System wells R-26, CDV-R-37-2 and CDV-R-15-3

If there are any questions regarding this report, please contact a Westbay specialist by e-mail at westbay@slb.com or by telephone at 1-800-663-8770.

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RETRIEVAL REPORT

Westbay System Monitoring Wells: R-26, CDV-R-37-2 and CDV-R-15-3

Los Alamos, NM

Prepared for:

Terranear PMC
Research Park
4200 West Jemez Road, Suite 502
Los Alamos, NM
87544
USA

Prepared by:
Schlumberger Canada Ltd. (Westbay)
WB777

May 16, 2011

CONTENTS:

APPENDICES

1. Introduction

This report and the attached Appendices document the technical services carried out by Schlumberger Canada Ltd. (Westbay) under Terranear PMC, LLC (TPMC) Task Order No. 1 dated February 3, 2011, under Subcontract Agreement No. SCHLUM80010.

Westbay technical services representative Mr. Andrew Bessant was on site for the retrieval tasks from March 17 to April 05, 2011. The work was supervised by Mr. S. White and Mr. Ryan Mcguill of TPMC. This report documents the retrieval tasks and related QA checks for wells R-26, CDV-R-37-2 and CDV-R-15-3.

2. Westbay Casing Retrieval

The monitoring wells had previously been installed as indicated below. Details of the well installations were described in the respective Westbay Installation Reports.

(Note: all depths are with respect to ground surface. The monitoring well depth reference point was ground level as defined by a brass survey marker set in a concrete pad at the well.

Table 1, Summary of MP Well Installation

Well No.	Installation Date	Westbay Casing Length (ft)	No. Screens	No. Packers	Open Hole Depth to Water (ft)
R-26	July 2004	1450	2	8	Approx. 604
R-37-2	October 2001	1585	4	14	Approx. 1194
R-15-3	September 2000	1670	6	19	Approx. 1246

The procedure for retrieval of the Westbay casing from each of the wells is described in the following sections. The Westbay System completion was successfully retrieved from CDV-R-15-3 and CDV-R37-2. However, the Westbay System casing in R-26 was lodged downhole. The extra tasks carried out in the attempt to free the Westbay System casing in R-26 are described in a separate section. However, the retrieval attempts carried out while the Westbay representative was on site were not successful.

Retrieval equipment and field assistance from a third party supplier was mobilized to the site and the Westbay representative and equipment were de-mobilized. We understand that the subsequent retrieval attempts were successful in removing all of the Westbay System components from the well. The procedures and equipment used after the Westbay representative left the site are not covered in this report.

2.1 Pre-Deflation Profile

A pre-deflation pressure profile was carried out at each well prior to deflating the packers to confirm the proper operation and position of measurement ports and to confirm the present water levels inside and outside the well. The data confirmed that the ports operated properly. The data for the pre-deflation profile are shown on the pre-deflation Field Data and Calculation Sheets in the Appendices.

Based on the information from this profile it was determined that the water level inside the Westbay System casing was below the water levels in the screened intervals for Wells CDV-R-15-3 and CDV-R-37-2. Therefore, the water level did not require adjustment before the procedure for deflation of the packers could begin. However, the R-26 profile showed that the water level inside the Westbay System casing was above the water levels in the screened intervals. A rig and bailer were moblized to the site by TPMC to remove the water from inside the Westbay System, down to a level below that of the waters levels in the screened intervals.

2.2 Deflation of the Westbay Packers

The Westbay Model 6080 Packer Tool was deployed for deflation of the packers. De-ionized water purchased locally was used for operation of the packer deflation equipment. All of the packers in the wells were successfully deflated. After deflation the packer valves were left in the Open position. The field data for deflation of each packer are shown on the MP55 Packer Deflation Field Records in the Appendices.

2.3 Retrieval of Westbay Casing Components

Prior to retrieval of the Westbay System a post-deflation profile of fluid levels was measured. The head differences observed across each packer in the pre-deflation profile were no longer present. The fluid pressure distribution was hydrostatic, thus indicating that none of the packers were sealed inside the well.

The bottom Westbay Pumping Port was opened to allow the water levels inside and outside the Westbay casing to equilibrate.

The Westbay System casing was lifted from well CDV-R-15-3 on April 01, 2011. The tensile load applied to the Westbay casing was measured by means of a load gauge provided by Westbay. The maximum applied lifting load was 2600 lb, comparable to the maximum load during original installation of 2200 lb.

All of the installed Westbay System casing components were successfully retrieved from well CDV-R-15-3. Each retrieved casing component was set aside on a rack.

The Westbay System casing was lifted from well CDV-R-37-2 on April 04, 2011. The tensile load applied to the Westbay casing was measured by means of a load gauge provided by Westbay. The maximum applied lifting load was 3500 lb, comparable to the maximum load during original installation of 2200 lb.

All of the installed Westbay System casing components were successfully retrieved from well CDV-R-37-2. Each retrieved casing component was set aside on a rack.

3. Retrieval Attempt at Well R-26

The normal procedure for deflation of the Westbay System packers was followed at R-26. All of the packers were successfully deflated. The post-deflation profile was measured (data are in the Appendix). These data showed that all of the head differences previously present across the packers were gone, thus corroborating that the packers had been successfully deflated.

3.1 First Retrieval Attempt

On March 29, 2011 lifting of the Westbay System casing was started and it was immediately observed that the Westbay System casing was lodged in the well and all movement from pulling was related to stretch of the free portion of the Westbay casing. Repeated lifting efforts were made with no success. Lifting loads slightly greater than the specified maximum tensile load were applied in consultation with Schlumberger engineering staff.

- Maximum applied lifting load: 3,200 lb
- Maximum specified short term lifting load: 3,000 lb
- Expected suspended load of the Westbay System casing string: 1,000 lb.

3.2 Tests for Diagnosis and Remediation of Stuck Casing

During March 29, 2011, attempts were made to identify possible mechanisms for the stuck Westbay System casing. These included the following activities:

- Detailed pressure profile measurements to detect slight pressure head differences across packer locations. Figure 3
- Opening Pumping Port to balance internal water levels
- Tensile load to stretch measurement calculations.

3.3 Second Retrieval Attempt

A second attempt was made on March 29 to lift the Westbay casing from the well. With a lifting load of 2,000 lb, the Westbay System casing lifted to start, but lifting load rose to about 3000 lb. A total length of 104. 5 cm of Westbay casing was lifted from the well, at which time the Westbay casing movement stopped, and could not be moved with a lifting load of up to 3,200 lb.

- It was determined in consultation with Schlumberger engineers that the applied lifting load should not exceed 3,200 lb to avoid damage to downhole components.
- The Westbay System casing was left hanging free in the well at a tensile load of 600 lb.
- During a meeting with staff from LANL, and TPMC (by phone), the owner decided that a third-party internal grapple would be subcontracted to provide supplemental lifting capability from inside the Westbay System casing.

APPENDIX 1

Monitoring Well R-26

Summary Casing Log	- 7 pages
Pre-deflation Piezometric Pressure/Levels	
Field Data and Calculation Sheet (March 24, 2011)	- 2 pages
Post Deflation Piezometric Pressure/Levels	
Field Data and Calculation Sheet (March 28, 2011)	- 2 pages
Post Deflation Piezometric Pressure/Levels	
Field Data and Calculation Sheet (March 29, 2011)	- 2 pages
Packer Deflation Records	- 8 pages

Summary Casing Log

Company: Kleinfelder Consultants
Well: R26
Site: LANL
Project: Hydrogeology Study

Job No: WB777
Author: DL

Well Information

Reference Datum: Ground Level
Elevation of Datum: 0.00 ft.
MP Casing Top: 0.00 ft.
MP Casing Length: 1468.86 ft.
Depth Adjusted For:
  Field De-Stressing
Well Description:
  PlasticMP55
Other References:
  Pipe-based wire-wrapped screens.
  BF and screens: KC As-Built 12-2003
  All depths nominal (cold meas'd lengths)

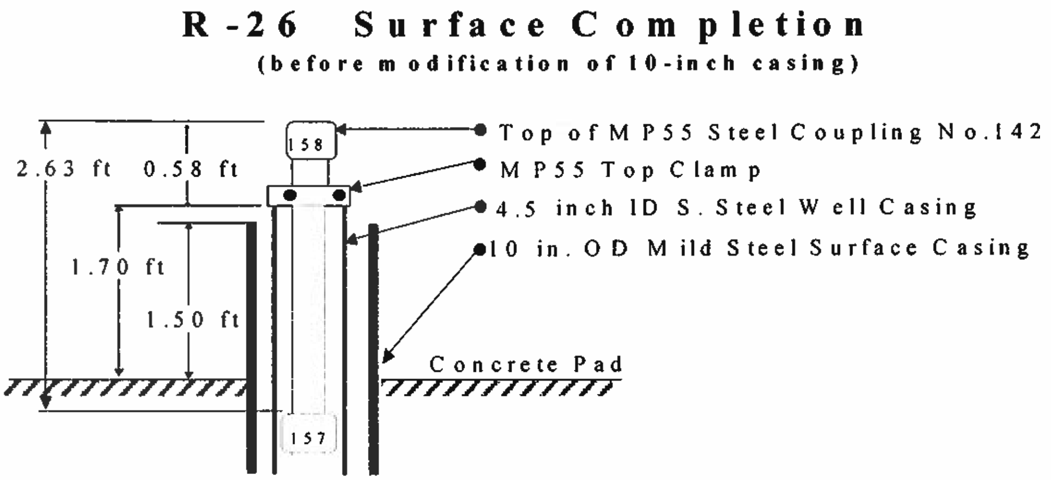
Borehole Depth: 1490.50 ft.
Borehole Inclination: vertical
Borehole Info: (# - start - end - diameter)

File Information

File Name: R26FINAL.WWD
Report Date: Wed Jul 21 20:02:57 2004

File Date: Jul 18 07:41:09 2004

Sketch of Wellhead Completion



Legend

(Qty) MP Components

(Library - WD Library 7/27/00)

▬	(2)	0603 - MP55 End Plug
| |	(8)	0601M15 - MP55 Casing, 1.5 m, PVC
| |	(141)	0601M30 - MP55 Casing, 3.0 m, PVC
▨ ▨	(8)	0612 - MP55 Packer, Stiffened, SS
| |	(1)	0601M10 - MP55 Casing, 1.0 m, PVC
—	(148)	0602 - MP55 Regular Coupling
●	(10)	0605 - MP55 Measurement Port
○	(2)	0607 - MP55 Hydraulic Pumping Port
◆	(5)	0608 - MP55 Magnetic Location Collar

Geology

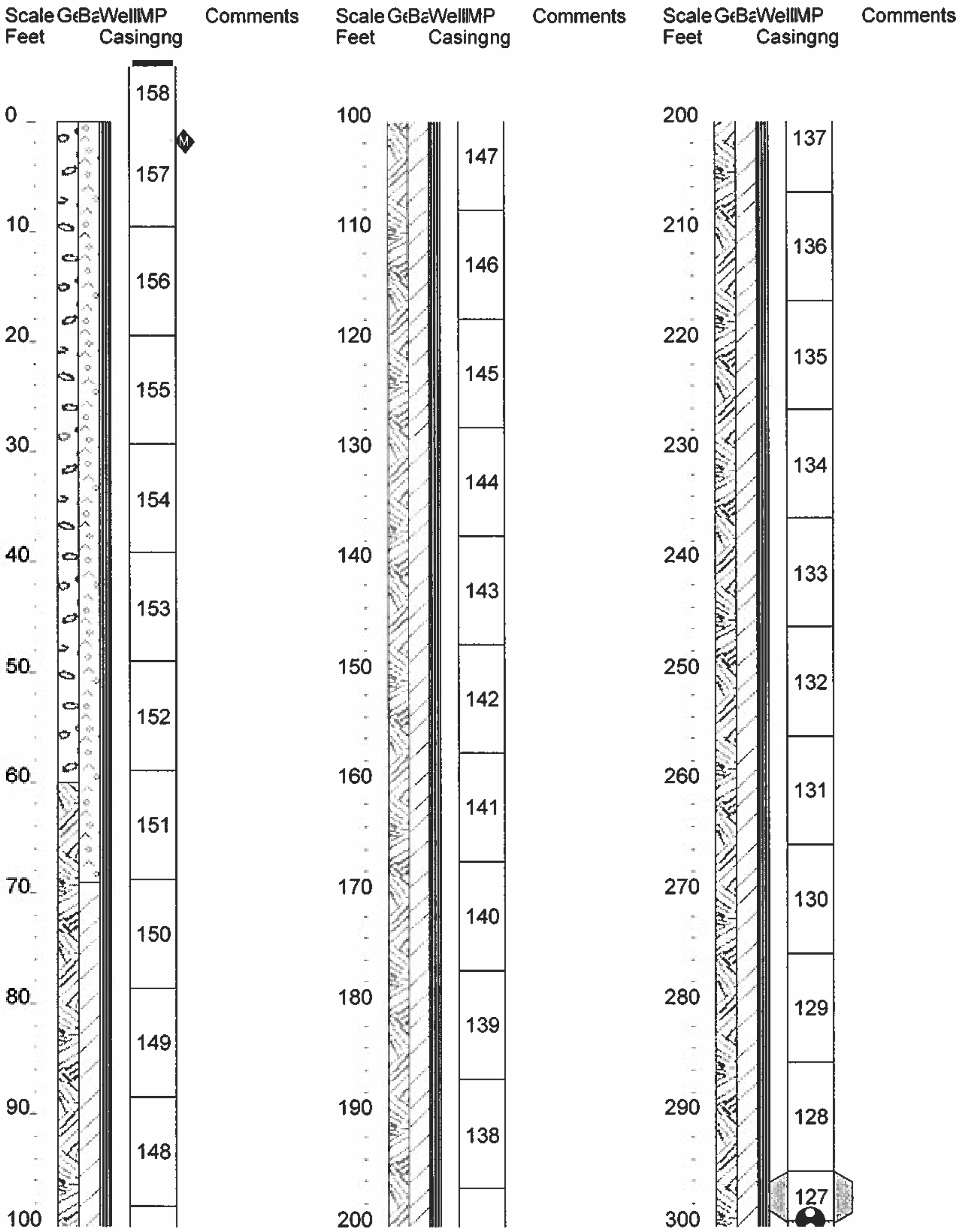
- ▨ Conglomerate
- ▨ Rock
- ▨ Lava, Basaltic
- ▨ Sandstone, Coarse

Backfill/Casing

- ▨ Concrete
- ▨ Bentonite
- ▨ Sand Fine
- ▨ Sand Coarse
- ▨ Bentonite, Sand
- ▨ Stainless Steel
- ▨ Well Screen

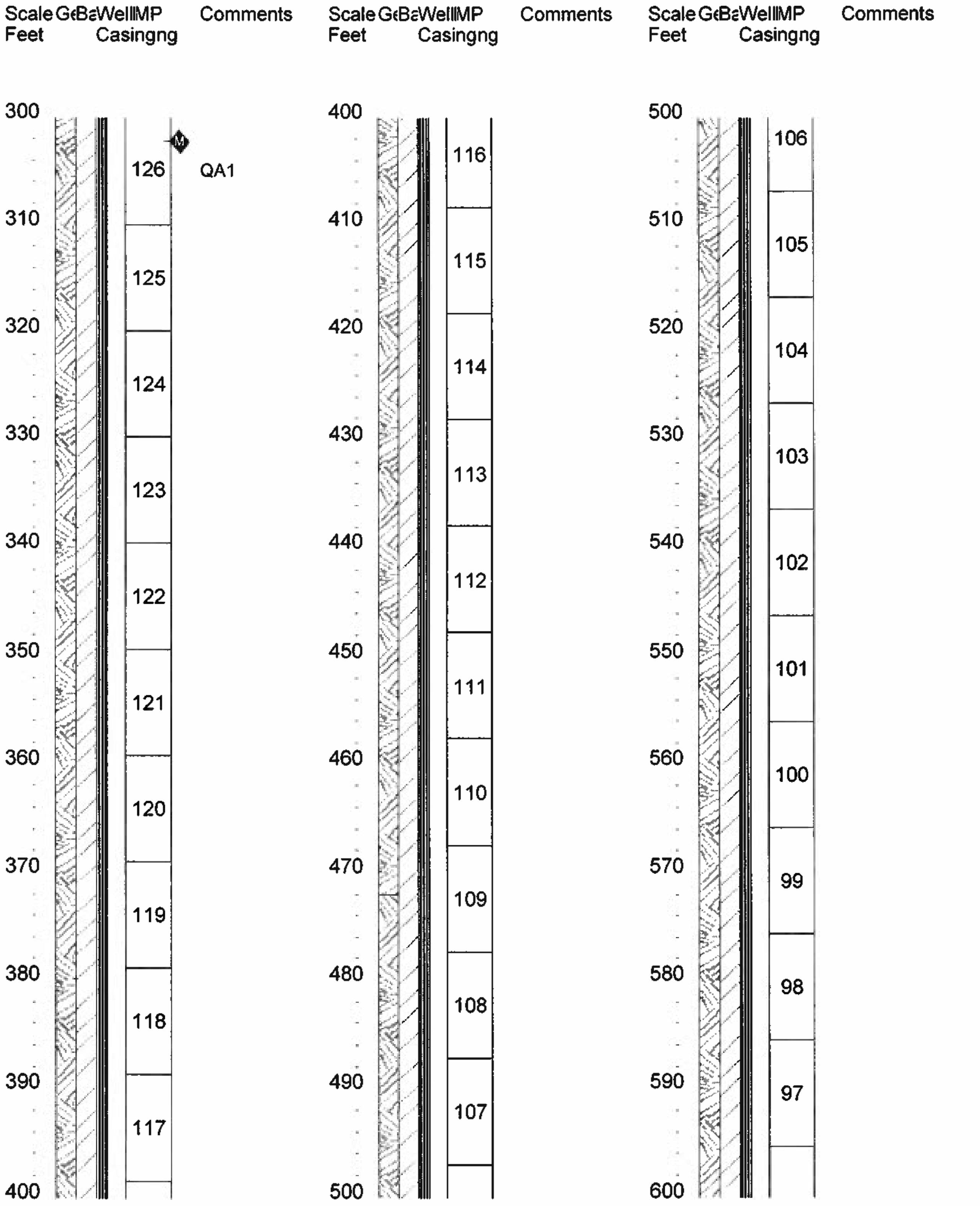
Summary Casing Log
Kleinfelder Consultants

Job No: WB777
Well: R26



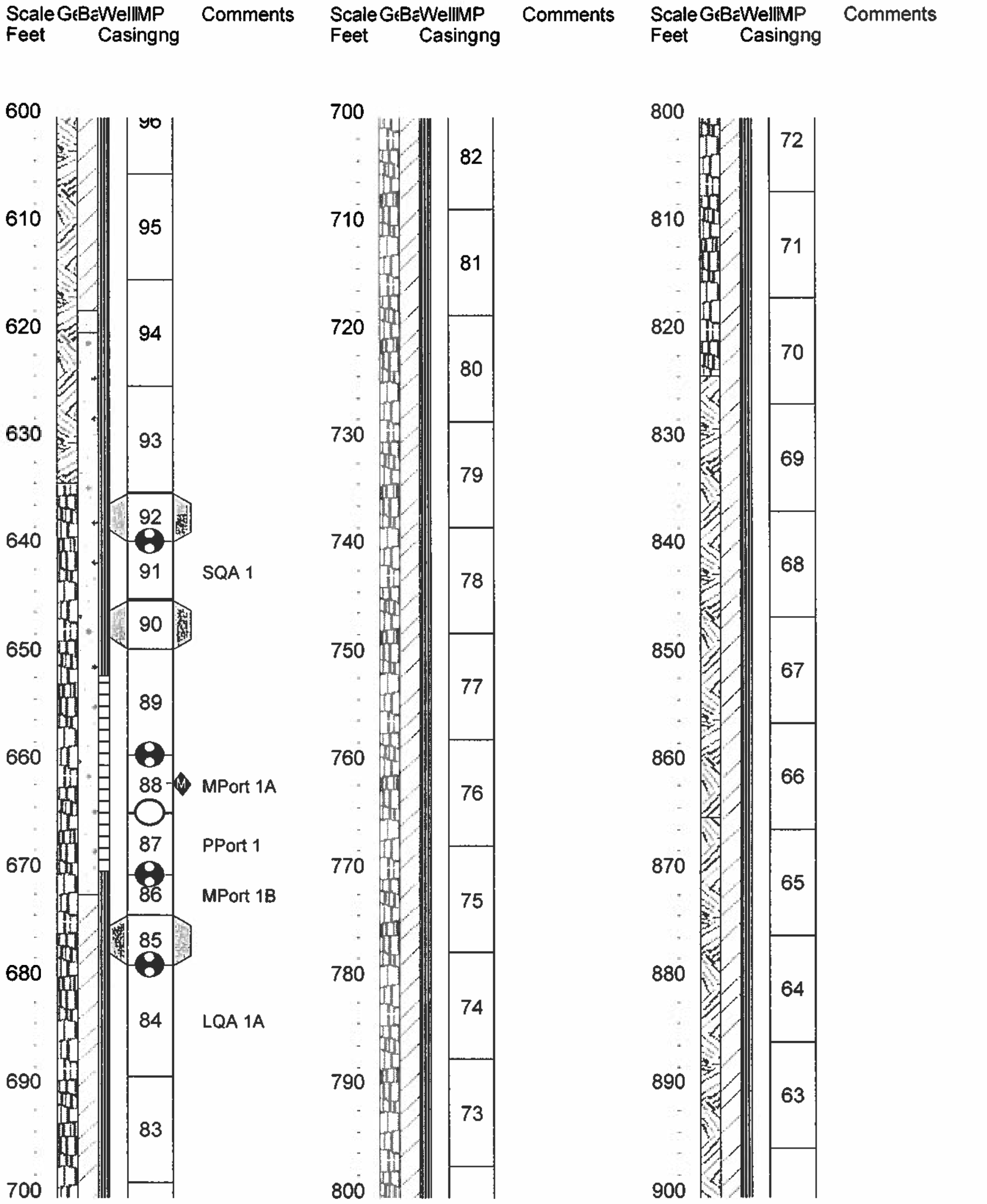
Summary Casing Log
Kleinfelder Consultants

Job No: WB777
Well: R26



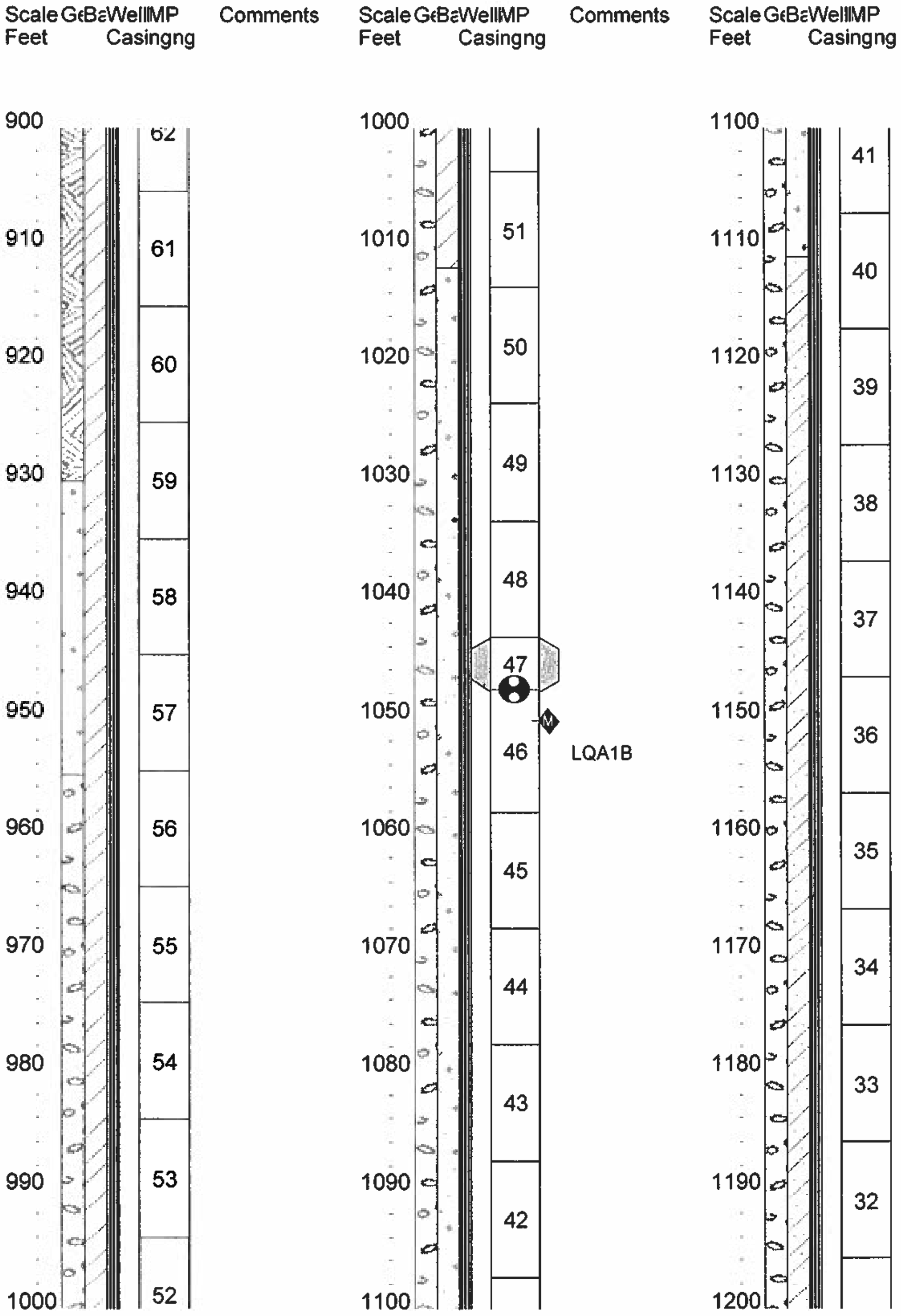
Summary Casing Log
Kleinfelder Consultants

Job No: WB777
Well: R26



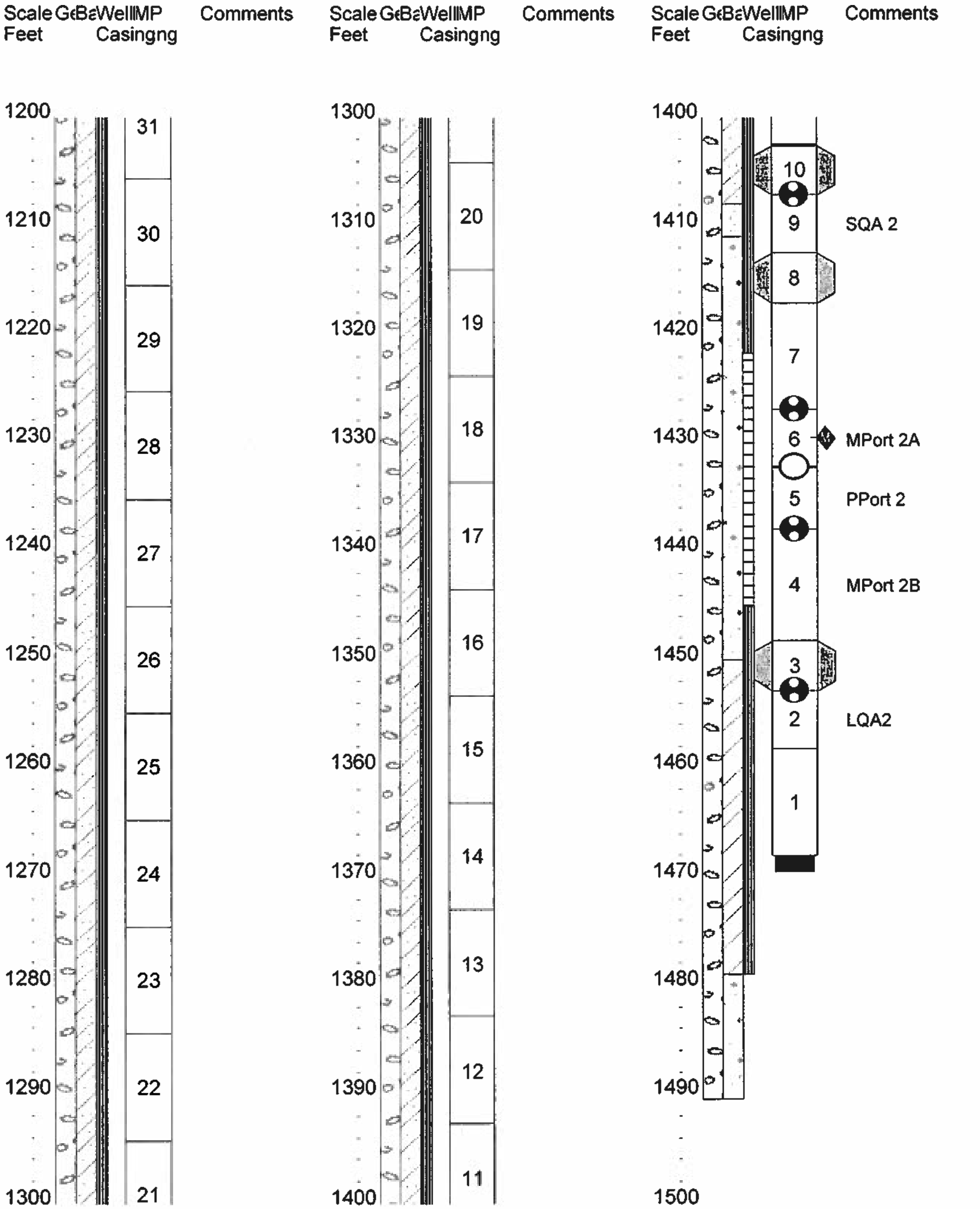
Summary Casing Log
Kleinfelder Consultants

Job No: WB777
Well: R26



Summary Casing Log
Kleinfelder Consultants

Job No: WB777
Well: R26



Schlumberger
WATER SERVICES

Westbay Piezometric Pressures/Levels
Field Data and Calculation Sheet

Well No.: **R-26**
Datum: —
Elev. G.S.: —
Height of Westbay above G.S.: —
Elev. top of Westbay Casing: —
Reference Elevation: —
Borehole angle: —

Probe Type: **EMS**
Serial No.: 2653
Probe Range: 2000
Westbay Casing Type: **MP55**
Sampler Valve Position: OFF

Date: MARCH 24/2011
Client: **LNAL**
Job No.: **WB 777**
Location: LANL
Weather: Sunny
Operator: **AB**

Note: "Port position" in angled boreholes refer to position along drillhole. True depth (Dp) needs to be calculated using borehole angle and deviation data to calculate zone piezometric level (Dz).

Ambient Reading (P_{atm}) (pressure, temperature, time)

		Start:	Finish:
	Pressure	11.02	11.11
	Temp		
	Time	12:15 pm	13:24 pm

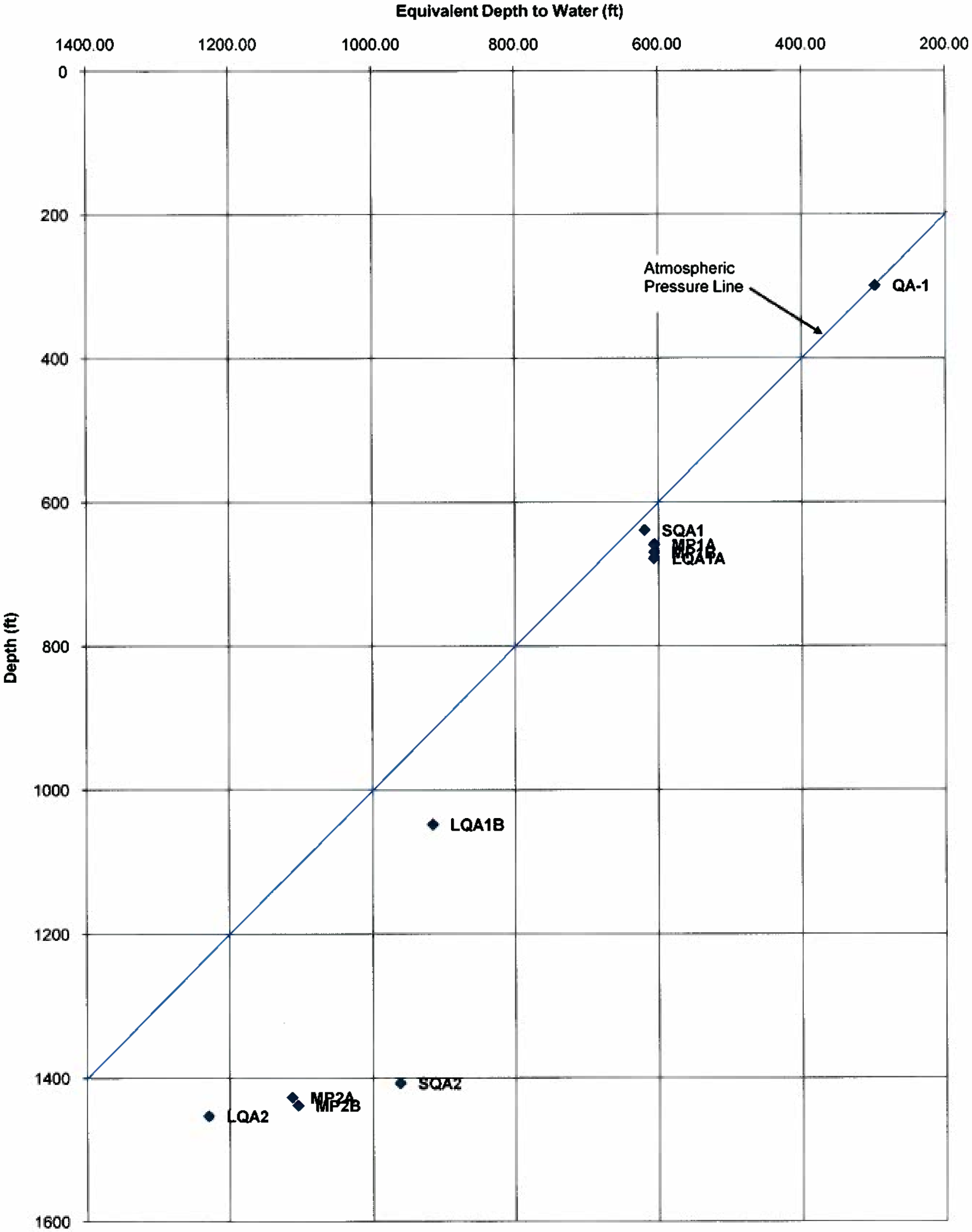
P_{atm} 11.02 psi

Port No.	Port Position From Log ( )	Port Position From Cable ( )	True Port Depth "Dp" ( )	Fluid Pressure Readings					Pressure Head Outside Port ( ) H = (P2-Patm)/w	Piez. Level Outside Port ( ) Dz = Dp - H	Comments
				Inside Casing (P1)	Outside Casing (P2)	Time H:M:S	Probe Temp. (°C)	Inside Casing (P1)			
LQA2	1452.9	—	—	284.24	107.80	12:35	—	284.16	223.25	1229.0	
MP2B	1438	—	—	277.67	155.56	12:38	—	277.64	333.43	1104.57	
MP2A	1427	—	—	272.89	147.20	12:42	—	272.89	314.14	1112.86	
SQA2	1407	—	—	264.27	203.98	12:46	—	264.27	445.12	961.88	
LQA1B	1047.8	—	—	108.49	68.30	12:56	—	108.56	132.13	915.67	
LQA1A	678.6	—	—	11.29	42.30	13:04	—	11.29	72.16	606.44	
MP1B	670.3	—	—	11.37	38.79	13:08	—	11.34	64.06	606.24	
MP1A	659.3	—	—	11.41	34.04	13:10	—	11.41	53.10	606.20	
SQA1	639.4	—	—	11.38	19.50	13:13	—	11.38	19.56	619.84	
QA-1	299.9	—	—	11.24	11.41	13:19	—	11.24	0.50	299.0	

Notes: w = 0.4335 psi/ft (1.422psi/m) of H_2O Dz = piezometric level in zone Patm = atmospheric pressure H = pressure head of water in zone Dp = true depth of measurement port

Piezometric Profile:
Monitoring Well: R-26

Profile Date:March 24/2011
Comments:Pre-deflation



Client:TPMC
Site:LANL
Datum:gsfc

Figure 1

Plote By:____Date:____
Checked By:____Date:____
Westbay Project: WB 777

Schlumberger
WATER SERVICES

Westbay Piezometric Pressures/Levels
Field Data and Calculation Sheet

Well No.: **R-26**
Datum: —
Elev. G.S.: —
Height of Westbay above G.S.: —
Elev. top of Westbay Casing: —
Reference Elevation: —
Borehole angle: —

Probe Type: **EMS**
Serial No.: 2653
Probe Range: 2000
Westbay Casing Type: **MP55**
Sampler Valve Position: Off

Date: March 28/11
Client: ~~**LNAE**~~ LANL
Job No.: **WB 777**
Location: LANL
Weather: Sun
Operator: **AB**

Note: "Port position" in angled boreholes refer to position along drillhole. True depth (Dp) needs to be calculated using borehole angle and deviation data to calculate zone piezometric level (Dz).

P_{atm} 11.12 psi

Ambient Reading (P_{atm}) (pressure, temperature, time)

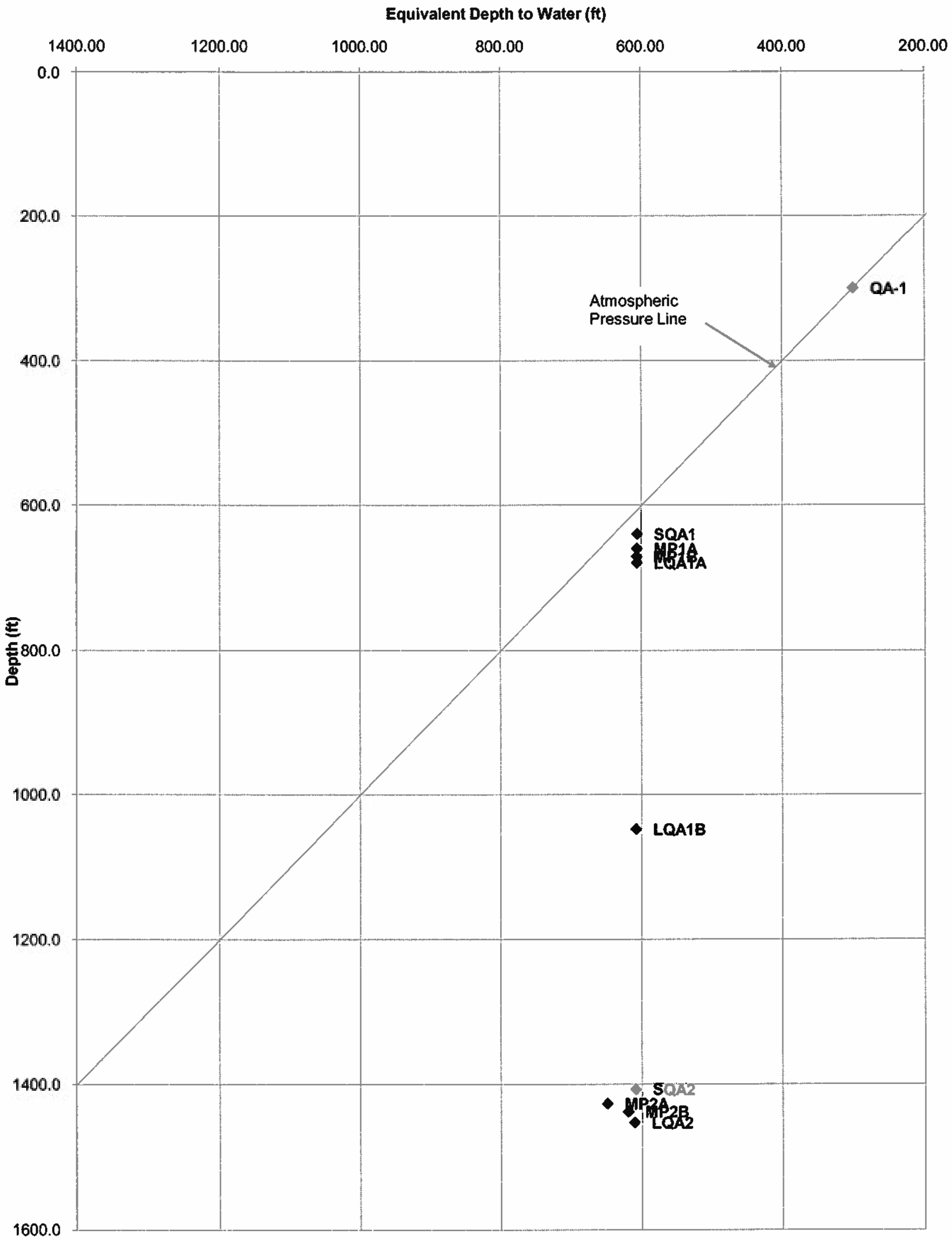
Start: Pressure ______ Finish: ______
Temp ______ ______
Time ______ ______

Port No.	Port Position From Log ( )	Port Position From Cable ( )	~~True Port Depth~~ "Dp" ( )	Fluid Pressure Readings					Pressure Head Outside Port ( )	Piez. Level Outside Port ( )	Comments
				Inside Casing (P1)	Outside Casing (P2)	Time H:M:S	Probe Temp. (°C)	Inside Casing (P1)	H = (P2-Patm)/w	Dz = Dp - H	
LQA2	1452.9	—	1448	132.03	376.0	13:05	—	132.03	843.09	609.81	
MP2B	1438	—	1334	125.47	365.73	13:09	—	125.46	818.02	619.98	
MP2A	1427	—	1425	120.64	348.32	13:12	—	120.62	777.85	649.15	Pressure Decreasing
SQA2	1407	—	—	112.08	356.9	13:16	—	112.11	797.65	609.35	
LQA1B	1047.8	—	—	11.53	201.7	13:23	—	11.53	439.63	608.17	
LQA1A	678.6	—	—	11.51	42.20	13:36	—	11.51	71.70	606.90	
MP1B	670.3	—	—	11.52	38.68	13:49	—	11.52	63.58	606.72	
MP1A	659.3	—	—	11.48	33.95	13:51	—	11.50	52.66	606.64	
SQA1	639.4	—	—	11.52	25.40	13:53	—	11.52	32.94	606.46	
QA-1	299.9	—	—	11.32	11.37	13:58	—	11.32	0.58	299.32	

Notes: w = 0.4335 psi/ft (1.422psi/m) of H_2O Dz = piezometric level in zone Patm = atmospheric pressure H = pressure head of water in zone Dp = true depth of measurement port

Piezometric Profile:
Monitoring Well:R-26

Profile Date: March 28/2011
Comments:Post-deflation Profile



Client:TPMC
Site:LANL
Datum:gsfc

Plot By:____Date:______
Checked By:____Date:_____
Westbay Project:WB777

Figure 2

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WATER SERVICES

Westbay Piezometric Pressures/Levels

Field Data and Calculation Sheet

Well No.: R-26
Datum: —
Elev. G.S.: —
Height of Westbay above G.S.: —
Elev. top of Westbay Casing: —
Reference Elevation: —
Borehole angle: —

Probe Type: EmS
Serial No.: 2653
Probe Range: 2000
Westbay Casing Type: MPSS
Sampler Valve Position: off

Date: March 29/2011
Client: LANL
Job No.: WB 777
Location: LANL
Weather: Sunny
Operator: AB

Note: "Port position" in angled boreholes refer to position along drillhole. True depth (Dp) needs to be calculated using borehole angle and deviation data to calculate zone piezometric level (Dz).

Ambient Reading (P_{atm}) (pressure, temperature, time)

Start: Pressure ______ Finish: ______
Temp ______ ______
Time ______ ______

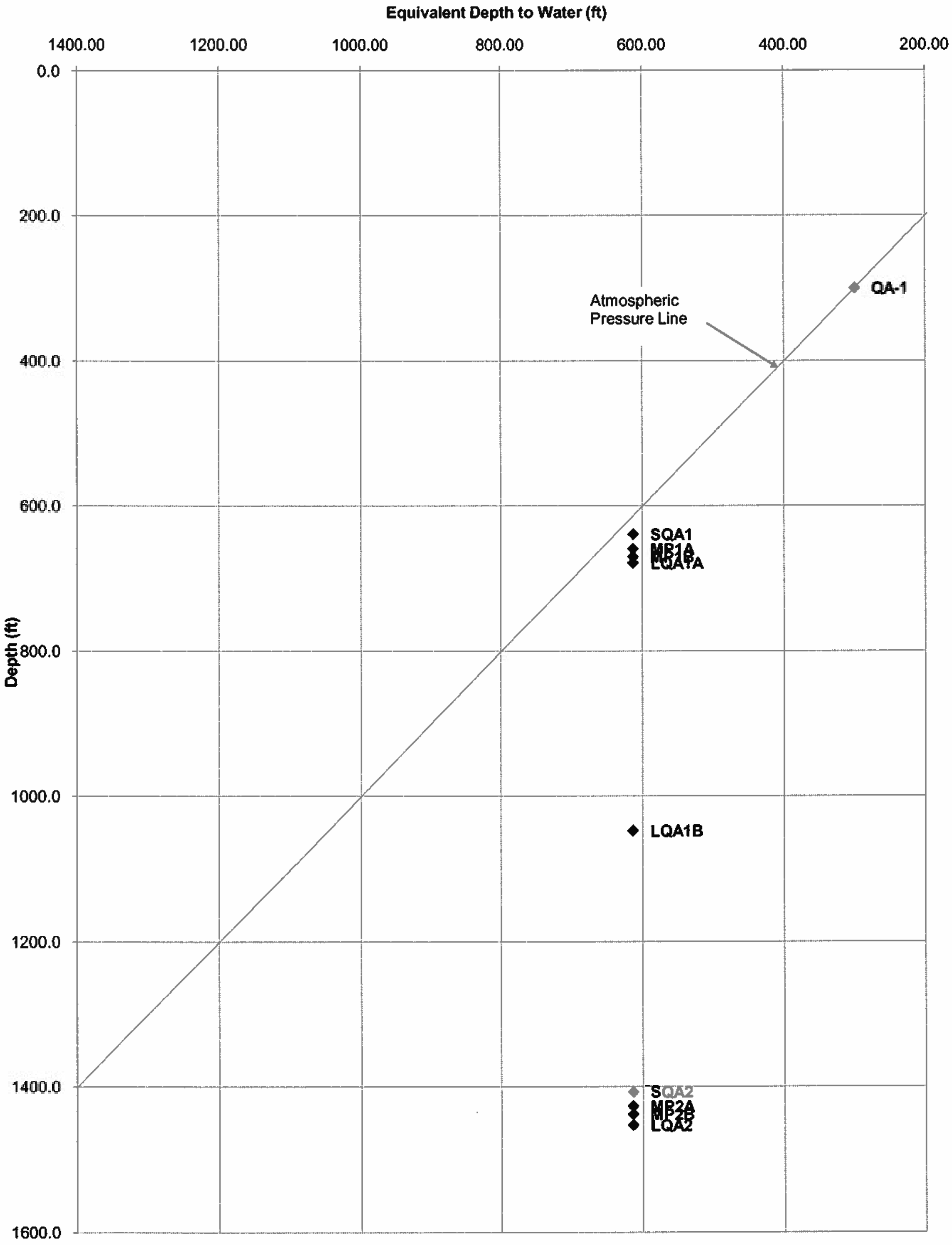
P_{atm} 11.35 psi

Port No.	Port Position From Log ( )	Port Position From Cable ( )	True Port Depth "Dp" ( )	Fluid Pressure Readings					Pressure Head Outside Port ( )	Piez. Level Outside Port ( )	Comments
				Inside Casing (P1)	Outside Casing (P2)	Time H:M:S	Probe Temp. (°C)	Inside Casing (P1)	H = (P2-Patm)/w	Dz = Dp - H	
	1452.9	—	—	374.95	374.9	—	—	374.95	839.54	613.36	
	1438	—	—	368.49	368.5	—	—	368.47	824.43	613.57	
	1427	—	—	363.70	363	—	—	363.72	813.38	613.62	
	1407	—	—	355.15	355.15	—	—	355.15	793.61	613.39	
	1047.8	—	—	199.49	199.50	—	—	199.51	434.53	613.27	
	678.6	—	—	39.65	39.65	—	—	39.65	65.81	612.79	
	670.3	—	—	36.09	36.08	—	—	36.08	57.58	612.72	
	659.3	—	—	31.29	31.29	—	—	31.33	46.53	612.77	
	639.4	—	—	22.74	22.74	—	—	22.74	26.81	612.59	
	295.9	—	—	11.34	11.34	—	—	11.34	299.39	299.39	

Notes: w = 0.4335 psi/ft (1.422psi/m) of H_2O Dz = piezometric level in zone Patm = atmospheric pressure H = pressure head of water in zone Dp = true depth of measurement port

Piezometric Profile:
Monitoring Well:R-26

Profile Date: March 29/2011
Comments:Post-deflation Profile



Client:TPMC
Site:LANL
Datum:gsfc

Figure 3

Plot By:____Date:______
Checked By:____Date:______
Westbay Project:WB777

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WATER SERVICES

Westbay System MP55 Packer Deflation
OCI/TPP Field Record

Page No:________of________

Project No: WB 777 Client: LANL By: AB Date: March 28/2011 Location: LANL

Well No. R-26 Borehole Dia: — Computer Data File: ________.WD3

Packer No: MP 3 Depth: 1448 ft ✓

OCI Tool No: OCI 3076 TPP Tool No: —

Zone Pressure (Pre-Deflation Profile,(Po)): —

Inside Casing Pressure (Before Def,(P i)): —

Inside Casing Pressure (After Def,(P i)): —

Initial Packer Volume Pumped (L): — Packer Volume Returned (L): —

Confirm Packer Valve Open: [✓ Yes] / No)

Comments: Sample Bottle @ 1500psi

O = Off, I = Inflate , C= Close **Tool Information**

WL ( )	OCI (psi)		~~TPP~~		Clock	Tag	OCI			~~TPP~~		Comments
	Open	Close	~~(mA)~~	(psi)			O	I	C	Off	~~On~~	
/	119.54	119.87	—	1500	9:30							Land / Rec / ~~IN~~ WATER
	119.54	"	—	"	9:34							Shoe out OCI ROT (17)
	134.2	121.0	—	"	9:35			✓				
	600	119.0	—	—			✓					
	336	"	—	—	9:35							
	332	119.9	—	—	9:36							Shoe in OCI ROT (17)
	119.52	120.09	—	—	9:38							WL
	119.50	120.09	—	—	9:39							Shoe OUT OCI ROT (17) NO Squeeze
	124.50	120.45	—	—	9:41			✓				
	145.0	"	—	—	9:42							
	137.2	"	—	—	9:42		✓					
	136.8	120.05	—	—	9:43							Shoe in OCI ROT (17)
	119.50	120.31	—	—	9:44							
												END
												Valve open ✓

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WATER SERVICES

Westbay System MP55 Packer Deflation
OCI/TPP Field Record

Page No:_____of_____

Project No: WB 777 Client: —
By: AB Date: March 28/11 Location: LANL
Well No. R-26 Borehole Dia: —
Computer Data File: — .WD3
Packer No: MP 8 Depth: 1412 ft

OCI Tool No: OCI 3076 TPP Tool No: —
Zone Pressure (Pre-Deflation Profile,(Po)): —
Inside Casing Pressure (Before Def,(P i)): —
Inside Casing Pressure (After Def,(P i)): —

Initial Packer Volume Pumped (L): —
Packer Volume Returned (L): —
Confirm Packer Valve Open: [✓ Yes] No
Comments: Sample Bottle @ 1500 psi

O = Off, I = Inflate , C= Close **Tool Information**

WL	OCI (psi)		~~TPP~~		Clock	Tag	OCI			TPP		Comments
( )	Open	Close	~~(mA)~~	(psi)			O	I	C	Off	On	
—	104.31	104.68	—	1500	10:21		✓			—		Land / Rec / In water
					10:22							Shoe out OCI Rot (14)
	377.4	124.11	—	1500	10:23							
								✓				
	302.9	104.97	—	—	10:25							
	301.6	104.79	—	—	10:26		✓					
	300.6	104.8	—	—	10:26							
												Shoe in OCI Rot (14)
	104.43	104.79	—	—	10:29							
	108.0	121.58	—	—	10:32							Shoe out OCI Rot (14) no squeal
	104.27	104.26	—	—	10:33							Shoe in OCI Rot (14)
												Valve open ✓

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WATER SERVICES

Westbay System MP55 Packer Deflation
OCI/TPP Field Record

Page No:_________of_________

Project No: WB 777 Client: LANL By: AB Date: March 28/11 Location: LANL
Well No. R-26 Borehole Dia: — Computer Data File: __________.WD3
Packer No: MP 10 Depth: 1402 ft

OCI Tool No: OCI 3076 TPP Tool No: —
Zone Pressure (Pre-Deflation Profile,(Po)): —
Inside Casing Pressure (Before Def,(P_i)): —
Inside Casing Pressure (After Def,(P_i)): —

Initial Packer Volume Pumped (L): — Packer Volume Returned (L): —
Confirm Packer Valve Open: ([✓ Yes] / No)
Comments: Sample Bottle @ 1500 psi

O = Off, I = Inflate , C= Close **Tool Information**

WL	OCI (psi)		TPP		Clock	Tag	OCI			TPP		Comments
( )	Open	Close	(mA)	(psi)			O	I	C	Off	On	
—	100.27	100.47	—	1500	11:14		✓					Landed / Rec / In water
	425.0	115.47	—	"	11:16							Shoe out OCI Rot (14) Squeeze
								✓				
	342	100.59	—	—	11:17							Valve open ✓
							✓					
	340	100.51	—	—	11:17							
												Shoe In OCI Rot (14)
	101.54	101.97	—	—	11:19							WL ↑
	102.2	102.8	—	—	11:20							
	103.15	103.58	—	—	11:21							
	103.59	104.13	—	—	11:22							
	103.74	104.24	—	—	11:23							
												End

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WATER SERVICES

Westbay System MP55 Packer Deflation
OCI/TPP Field Record

Page No:________ of________

Project No: WB 777 Client: LANL By: AB Date: March 28/11 Location: LANL

Well No. R-26 Borehole Dia: — Computer Data File: — .WD3

Packer No: MP 47 Depth: 1044 ft

OCI Tool No: OCI 3076 TPP Tool No: —

Zone Pressure (Pre-Deflation Profile,(Po)): —

Inside Casing Pressure (Before Def,(P_i)): —

Inside Casing Pressure (After Def,(P_i)): —

Initial Packer Volume Pumped (L): — Packer Volume Returned (L): —

Confirm Packer Valve Open: [✓ Yes] / No)

Comments: Sample Bottle @ 1500 psi

O = Off, I = Inflate , C= Close **Tool Information**

WL ( )	OCI (psi)		TPP		Clock	Tag	OCI			TPP		Comments
	Open	Close	(mA)	(psi)			O	I	C	Off	On	
/	9.19	9.12	/	1500	12:15		✓			✓		Landed / Rec / In Air
—	24.29	9.36	—	"	12:17							Show out OCI Rot (14) squeeze
								✓				
	311.48	9.28	—	—	12:18							Valve open ✓
	301.20	9.34	—	—	12:19		✓					
												Show in OCI Rot (14)
	9.13	9.24	—	—	12:20							
	~~[illegible]~~											Show out OCI Rot (14) no squeeze
↑	30.2	9.51	—	—	12:22							Packer Pressure does build up
												Show in OCI Rot 14
												End

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WATER SERVICES

Westbay System MP55 Packer Deflation
OCI/TPP Field Record

Page No:________of________

Project No: WB 777 Client: LANL By: AB Date: March 24/11 Location: LANL
Well No. R-26 Borehole Dia: — Computer Data File: ________.WD3
Packer No: MP 8S Depth: 674 ft

OCI Tool No: OCI 3076 TPP Tool No: —
Zone Pressure (Pre-Deflation Profile,(Po)): —
Inside Casing Pressure (Before Def,(P I)): —
Inside Casing Pressure (After Def,(P I)): —

Initial Packer Volume Pumped (L): — Packer Volume Returned (L): —
Confirm Packer Valve Open: (Yes / No)
Comments: Sample Bottle pressurized to 1500psi

O = Off, I = Inflate , C= Close **Tool Information**

WL	OCI (psi)		~~TPP~~		Clock	Tag	OCI			TPP		Comments
( )	Open	Close	~~(mA)~~	(psi)			O	I	C	Off	On	
0	8.72	8.97	—	1500	15:15		✓			/		Landed /REC
	10.54	9.15	—	"	15:17							Shoe out OCI ROT 14
	310	"	—	"				✓				OCI TO I
	7277	9.53	—		15:20							
			—				✓					OCI TO O
	72.3	9.53	—		15:21							
	"	"	—	N/A					✓			OCI TO C
	"	"	—				✓					
	"	"	—		15:22							SHOE IN OCI ROT 14
												End Trip out /Save File

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WATER SERVICES

Westbay System MP55 Packer Deflation
OCI/TPP Field Record

Page No:________of________

Project No: WB 777 Client: LANL By: AB Date: March 24/11 Location: LANL

Well No. R-26 Borehole Dia: — Computer Data File: ________.WD3

Packer No: MP 90 Depth: 645 ft

OCI Tool No: OCT 3076 TPP Tool No: —

Zone Pressure (Pre-Deflation Profile,(Po)): —

Inside Casing Pressure (Before Def,(P i)): —

Inside Casing Pressure (After Def,(P i)): —

Initial Packer Volume Pumped (L): — Packer Volume Returned (L): —

Confirm Packer Valve Open: (Yes / No)

Comments: Sample Bottle at 1500 psi

O = Off, I = Inflate , C= Close **Tool Information**

WL	OCI (psi)		~~TPP~~ Bottle		Clock	Tag	OCI			TPP		Comments
( )	Open	Close	(mA)	(psi)			O	I	C	Off	On	
✓	8.72	9.11	—	1500	15:56		✓				/	LANDED / REC
				"								Show out OCI Rot (18)
	9.63	9.25	—	"	15:57			✓				
	257	9:50	—	"	16:00		✓					
	255	"	—	"	16:01							Show in OCI Rot 18
			—	"			✓					Re land
			—									Show out OCI Rot 18
	9.07	9.20	—		16:05			✓				
	38	9.59	—									
	1666	9:44	—		16:07		✓					
												Show in Rot 18
												Valve open ✓

Schlumberger
WATER SERVICES

Westbay System MP55 Packer Deflation
OCI/TPP Field Record

Page No:_________of_________

Project No: WB 777 Client: LANL By: AB Date: March 24/11 Location: LANL
Well No. R-26 Borehole Dia: — Computer Data File: ________.WD3
Packer No: MP 92 Depth: 635 ft

OCI Tool No: OCI 3076 TPP Tool No: —
Zone Pressure (Pre-Deflation Profile,(Po)): —
Inside Casing Pressure (Before Def,(P_i)): —
Inside Casing Pressure (After Def,(P_i)): —

Initial Packer Volume Pumped (L):________ Packer Volume Returned (L):________
Confirm Packer Valve Open: (Yes / No)
Comments: Sample Bottle @ 1500psi

O = Off, I = Inflate , C= Close **Tool Information**

WL ( )	OCI (psi)		TPP		Clock	Tag	OCI			TPP		Comments
	Open	Close	(mA)	(psi)			O	I	C	Off	On	
	8.89	8.94	—	1500	16:31		✓					LANDED / REC
												Shoe out OCI Rot 14
	10.60	9.15	—	1500	16:33							
								✓				
	208	9.63	—	N/A	16:34							
	203	9.59	—		16:35		✓					
												Shoe in OCI Rot 14
	8.39	9.81	—		16:36							
					16:37							
	9.42	9.12	—									Shoe out OCI Rot 14
								✓				
	38.0	9.56	—		16:40							Valve open
	15.92	9.41	—		16:41		✓					
	14.8	9.60	-		16:41							
												Shoe in OCI Rot 14

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WATER SERVICES

Westbay System MP55 Packer Deflation
OCI/TPP Field Record

Page No:______of______

Project No: WB 777 Client: LANL By: AB Date: March 28/11 Location: LANL

Well No. R-26 Borehole Dia: — Computer Data File: ______.WD3

Packer No: MP 127 Depth: 295 ft

OCI Tool No: OCI 3076 TPP Tool No: —

Zone Pressure (Pre-Deflation Profile,(Po)): —

Inside Casing Pressure (Before Def,(P i)): —

Inside Casing Pressure (After Def,(P i)): —

Initial Packer Volume Pumped (L): — Packer Volume Returned (L): —

Confirm Packer Valve Open: [✓ Yes] / No)

Comments: Sample Bottle @ 1500 psi

Tool Information

O = Off, I = Inflate , C= Close

WL ( )	OCI (psi)		TPP		Clock	Tag	OCI			TPP		Comments
	Open	Close	(mA)	(psi)			O	I	C	Off	On	
—	8.61	8.80	—	1500	11:49		✓			—	—	Landed / Rec / In Air
	—	—	—	—	11:51							Shoe out OCI Rot 14 squeeze
	31.23	9.11	—	1500	11:51			✓				
	139.35	9.34	—	~~[illegible]~~	11:52							Valve open ✓
	138.07	9.19	—	~~—~~	11:53		✓					
	8.61	8.57	—	—	11:54							Shoe in OCI Rot (14)
	"	"	—	—	11:55							
	9.30	8.93	—	—	11:57							Shoe out OCI Rot (14)
												" NO SQUEEZE I
												Shoe in OCI Rot (14)
												END

APPENDIX 2

Monitoring Well CDV-R-15-3

Summary MP Casing Log

Company: LANL
Well: CdV15
Site: TA15
Project: HE Plume Characterization

Job No: WB777
Author: DL

Well Information

Reference Datum: ground level
Elevation of Datum: 0.00 ft.
MP Casing Top: 0.00 ft.
MP Casing Length: 1670.09 ft.

Borehole Depth: 1670.00 ft.
Borehole Inclination: vertical
Borehole Diameter: 12.00 in.

Well Description:
Plastic MP55 System
Other References:
5.0 in ID SS casing+screens: LANL8/11/00
B/F LANL 8/15/00 from Gamma Log 8/11/00
M-Collars 2.5 ft below port top

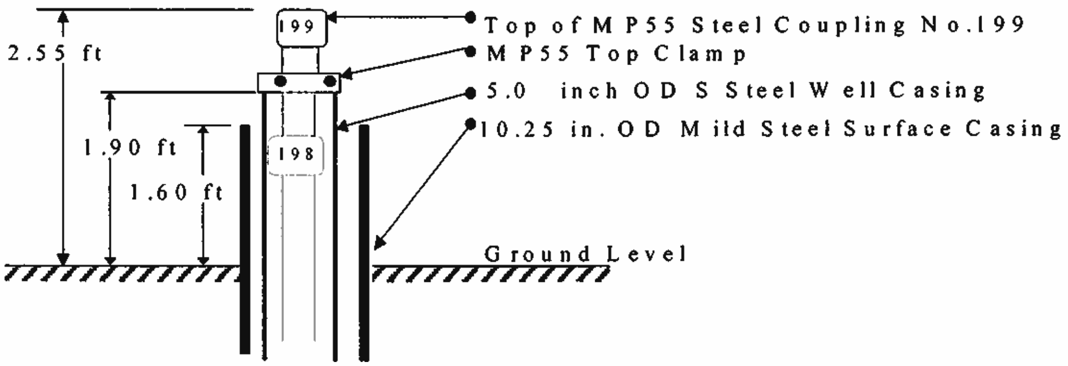
File Information

File Name: 777CV15A.WWD
Report Date: Sun Sep 24 16:25:48 2000

File Date: Sep 24 16:08:23 2000

Sketch of Wellhead Completion

CdV-R15-3 Surface Completion



Legend

(Qty) MP Components

- (2) 0603 - MP55 End Plug
- (143) 0601M30 - MP55 Casing, PVC, 3.0m
- (19) 0612M15 - MP55 Packer with stiffeners
- (26) 0601M15 - MP55 Casing, PVC, 1.5m
- (10) 0601M10 - MP55 Casing, PVC, 1.0m
- (165) 0602 - MP55 Regular Coupling
- (28) 0605 - MP55 Measurement Port
- (7) 0607 - MP55 Hydraulic Pumping Port
- (10) 0608 - MP55 Magnetic Location Collar

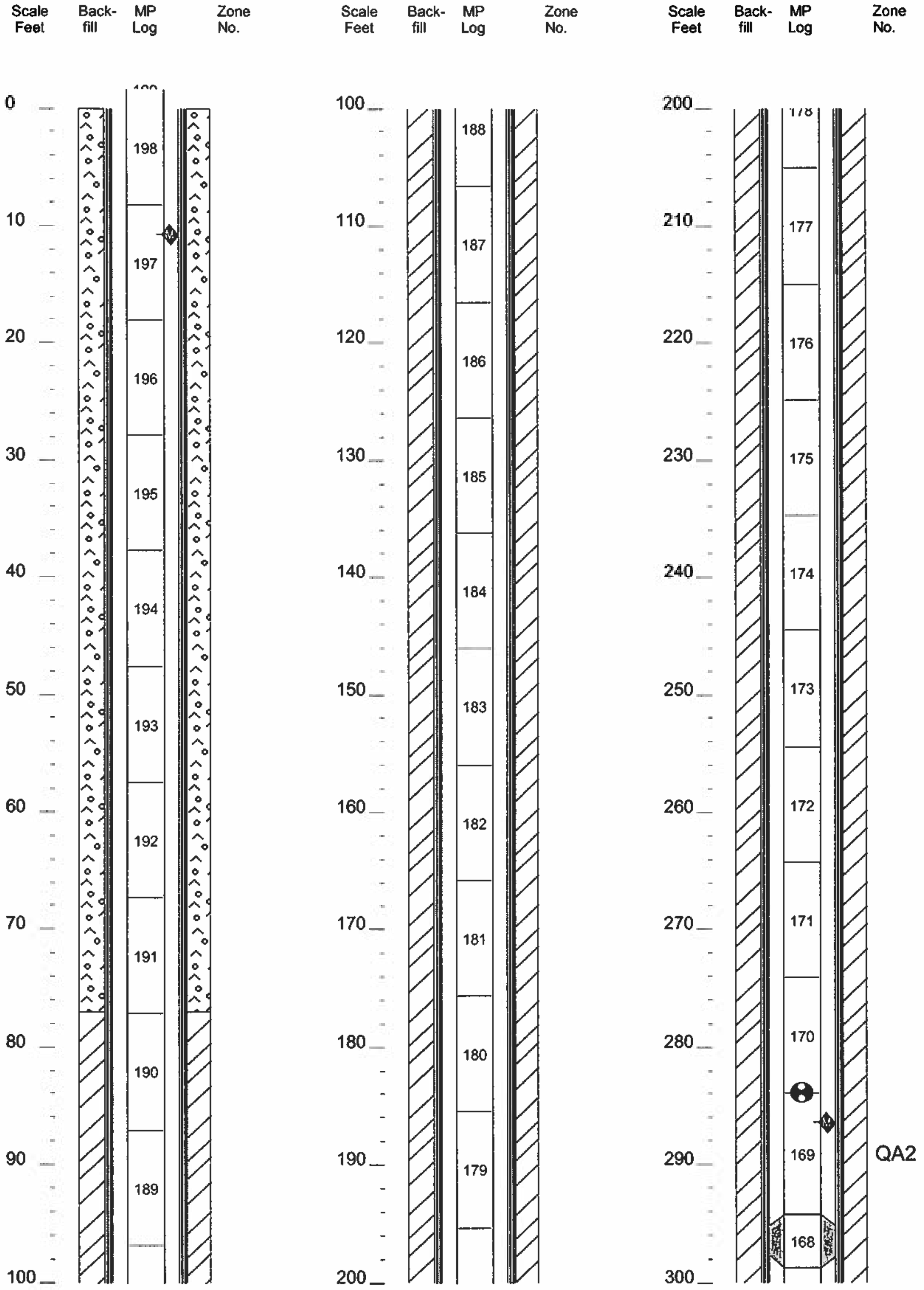
Geology

Backfill/Casing

- Concrete
- Bentonite
- Sand Fine
- Sand Coarse
- Grout
- Native / Cave
- Stainless Steel
- Well Screen

Summary MP Casing Log
LANL

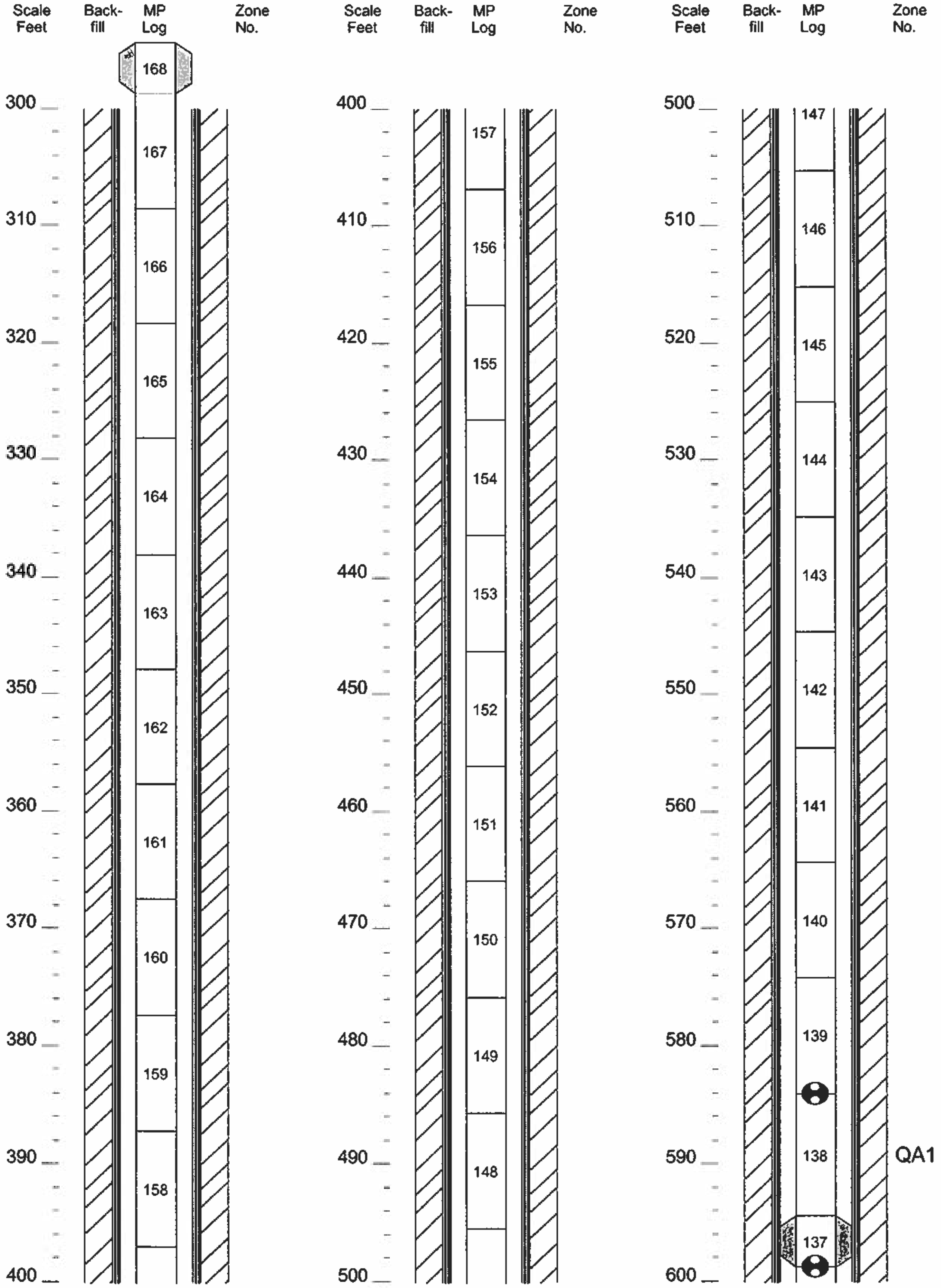
Job No: WB777
Well: CdV15



Sun Sep 24 16:25:49 2000

Summary MP Casing Log
LANL

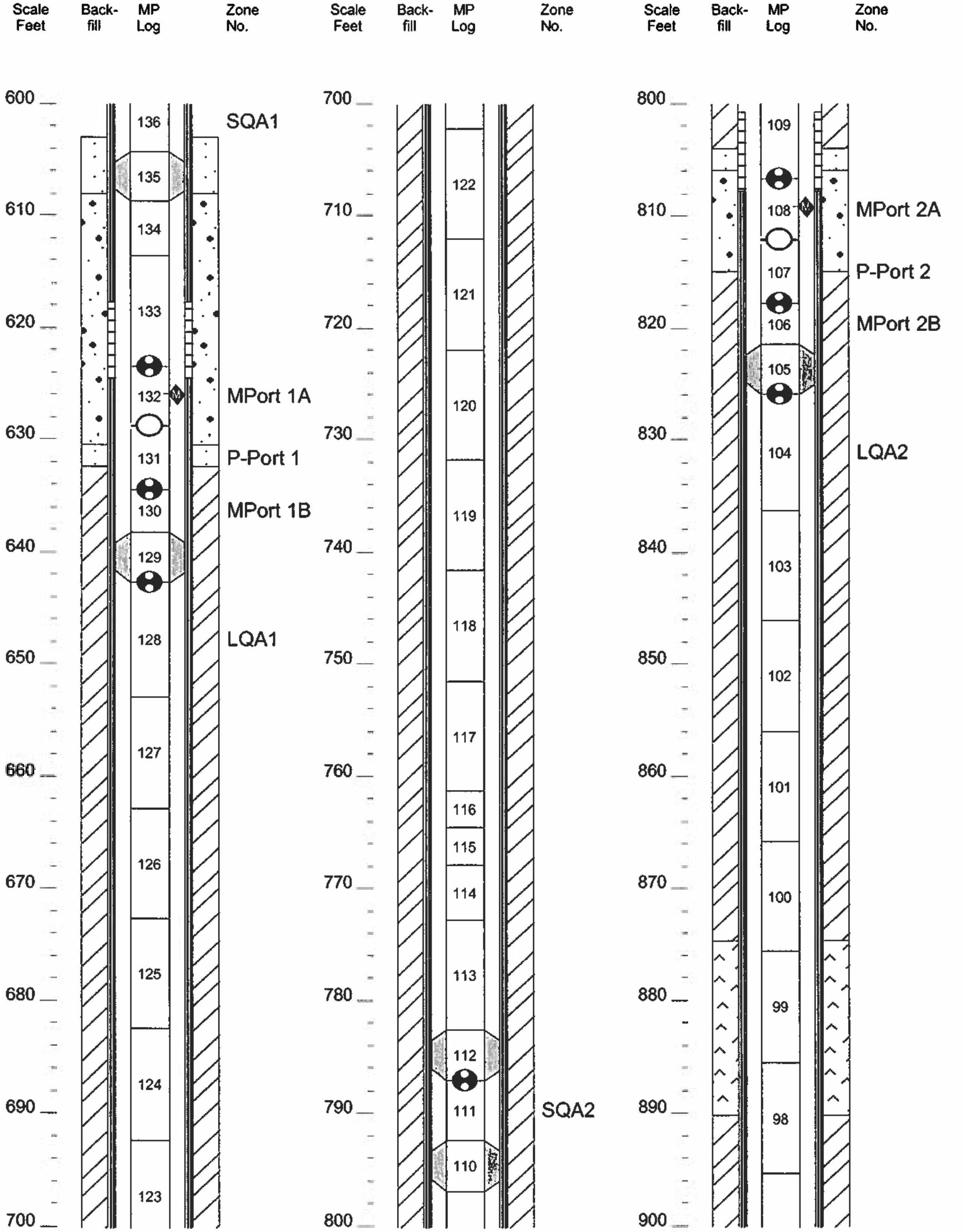
Job No: WB777
Well: CdV15



Sun Sep 24 17:22:20 2000

Summary MP Casing Log
LANL

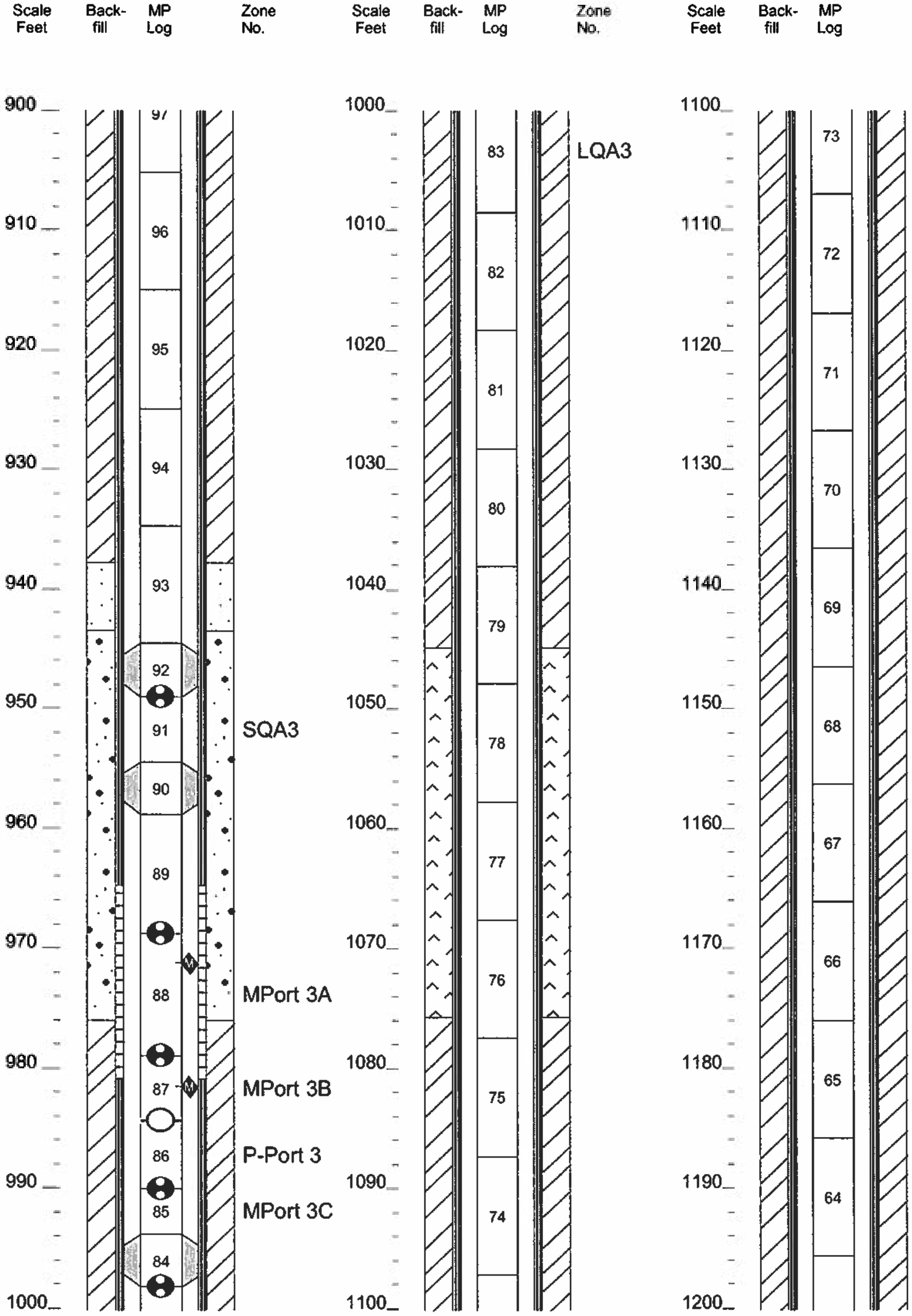
Job No: WB777
Well: CdV15



Sun Sep 24 17:22:24 2000

Summary MP Casing Log
LANL

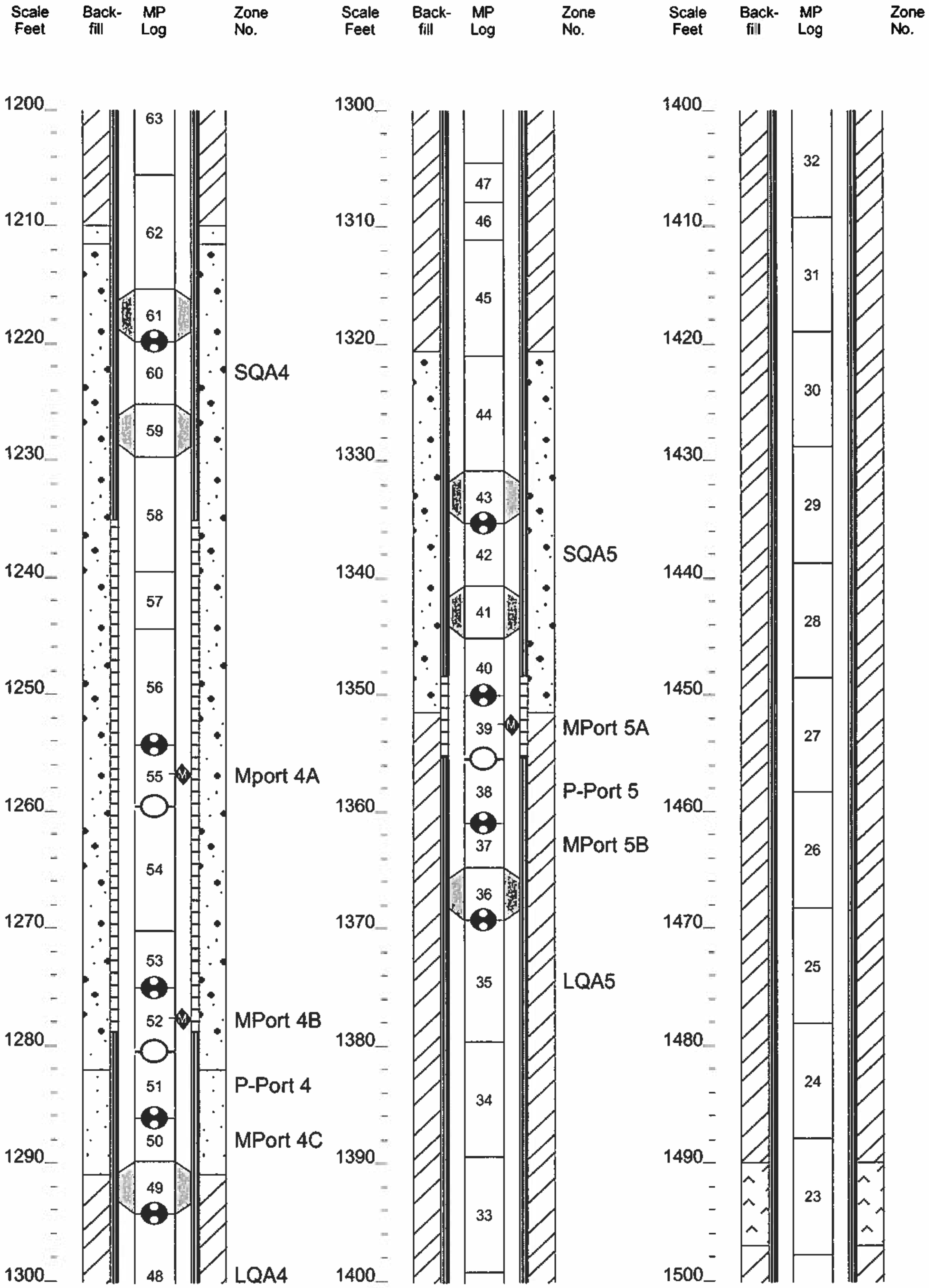
Job No: WB777
Well: CdV15



Sun Sep 24 17:22:28 2000

Summary MP Casing Log
LANL

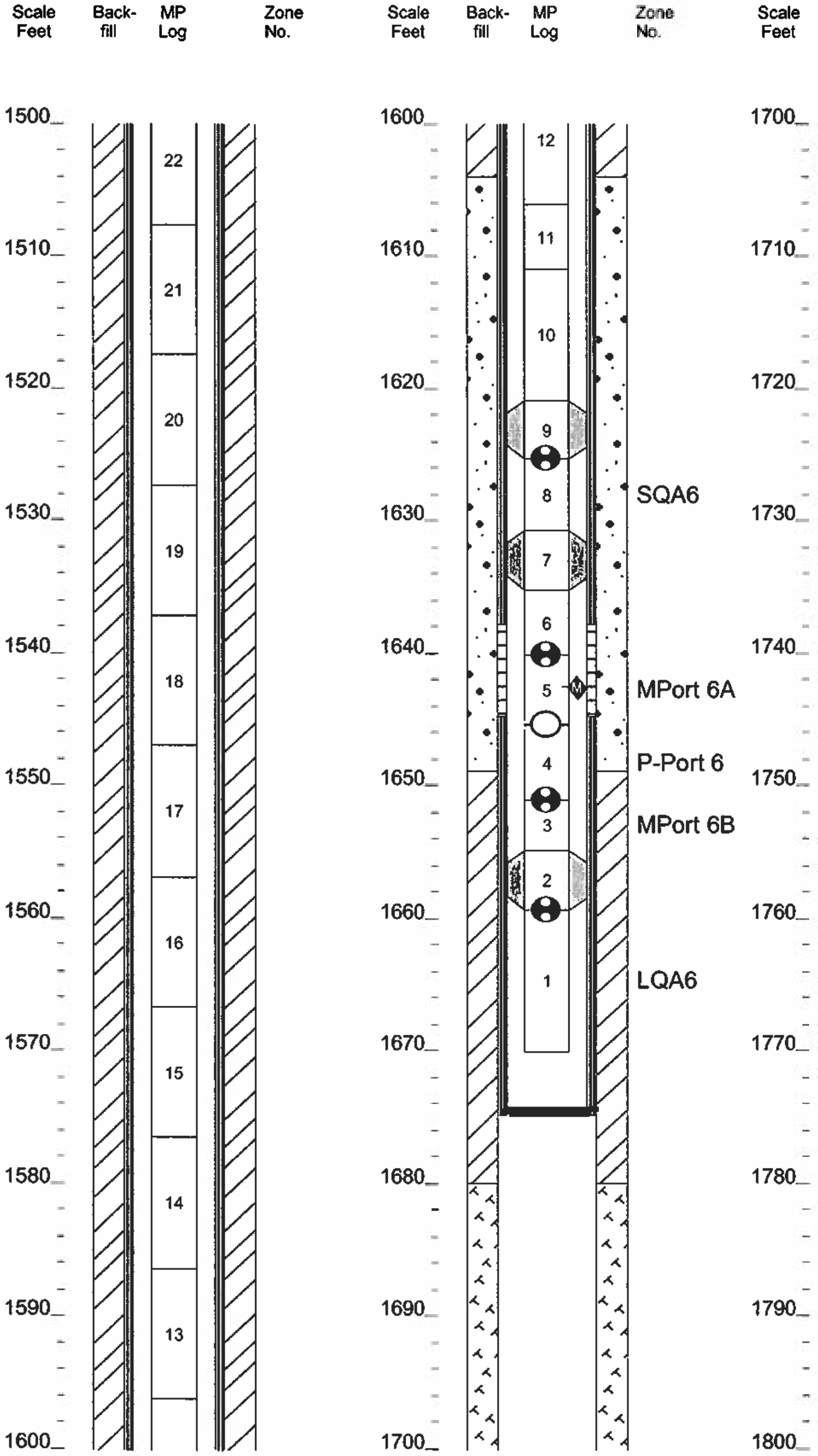
Job No: WB777
Well: CdV15



Sun Sep 24 17:22:34 2000

Summary MP Casing Log
LANL

Job No: WB777
Well: CdV15



1/2

Schlumberger
WATER SERVICES

Westbay Piezometric Pressures/Levels
Pre-Deflation Field Data and Calculation Sheet

Well No.: **Cdv-R-15-3**
Datum: —
Elev. G.S.: —
Height of Westbay above G.S.: —
Elev. top of Westbay Casing: —
Reference Elevation: —
Borehole angle: —

Probe Type: **EMS**
Serial No.: 2653
Probe Range: 2000
Westbay Casing Type: **MP55**
Sampler Valve Position: —

Date: March 26/2011
Client: ~~LNAL~~ LANL
Job No.: **WB 777**
Location: Los Alamos
Weather: Sunny
Operator: **AB**

Note: "Port position" in angled boreholes refer to position along drillhole. True depth (Dp) needs to be calculated using borehole angle and deviation data to calculate zone piezometric level (Dz).

P_{atm} 11.38 psi

Ambient Reading (P_{atm}) (pressure, temperature, time)
Start: Pressure 11.38 Finish: 11.32
Temp
Time 9:14am 10:56

Port No.	Port Position From Log ( )	Port Position From Cable ( )	True Port Depth "Dp" ( )	Fluid Pressure Readings: Inside Casing (P1)	Outside Casing (P2)	Time H:M:S	Probe Temp. (°C)	Inside Casing (P1)	Pressure Head Outside Port ( ) H = (P2-Patm)/w	Piez. Level Outside Port ( ) Dz = Dp - H	Comments Est DTW = 1254 ft
LQA6	1659.3	1667	—	193.08	184.30	9:37		—	398.89	1260.41	
MP6B	1651.1	1659	—	189.56	—	9:42		—	—	—	Not Functioning Time of Install
MP6A	M 1640.1	1648	—	184.65	169.38	9:45		183.92	364.48	1275.6	Callan @ 1648
SQA6	1625.2	1633	—	177.41	177.60	9:53		177.41	383.44	1241.76	→ Open Valve Lower Inside
LQA5	1369.3	1377	—	66.63	67.12	9:58		66.57	128.58	1240.72	Water Level
MP5B	1361.1	1369	—	63.17	64.46	10:00		63.17	122.45	1238.65	
MP5A	M 1350.1	1357	—	58.29	59.71	10:02		58.29	111.49	1238.61	Callan @ 1358
SQA5	1335.3	1341	—	51.86	44.23	10:06		51.85	75.78	1259.52	Valve open WL↓ P1 - No change
LQA4	1294.3	1300	—	33.92	32.22	10:12		33.92	48.07	1246.23	
MP4C	1286.1	1292	—	30.40	32.07	10:14		30.46	47.73	1238.37	
MP4B	M 1275.1	1232	—	25.71	27.31	10:16		25.77	36.75	1238.35	
MP4A	M 1254.4	1261	—	16.65	18.25	10:18		16.65	15.85	1238.35	
SQA4	1219.9	1225	—	11.83	13.87	10:20		11.83	5.74	1214.16	
LQA3	998.5	1005	—	11.76	11.32	10:25		11.76	1.01	997.49	Dry
MP3C	990.3	997	—	11.69	14.78	10:27		11.69	7.84	982.46	

Notes: w = 0.4335 psi/ft (1.422psi/m) of H_2O Dz = piezometric level in zone Patm = atmospheric pressure H = pressure head of water in zone Dp = true depth of measurement port

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Schlumberger
WATER SERVICES

Westbay Piezometric Pressures/Levels
Field Data and Calculation Sheet

Well No.: **Cdv-R-15-3**
Datum: —
Elev. G.S.: —
Height of Westbay above G.S.: —
Elev. top of Westbay Casing: —
Reference Elevation: —
Borehole angle: —

Probe Type: **EMS**
Serial No.:
Probe Range:
Westbay Casing Type: **MP55**
Sampler Valve Position:

Date:
Client: ~~LNAL~~ LANL
Job No.: **WB 777**
Location:
Weather:
Operator: **AB**

Note: "Port position" in angled boreholes refer to position along drillhole. True depth (Dp) needs to be calculated using borehole angle and deviation data to calculate zone piezometric level (Dz).

Ambient Reading (P_{atm}) (pressure, temperature, time)

P_{atm} ________ psi

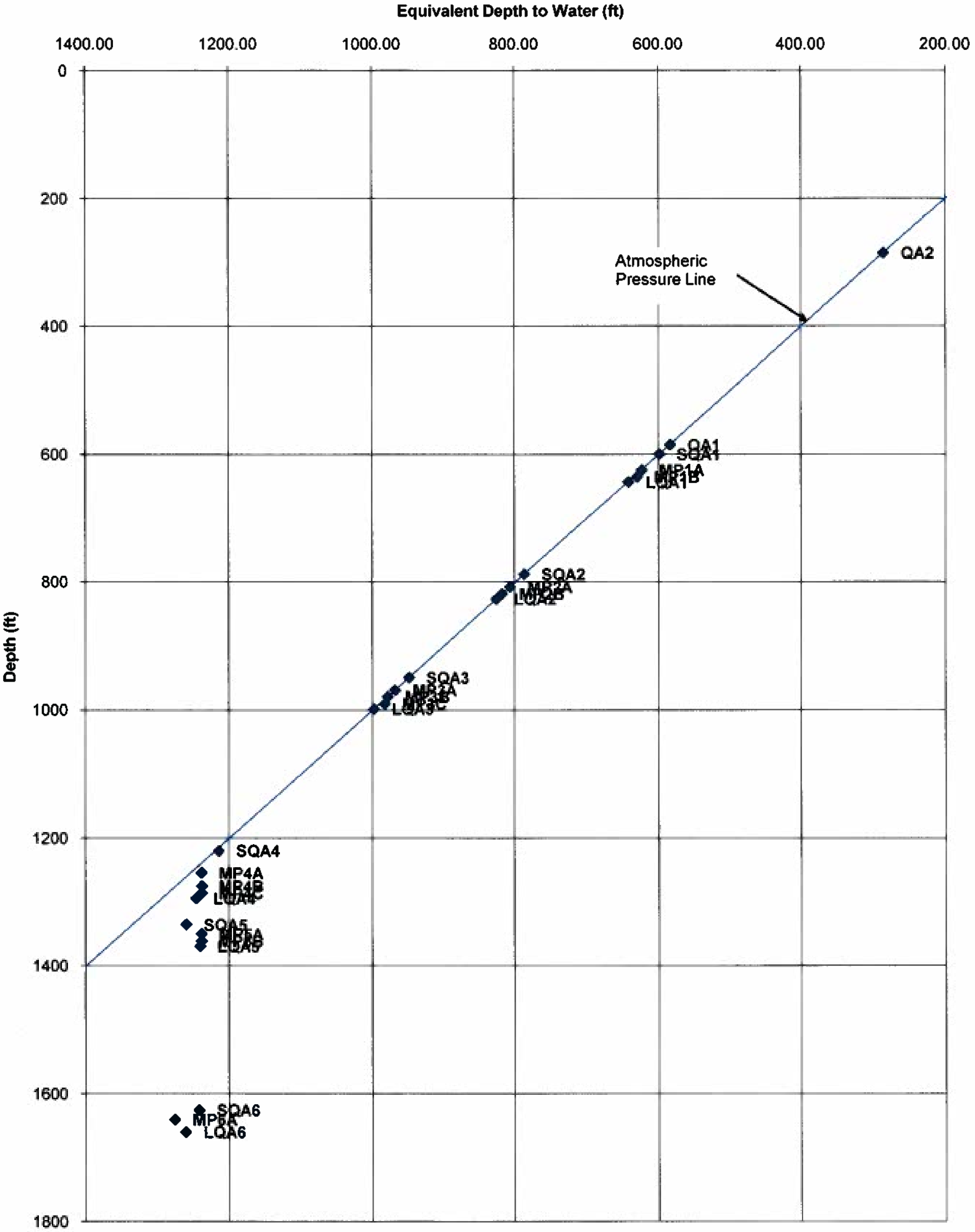
Start: Pressure ________ Finish: ________
Temp ________ ________
Time ________ ________

Port No.	Port Position From Log ( )	Port Position From Cable ( )	True Port Depth "Dp" ( )	Fluid Pressure Readings					Pressure Head Outside Port ( ) H = (P2-Patm)/w	Piez. Level Outside Port ( ) Dz = Dp - H	Comments
				Inside Casing (P1)	Outside Casing (P2)	Time H:M:S	Probe Temp. (°C)	Inside Casing (P1)			
MP3B	M 979.3	986	—	11.75	11.81	10:28	—	11.75	0.99	978.31	Port Dry - Zone Bottom Wet
MP3A	M 969	976	—	11.74	11.81	10:30	—	11.74	0.99	968.01	Dry
SQA3	949.5	956	—	11.74	11.61	10:32	—	11.74	0.99	948.51	"
LQA2	826.5	833	—	11.67	11.60	10:34	—	11.67	0.99	825.51	"
MP2B	818.3	825	—	11.66	11.78	10:36	—	11.66	0.99	817.31	"
MP2A	M 807.3	814	—	11.65	11.78	10:37	—	11.65	0.99	806.31	"
SQA2	787.7	794	—	11.65	11.71	10:38	—	11.65	0.99	786.71	"
LQA1	643.4	649	—	11.63	11.69	10:41	—	11.63	0.99	642.41	"
MP1B	635.3	642	—	11.62	13.65	10:43	—	11.62	5.24	630.06	Wet
MP1A	M 624.3	630	—	11.54	11.66	10:45	—	11.53	0.65	623.65	Dry
SQA1	599.7	606	—	11.58	11.46	10:46	—	11.57	0.65	599.05	Dry
QA1	584.9	590	—	11.64	11.69	10:48	—	11.64	0.65	584.25	Dry
QA2	285.3	291	—	11.53	11.52	10:52	—	11.53	0.65	284.65	Dry

Notes: w = 0.4335 psi/ft (1.422psi/m) of H_2O Dz = piezometric level in zone Patm = atmospheric pressure H = pressure head of water in zone Dp = true depth of measurement port

Piezometric Profile:
Monitoring Well: CDV-R-15-3

Profile Date:March 26/2011
Comments:Pre-deflation



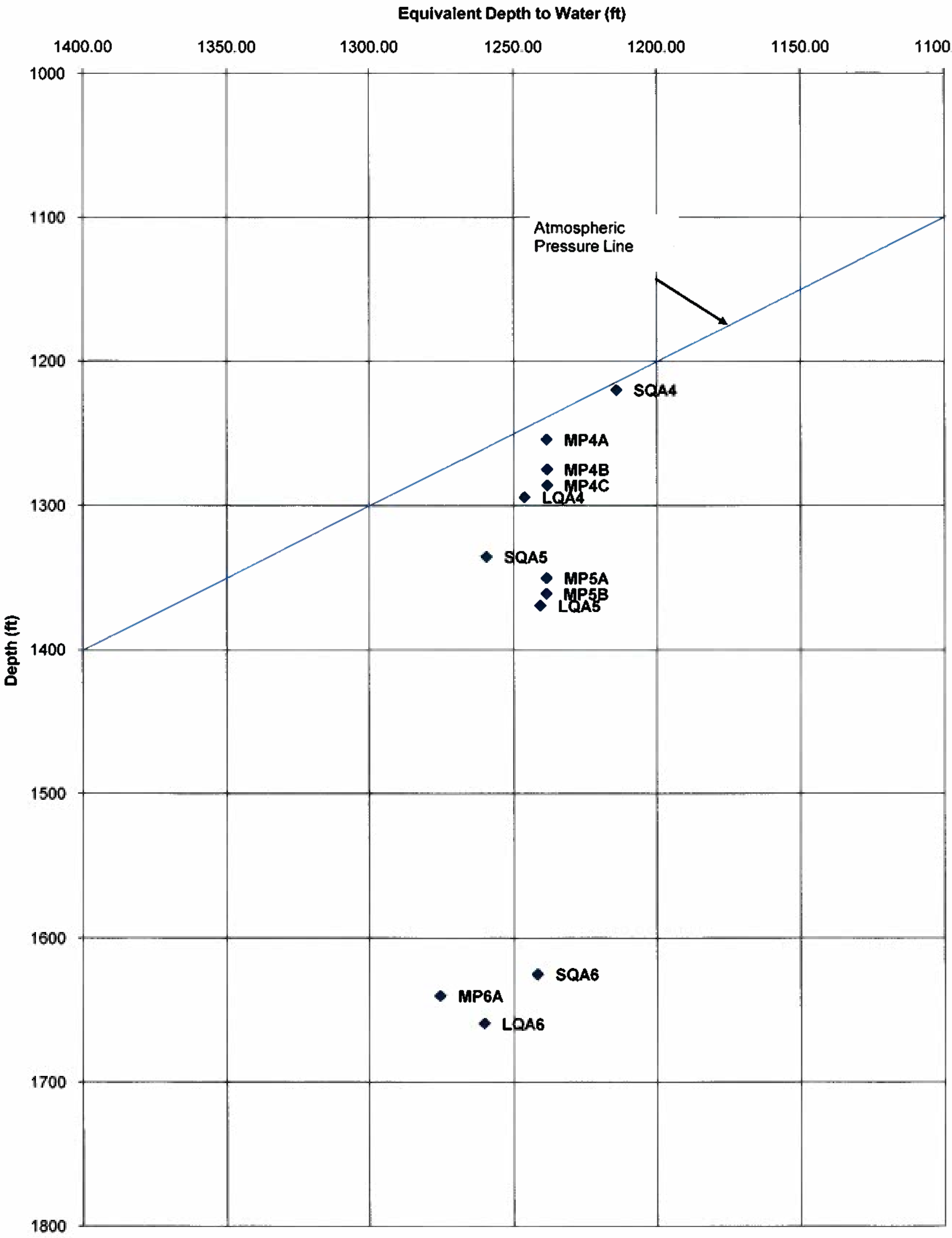
Client:TPMC
Site:LANL
Datum:gsfc

Figure 1

Plote By:____Date:____
Checked By:____Date:____
Westbay Project: WB 777

Piezometric Profile:
Monitoring Well: CDV-R-15-3

Profile Date:March 26/2011
Comments:Pre-deflation



Client:TPMC
Site:LANL
Datum:gsfc

Figure 1

Plote By:____Date:____
Checked By:____Date:____
Westbay Project: WB 777

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WATER SERVICES

Westbay Piezometric Pressures/Levels
Post-Deflation Field Data and Calculation Sheet

Well No.: Cdv-R-15-3
Datum: —
Elev. G.S.: —
Height of Westbay above G.S.: —
Elev. top of Westbay Casing: —
Reference Elevation: —
Borehole angle: —

Probe Type: EMS
Serial No.: 2653
Probe Range: 2000
Westbay Casing Type: MP55
Sampler Valve Position: —

Date: March 31/11
Client: ~~LNAL~~ LANL
Job No.: WB 777
Location: LANL
Weather: Sun
Operator: AB

Note: "Port position" in angled boreholes refer to position along drillhole. True depth (Dp) needs to be calculated using borehole angle and deviation data to calculate zone piezometric level (Dz).

Ambient Reading (P_{atm}) (pressure, temperature, time)
Start: Pressure 11.48 Finish:
Temp
Time 8:40

P_{atm} 11.48 psi

Port No.	Port Position From Log ( )	Port Position From Cable ( )	True Port Depth "Dp" ( )	Fluid Pressure Readings					Pressure Head Outside Port ( ) H = (P2-Patm)/w	Piez. Level Outside Port ( ) Dz = Dp - H	Comments
				Inside Casing (P1)	Outside Casing (P2)	Time H:M:S	Probe Temp. (°C)	Inside Casing (P1)			
LQA6	1659.3	—	—	193.97	193.96	8:57	—	193.97	420.95	1238.35	
MP6B	1651.1	—	—	190.50	222.0	9:00	—	190.50	—	—	Port not working 2006 ?
MP6A	1640.1	—	—	185.58	185.64	9:05	—	185.58	401.75	1238.35	
SQA6	1625.2	—	—	179.20	179.08	9:07	—	179.20	386.62	1238.58	
LQA5	1369.3	—	—	68.80	68.79	9:13	—	68.80	132.20	1237.10	
MP5B	1361.1	—	—	65.20	65.20	9:14	—	65.20	123.92	1237.18	
MP5A	1350.1	—	—	60.38	60.43	9:17	—	60.43	112.92	1237.18	
SQA5	1335.3	—	—	54.08	54.08	9:18	—	54.08	98.27	1237.14	
LQA4	1294.3	—	—	36.27	36.26	9:20	—	36.26	57.16	1237.33	
MP4C	1286.1	—	—	32.62	32.62	9:22	—	32.62	48.77	1237.29	
MP4B	1275.1	—	—	27.87	27.87	9:24	—	27.87	37.81	1237.24	
MP4A	1254.4	—	—	18.93	18.92	9:26	—	18.93	17.16	1237.24	
SQA4	1219.9	—	—	11.95	11.93	9:28	—	11.95	1.08	1218.82	
LQA3	998.5	—	—	11.95	11.95	9:34	—	11.95	1.08	997.42	
MP3C *	990.3	—	—	11.88	11.88	9:35	—	11.88	0.92	989.38	

Notes: w = 0.4335 psi/ft (1.422psi/m) of H_2O Dz = piezometric level in zone Patm = atmospheric pressure H = pressure head of water in zone Dp = true depth of measurement port

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Schlumberger
WATER SERVICES

Westbay Piezometric Pressures/Levels
Field Data and Calculation Sheet

Well No.: **Cdv-R-15-3**
Datum: —
Elev. G.S.: —
Height of Westbay above G.S.: —
Elev. top of Westbay Casing: —
Reference Elevation: —
Borehole angle: —

Probe Type: **EMS**
Serial No.: 2653
Probe Range: 2000
Westbay Casing Type: **MP55**
Sampler Valve Position: —

Date: MARCH 31/2011
Client: ~~LNAE~~ LANL
Job No.: **WB 777**
Location: LANL
Weather: Sun
Operator: **AB**

Note: "Port position" in angled boreholes refer to position along drillhole. True depth (Dp) needs to be calculated using borehole angle and deviation data to calculate zone piezometric level (Dz).

Ambient Reading (P_{atm}) (pressure, temperature, time)

Start: Pressure ______ Finish: ______
Temp ______ ______
Time ______ ______

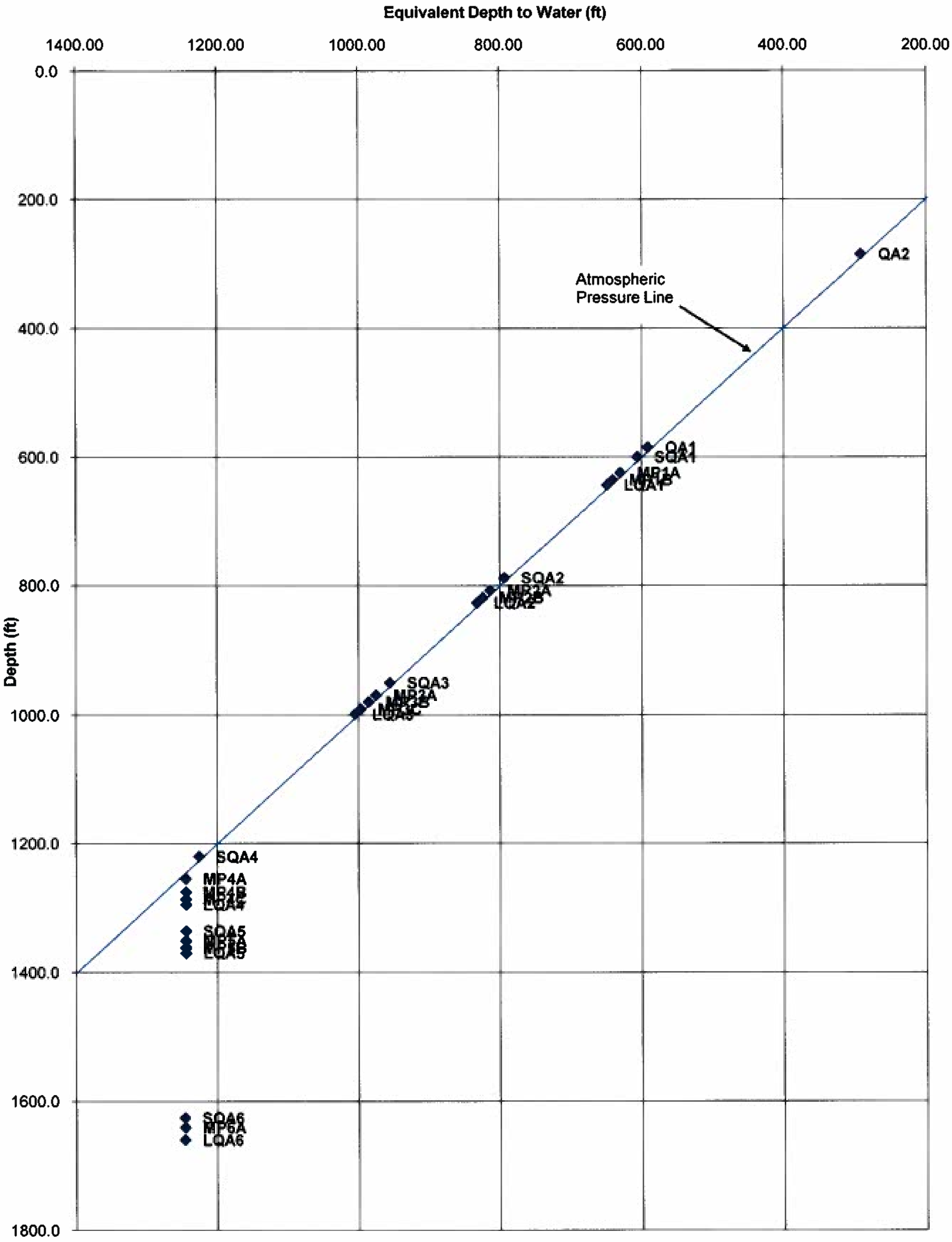
P_{atm} 11.45 psi

Port No.	Port Position From Log ( )	Port Position From Cable ( )	True Port Depth "Dp" ( )	Fluid Pressure Readings					Pressure Head Outside Port ( )	Piez. Level Outside Port ( )	Comments
				Inside Casing (P1)	Outside Casing (P2)	Time H:M:S	Probe Temp. (°C)	Inside Casing (P1)	H = (P2-Patm)/w	Dz = Dp - H	
MP3B	979.3			11.87	11.87	—		11.87	0.90	978.4	
MP3A	969			11.87	11.87	—		11.87	0.90	968.1	
SQA3 ✓	949.5			11.87	11.86	9:42	—	11.87	0.88	948.6	
LQA2	826.5			11.86	11.86	—		11.86	0.85	825.6	
MP2B ✓	818.3			11.85	11.84	9:44	—	11.85	0.85	817.4	
MP2A	807.3			11.78	11.78	—		11.78	0.69	806.6	
SQA2 ✓	787.7			11.78	11.84	9:46	—	11.82	0.69	787.0	
LQA1	643.4			11.78	11.78	—		11.78	0.69	642.9	
MP1B ✓	635.3			11.69	11.69	9:49	—	11.65	0.48	634.8	
MP1A	624.3			11.65	11.69	—		11.69	0.48	623.8	
SQA1	599.7			11.69	11.69	—		11.69	0.48	599.2	
QA1 ✓	584.9			11.73	11.72	9:52	—	11.72	0.48	584.4	
QA2	285.3			11.69	11.66	—		11.69	0.48	284.8	

Notes: w = 0.4335 psi/ft (1.422psi/m) of H_2O Dz = piezometric level in zone Patm = atmospheric pressure H = pressure head of water in zone Dp = true depth of measurement port

Piezometric Profile:
Monitoring Well:CDV-R-15-3

Profile Date: March 31/2011
Comments:Post-deflation Profile



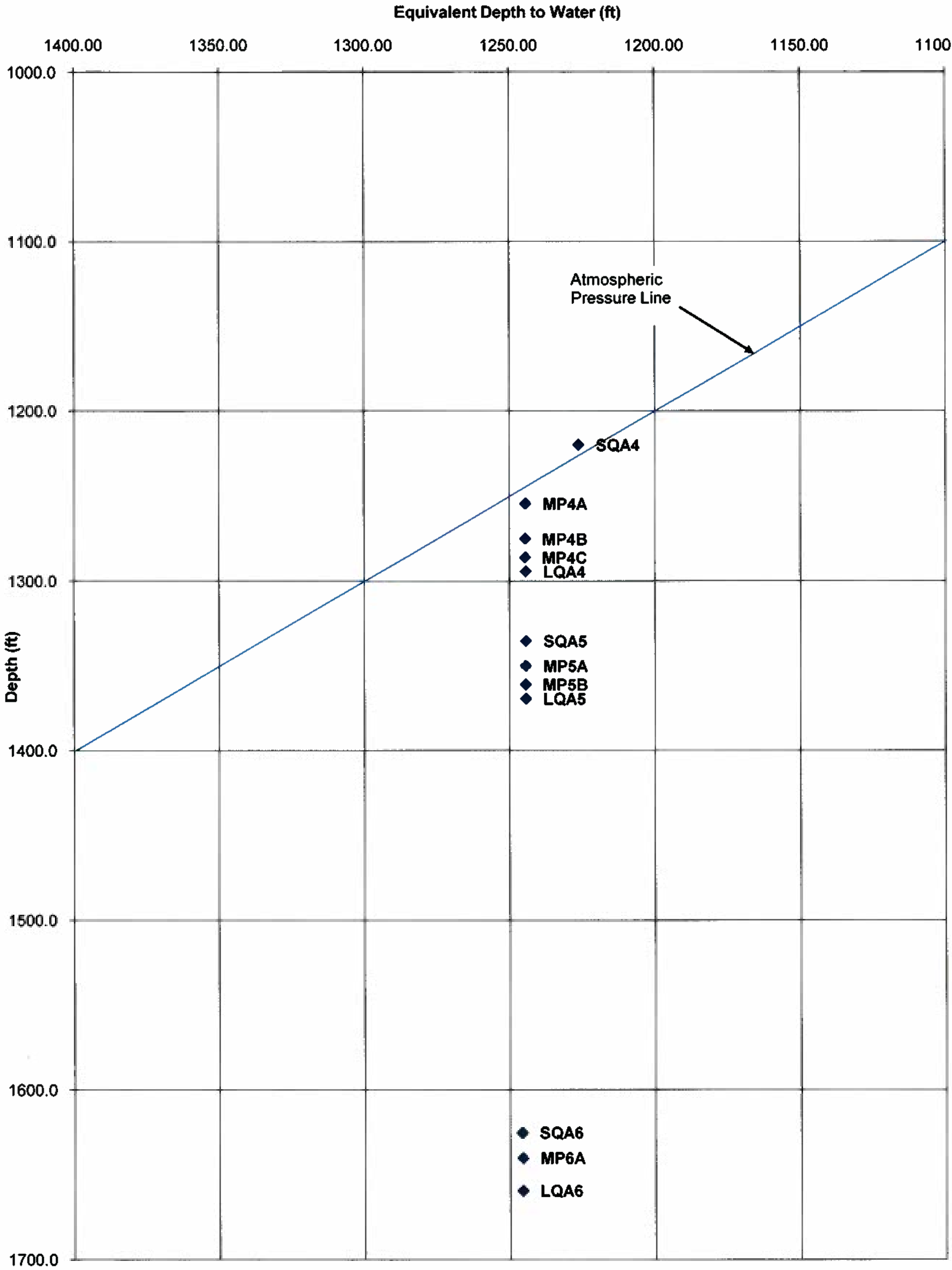
Client:TPMC
Site:LANL
Datum:gsfc

Figure 2

Plot By:____Date:______
Checked By:____Date:_____
Westbay Project:WB777

Piezometric Profile:
Monitoring Well:CDV-R-15-3

Profile Date: March 31/2011
Comments:Post-deflation Profile



Client:TPMC
Site:LANL
Datum:gsfc

Figure 2

Plot By:____Date:______
Checked By:____Date:______
Westbay Project:WB777

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WATER SERVICES

Westbay System MP55 Packer Deflation
OCI/TPP Field Record

Page No: 1 of 1

Project No: WB 777 Client: LANL By: AB Date: March 26/11 Location: LANL

Well No. CdV-R-15-3 Borehole Dia: Computer Data File: .WD3

Packer No: 2 MP 13B Depth: 604 ft

OCI Tool No: OCI 3076 TPP Tool No: —

Zone Pressure (Pre-Deflation Profile,(Po)): —

Inside Casing Pressure (Before Def,(P_i)): —

Inside Casing Pressure (After Def,(P_i)): —

Initial Packer Volume Pumped (L): — Packer Volume Returned (L): —

Confirm Packer Valve Open: [✓ Yes] / No)

Comments: Sample Bottle 1500 psi

O = Off, I = Inflate , C= Close **Tool Information**

WL	OCI (psi)		TPP		Clock	Tag	OCI			TPP		Comments
( )	Open	Close	(mA)	(psi)			O	I	C	Off	On	
/	8.81	9.16	—	1500	14:33		✓			/		Landed / Rec Bottle @ 1500
												Shoe out OCI Rot (18)
	10.04	9.35	—	—	14:39			✓				
			—	—								
	280		—	—								
	154	9.40	—	—	14:41							Valve open ✓
	152	9.40	—	—			✓					
			—	—	14:45							Shoe in OCI Rot (18)
	8.75	9.06	—	—	14:46							
												End

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WATER SERVICES

Westbay System MP55 Packer Deflation
OCI/TPP Field Record

Page No: 1 of 1

Project No: WB 777 Client: LANL By: AB Date: March 26/11 Location: LANL
Well No. R-15-3 Borehole Dia: — Computer Data File: .WD3
Packer No: 2 MP 137 Depth: 594 ft

OCI Tool No: OCI 3076 TPP Tool No: —
Zone Pressure (Pre-Deflation Profile,(Po)): —
Inside Casing Pressure (Before Def,(P i)): —
Inside Casing Pressure (After Def,(P i)): —

Initial Packer Volume Pumped (L): — Packer Volume Returned (L): —
Confirm Packer Valve Open: [✓ Yes] / No)
Comments: Both @ 1500 psi

O = Off, I = Inflate , C= Close **Tool Information**

WL	OCI (psi)		TPP		Clock	Tag	OCI			TPP		Comments
( )	Open	Close	(mA)	(psi)			O	I	C	Off	On	
—	8.96	9.01	—	1500	15:13		✓					Landed /Rec
—	10.10	9.28	—	—	15:14							Shoe out OCI ⑱
—	500		—	—	15:15			✓				OCI I ✓
—	132	9.72	—	—	15:15		✓					
—	128.5	9.57	—	—	15:17							Shoe in OCI ⑱
—	8.98	9.04	—	—	15:19							
												Dump Valve open ✓
												END

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WATER SERVICES

Westbay System MP55 Packer Deflation
OCI/TPP Field Record

Page No: 1 of 1

Project No: WB 777 Client: LANL By: AB Date: March 27/2011 Location: LANL
Well No. CdV-R-15-3 Borehole Dia: — Computer Data File: .WD3
Packer No: MP41 Depth: 1342 ft

OCI Tool No: 3076 / 3067 TPP Tool No: 4259
Zone Pressure (Pre-Deflation Profile,(Po)): —
Inside Casing Pressure (Before Def,(P I)): 37.54
Inside Casing Pressure (After Def,(P I)): —

Initial Packer Volume Pumped (L): — Packer Volume Returned (L): —
Confirm Packer Valve Open: [✓ Yes] / No)
Comments:

O = Off, I = Inflate , C= Close **Tool Information**

WL	OCI (psi)		TPP		Clock	Tag	OCI			TPP		Comments
( )	Open	Close	(mA)	(psi)			O	I	C	Off	On	
/	37.69	38.01	/	78.95	9:42	/	✓			✓		Landed / Rec
	—	—	20	—	9:44						✓	TPP Pump up
	—	—	24	—	9:45							
	—	—	33	—	9:46							
			41	—	9:47							
			47	—	9:48							
			50	—	9:49							
			51	1398	9:50					✓		TPP off Rot 67
	37.23	37.82	—	1385	9:51							OCI Shoe out Rot 18
	38.31	41.29	—	1358	9:52							
								✓				Valve open ✓
	148.26	37.78	—	162.58	9:53							
	147.65	〃	—	161.92	9:54		✓					
												[illegible] OCI Rot 18
	37.86	38.41	—	156.3	9:58							
	38.01	38.51	—	158.1	9:59							

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Westbay System MP55 Packer Deflation
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Project No: WB 777 Client: LANL By: AB Date: March 27/2011 Location: LANL
Well No. R-15-3 Borehole Dia: — Computer Data File: .WD3
Packer No: MP-59 Depth: 1225 ft

OCI Tool No: 3076 TPP Tool No: 4259
Zone Pressure (Pre-Deflation Profile,(Po)): —
Inside Casing Pressure (Before Def,(P_i)): —
Inside Casing Pressure (After Def,(P_i)): —

Initial Packer Volume Pumped (L): — Packer Volume Returned (L): —
Confirm Packer Valve Open: [✓ Yes] / No)
Comments:

O = Off, I = Inflate , C= Close **Tool Information**

WL	OCI (psi)		TPP		Clock	Tag	OCI			TPP		Comments
( )	Open	Close	(mA)	(psi)			O	I	C	Off	On	
	9.00	9.46	—	10.34	10:05		✓			✓		Land - Rec / In Air
	#	〃	〃	〃	10:07							Blow out OCI Rot 18
	9.66	9.86	—	10.64	10:09							
			15.7	—	10:10						✓	
			18.5	—	10:12							
			30.5	—	10:13							
			40.0	—	10:14							
			50.0	—	10:15							
			52.0	—	10:16					✓		TPP Rot 69
	10.45	9.75	—	1381	10:16							
	113	9.90	~~127~~	127	10:18			✓				Valve open ✓
	109	10.05	—	124	10:19		✓					
			—									Close in OCI Rot 18
	9.13	9.32	—	119	10:21							
	9.30	9.50	—	119	10:23							End OCI I pressure ↑↓

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Westbay System MP55 Packer Deflation
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Project No: WB 777 Client: LANL By: AB Date: March 27/11 Location: LANL
Well No. R-15-3 Borehole Dia: — Computer Data File: .WD3
Packer No: MP-6I Depth: 1215 ft

OCI Tool No: 3076 TPP Tool No: 4259
Zone Pressure (Pre-Deflation Profile,(Po)): —
Inside Casing Pressure (Before Def,(P_i)): —
Inside Casing Pressure (After Def,(P_i)): —

Initial Packer Volume Pumped (L): — Packer Volume Returned (L): —
Confirm Packer Valve Open: [✓ Yes] / No)
Comments:

O = Off, I = Inflate , C= Close **Tool Information**

WL ( )	OCI (psi)		TPP		Clock	Tag	OCI			TPP		Comments
	Open	Close	(mA)	(psi)			O	I	C	Off	On	
/	9.16	9.36	—	10.38	10:30		✓			✓		Landed / Rec / in Air
	9.86	9.80	—	10.52	10:32							Shoe out OCI Rot 18
								✓				
	21.42	9.94	—	10.52	10:33						✓	TPP ON
			15.7	—	10:33							
			20	—	10:35							
			30	—	10:36							4 ft
			40	—	10:37							BAL
			13	—	10:37					✓		Valve open ✓
	55.46	9.80	—	69.4	10:38							
	53.69	10.09	—	67.8	10:39		✓					
												Shoe in OCI Rot 18
	9.20	9:40	—	66.8	10:40							
												END

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Westbay System MP55 Packer Deflation
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Project No: WB 777 Client: LANL
Well No. R-15-3 Borehole Dia: —
Packer No: MP 84 Depth: 994 ft
By: AB Date: March 27/2011 Location: LANL
Computer Data File: .WD3

OCI Tool No: 3076 TPP Tool No: 4259
Zone Pressure (Pre-Deflation Profile,(Po)): —
Inside Casing Pressure (Before Def,(P i)): —
Inside Casing Pressure (After Def,(P i)): —

Initial Packer Volume Pumped (L): —
Packer Volume Returned (L): —
Confirm Packer Valve Open: [✓ Yes] / No
Comments:

O = Off, I = Inflate , C= Close **Tool Information**

WL	OCI (psi)		TPP		Clock	Tag	OCI			TPP		Comments
( )	Open	Close	(mA)	(psi)			O	I	C	Off	On	
✓	9.07	9.09	—	10.44	10:52		✓			✓		Landed / Rec / In Air
	9.72	9.68	—	10.33	10:54							Slow out OCI Rot (18)
	-1.04	9.87	—	10.36	10:56			✓				OCI I
			15.4	—	10:57						✓	TPP On
			20	—	10:59							
			25	—	11:00							
			30	—	11:01							
			35	—	11:01							Rot 51 Valve open ✓
			13.9	—	11:01					✓		
	95.1	9.96	—	109.2	11:02		✓					OCI O
	94.54	9.76	—	106.9	11:03							
												Thru in OCI Rot (18)
	9.22	9.27	—	98.33	11:05							
												END
	9.10	9.41	—	96.00								

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Project No: WB 777 Client: LANL By: AB Date: March 27/11 Location: LANL
Well No. R-15-3 Borehole Dia: Computer Data File: .WD3
Packer No: MP90 Depth: 954 ft

OCI Tool No: OCI 3076 TPP Tool No: 4259
Zone Pressure (Pre-Deflation Profile,(Po)): —
Inside Casing Pressure (Before Def,(P$_i$)): —
Inside Casing Pressure (After Def,(P$_i$)): —

Initial Packer Volume Pumped (L): —
Packer Volume Returned (L): —
Confirm Packer Valve Open: [✓ Yes] / No
Comments:

O = Off, I = Inflate , C= Close **Tool Information**

WL ( )	OCI (psi)		TPP		Clock	Tag	OCI			TPP		Comments
	Open	Close	(mA)	(psi)			O	I	C	Off	On	
/	9.16	9.35	—	14.11	11:12		✓			✓		Land / Rec / In Air
	11.25	9.54	—	13.96	11:15							Show out 'OCI' Port (18)
	0.03	9.54	—	14.40	11:15			✓				
											✓	TPP On
			14.4	—	11:16							
			20.0	—	11:17							
			25.0	—	11:18							
			30.0	—	11:19							
			35.0	—	11:19							35 mA = Est 809psi
			14.0	—	11:19							Valve open
										✓		
—	81.12	9.69	—	95.40	11:20							
	80.98	9.69	—	94.51	11:21		✓					
												Show for OCI (18)
	9.07	9.15	—	87.27	11:23							
												End

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Westbay System MP55 Packer Deflation
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Project No: WB 777 Client: LANL By: AB Date: March 27/11 Location: LANL
Well No. R-15-3 Borehole Dia: — Computer Data File: .WD3
Packer No: MP92 Depth: 944 ft

OCI Tool No: OCI 3076 TPP Tool No: 4259
Zone Pressure (Pre-Deflation Profile,(Po)): —
Inside Casing Pressure (Before Def,(P $_i$)): —
Inside Casing Pressure (After Def,(P $_i$)): —

Initial Packer Volume Pumped (L): ✓ Packer Volume Returned (L): —
Confirm Packer Valve Open: [✓ Yes] / No)
Comments:

O = Off, I = Inflate , C= Close **Tool Information**

WL	OCI (psi)		TPP		Clock	Tag	OCI			TPP		Comments
( )	Open	Close	(mA)	(psi)			O	I	C	Off	On	
/	9.10	9.34	—	1244	11:28		✓			✓		Land / Rec In Air
	12.82	9.49	—	12.58	11:31							Shoe out OCI Rot ⑱
	-1.50	9.63	—	12.58	11:31			✓				
			14.9	—	11:32						✓	TPP On
			20	—	11:34							
			25	—	11:35							
			30	—	11:35							
			35	—	11:36							
			36	—	11:36							
			13	—	11:36					✓		TPP OFF / Valve open ✓ Est 800 psi
	65.71	9.82	—	80.13	11:38							
	65.56	9.78	—	72.64	11:39		✓					
												Shoe In OCI Rot ⑱
	9.13	9.19	—	72.18	11:41							
												END

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Westbay System MP55 Packer Deflation
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Project No: WB 777 Client: LANL By: AB Date: March 27/11 Location: LANL

Well No. R-15-3 Borehole Dia: — Computer Data File: .WD3

Packer No: MP105 Depth: 822 ft

OCI Tool No: OCI 3076 TPP Tool No: 4259

Zone Pressure (Pre-Deflation Profile,(Po)): —

Inside Casing Pressure (Before Def,(P_I)): —

Inside Casing Pressure (After Def,(P_I)): —

Initial Packer Volume Pumped (L): — Packer Volume Returned (L): —

Confirm Packer Valve Open: [✓ Yes] / No

Comments:

O = Off, I = Inflate , C= Close **Tool Information**

WL	OCI (psi)		TPP		Clock	Tag	OCI			TPP		Comments
( )	Open	Close	(mA)	(psi)			O	I	C	Off	On	
/	9.05	9.14	—	15.02	10:49		/			/		Land / Rev / In Air
	14.38	9.28	—	15.34	11:52							Shoe out OCI Rot (18)
	0.80	9.62	—	15.34	11:52			✓				
											✓	TPP On
			14.4	—	11:53							
			20	—	11:54							16
			30	—	11:55							27
			35	—	11:56							34
			40	-	11:57							39
			44	-	11:57							44 Valve Open ✓
			14	-	11:57					✓		46 Test 1000psi
	96.89	9.66	—	110.7	11:58							
	94.3	9.66	—	108.9	11:59		✓					
	8.90	8.83	—	102.4	12:01							Shoe in OCI Rot (18)
												End

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OCI/TPP Field Record

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Project No: WB 777 Client: LANL By: AB Date: March 27/2011 Location: LANL
Well No. R-15-3 Borehole Dia: —
Computer Data File: .WD3
Packer No: MP110 Depth: 792 ft

OCI Tool No: OCI 3076 TPP Tool No: 4259
Zone Pressure (Pre-Deflation Profile,(Po)): —
Inside Casing Pressure (Before Def,(P i)): —
Inside Casing Pressure (After Def,(P i)): —

Initial Packer Volume Pumped (L): — Packer Volume Returned (L): —
Confirm Packer Valve Open: [✓ Yes] / No
Comments:

O = Off, I = Inflate , C= Close **Tool Information**

WL	OCI (psi)		TPP		Clock	Tag	OCI			TPP		Comments
( )	Open	Close	(mA)	(psi)			O	I	C	Off	On	
✓	8.02	9.17	—	14.56	12:06		✓			✓		Landed / Rec / In Air
	11.67	9.46	—	12.67	12:08							Shoe out OCI Rot (18)
	26.11	9.46	-	12.67	12:09			✓				
											✓	TPP On
			14.3	—	12:09							
			20	-	12:10							13
			25	-	12:11							18
			30	—	12:12							24
			35	—	12:12							29
			40	—	12:13							37 Value open ✓
			13	—	12:13					✓		39
	75.35	9.65	—	79.64	12:14							
	75.2	9.50	—	89.49	12:15		✓					
												Shoe in OCI Rot 18
	914	8.51	—	25.01	13:32							
												END

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Project No: WB 777 Client: LANL By: AB Date: March 27/11 Location: LANL

Well No. R-15-3 Borehole Dia: — Computer Data File: .WD3

Packer No: MP112 Depth: 782 ft

OCI Tool No: OCI 3076 TPP Tool No: 4259

Zone Pressure (Pre-Deflation Profile,(Po)): —

Inside Casing Pressure (Before Def,(P i)): —

Inside Casing Pressure (After Def,(P i)): —

Initial Packer Volume Pumped (L): — Packer Volume Returned (L): —

Confirm Packer Valve Open: [✓ Yes] / No)

Comments:

O = Off, I = Inflate , C= Close **Tool Information**

WL	OCI (psi)		TPP		Clock	Tag	OCI			TPP		Comments
( )	Open	Close	(mA)	(psi)			O	I	C	Off	On	
✓	9.03	9.10	—	10.23	13:41		✓			✓		Land / Rec / In Air
	9.18	9.24	—	10:38	13:44							Shoe out OCI Rot (22) ?
	9.47	9:10	—	10:12	13:45			✓				
											✓	TPP On
			14.3	—	13:45							4
			20	—	13:47							27
			25	—	13:48							33
			30	—	13:49							39
			35	—								
			13	—	13:49					✓		42 Valve open ✓
	67.07	9.10	—	81.35	13:50							
							✓					
	67.07	9.10	—	80.46	13:51							
												Shoe in OCI Rot 22
	9.21	9.10	—	73.52	13:53							
												End

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Project No: WB 777 Client: By: AB Date: March 30/11 Location:

Well No. Borehole Dia: Computer Data File: .WD3

Packer No: MP7 Depth: 1632 ft

OCI Tool No: TPP Tool No:

Zone Pressure (Pre-Deflation Profile,(Po)):

Inside Casing Pressure (Before Def,(P_i)):

Inside Casing Pressure (After Def,(P_i)):

Initial Packer Volume Pumped (L): Packer Volume Returned (L):

Confirm Packer Valve Open: (Yes / No)

Comments:

O = Off, I = Inflate , C= Close **Tool Information**

WL	OCI (psi)		TPP		Clock	Tag	OCI			TPP		Comments
( )	Open	Close	(mA)	(psi)			O	I	C	Off	On	
/	162.43	162.97	—	—	10:01		/			/		Landed / Rec
/	162.43	162.83	—	—	10:04							Shoe out OCI Rot 18
	4004							✓				Valve open ✓
	244	162.8	—	—	10:04							
	241	〃	—	—	10:05		✓					
												Shoe in OCI Rot 18
	162.4	1625	—	—	10:07							
												End

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Project No: WB 777 Client: By: AB Date: March 30/11 Location:

Well No. Borehole Dia: Computer Data File: .WD3

Packer No: MP-2 Depth: 1655 ft

OCI Tool No: TPP Tool No:

Zone Pressure (Pre-Deflation Profile,(Po)):

Inside Casing Pressure (Before Def,(P_i)):

Inside Casing Pressure (After Def,(P_i)):

Initial Packer Volume Pumped (L): Packer Volume Returned (L):

Confirm Packer Valve Open: (Yes / No)

Comments:

O = Off, I = Inflate , C= Close **Tool Information**

WL ( )	OCI (psi)		TPP		Clock	Tag	OCI			TPP		Comments
	Open	Close	(mA)	(psi)			O	I	C	Off	On	
✓	173.34	173.73	—	2000	10:52		✓					Land / Rec
	224.6	173.62	—	—	10:54							Shove out OCI Rot 18
								✓				Valve open ✓
	329	173.4	—	—	10:56							
	326	173.4	—	—	10:57		✓					
												Shove in OCI Rot 18

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Project No: WB 777 Client: LANL By: AB Date: March 30/11 Location: LANL
Well No. R-15-3 Borehole Dia: — Computer Data File: .WD3
Packer No: MP43 Depth: 1332 ft

OCI Tool No: OCI 3076 TPP Tool No: 4259
Zone Pressure (Pre-Deflation Profile,(Po)): —
Inside Casing Pressure (Before Def,(P i)): —
Inside Casing Pressure (After Def,(P i)): —

Initial Packer Volume Pumped (L): — Packer Volume Returned (L): —
Confirm Packer Valve Open: ([✓ Yes] / No)
Comments:

O = Off, I = Inflate , C= Close **Tool Information**

WL ( )	OCI (psi)		TPP		Clock	Tag	OCI			TPP		Comments
	Open	Close	(mA)	(psi)			O	I	C	Off	On	
/	48.36	48.27	—	90.25	12:31		✓			✓		Landed / Rec
	7267	49.11	—	85.82	12:33							Shoe out OCI Rot ㉒
								✓				
	65.72	48.27	—	80.0	12:34						✓	
			15	—	12:34							
			20	—	12:35							9
			25	—	12:36							18
			30	—	12:36							25
			32	—	12:37							
			14	—	12:37							Valve Open ✓
	126.85	48.22	—	141.07	12:38							
							✓					
	126.03	48.23	—	130.0	12:38							
												Shoe in OCI Rot ㉒
	48.36	48.27	—	108.0	12:41							
												END

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Project No: WB 777 Client: By: AB Date: March 30/11 Location:

Well No. R-15-3 Borehole Dia: Computer Data File: .WD3

Packer No: MP 9 Depth: 1621 ft

OCI Tool No: TPP Tool No:

Zone Pressure (Pre-Deflation Profile,(Po)):

Inside Casing Pressure (Before Def,(P_i)):

Inside Casing Pressure (After Def,(P_i)):

Initial Packer Volume Pumped (L): Packer Volume Returned (L):

Confirm Packer Valve Open: (Yes / No)

Comments:

O = Off, I = Inflate , C= Close **Tool Information**

WL	OCI (psi)		TPP		Clock	Tag	OCI			TPP		Comments
( )	Open	Close	(mA)	(psi)			O	I	C	Off	On	
/	158.5	159.10	—	1240	12:54		✓			✓		Land / Rec
	158.5	158.86	—	1240	12:56							Shoe out OCI Rot (18)
	158.5	158.81	—					✓				
	158.38	158.96	—									
								✓				Valve open ✓
	262	158.81	—	274.4	12:57							
							✓					
	245	158.96	—	263.8	12:58							
												Shoe in OCI Rot
												[illegible] for COMM ISSUES

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Project No: WB 777 Client: By: AB Date: March 30/11 Location:

Well No. R-15-3 Borehole Dia: Computer Data File: .WD3

Packer No: MP 36 Depth: 1865/

OCI Tool No: TPP Tool No:

Zone Pressure (Pre-Deflation Profile,(Po)):

Inside Casing Pressure (Before Def,(P_i)):

Inside Casing Pressure (After Def,(P_i)):

Initial Packer Volume Pumped (L): Packer Volume Returned (L):

Confirm Packer Valve Open: (Yes / No)

Comments:

Tool Information

O = Off, I = Inflate , C= Close

WL ( )	OCI (psi)		TPP		Clock	Tag	OCI			TPP		Comments
	Open	Close	(mA)	(psi)			O	I	C	Off	On	
/	47.86	47.90	–	140.8	13:10		✓			✓		Landed / Rec
/	72.00	49.36	–	131.43	13:13							Shut out OCI ROT 22
			17	–	13:13							
			20	–	13:14							8
			25	–	13:14 30							14
			30	–	13:15							20
			35	–	13:15 30							26
			37	–	13:16						✓	28 ~~Ab~~
	7011	49.36	–	850	13:16			✓				Valve open ✓
	158	47.9	–	172.9	13:17							
	155	54.92	–	163.0	13:18		✓					
												Shut in ROT
	62.74	62.78	–	138.90	13:21							

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Project No: WB 777 Client: LANL By: AB Date: March 31/ 11 Location: LANL

Well No. R-15-3 Borehole Dia: — Computer Data File: ________.WD3

Packer No: MP 1B8 Depth: 265 ft

OCI Tool No: OCI 3076 TPP Tool No: —

Zone Pressure (Pre-Deflation Profile,(Po)): —

Inside Casing Pressure (Before Def,(P$_I$)): —

Inside Casing Pressure (After Def,(P$_I$)): —

Initial Packer Volume Pumped (L): — Packer Volume Returned (L): —

Confirm Packer Valve Open: [✓ Yes] / No)

Comments: Sample Bottle 1500 psi

O = Off, I = Inflate , C= Close **Tool Information**

WL	OCI (psi)		TPP		Clock	Tag	OCI			TPP		Comments
( )	Open	Close	(mA)	(psi)			O	I	C	Off	On	
/	9.06	8.85	—	1500	8:12		/			—		Land / Rec / in Air
	9.79	9.20	—	1500	8:14							Shoe out OCI Rot (12)
	400	—	—	—	—			✓				Valve open
	84.68	9.13	—	N/A	8:15							
	83.77	9.18	—	"	8:16		/					
												Shoe in OCI Rot (18)
												End

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Westbay System MP55 Packer Deflation
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Project No: WB 777 Client: LANL By: AB Date: March 31/2011 Location: LANL
Well No. R-15-3 Borehole Dia: — Computer Data File: .WD3
Packer No: MP 45 Depth:

OCI Tool No: 3076 TPP Tool No: 4259
Zone Pressure (Pre-Deflation Profile,(Po)): —
Inside Casing Pressure (Before Def,(P_i)): —
Inside Casing Pressure (After Def,(P_i)): —

Initial Packer Volume Pumped (L): — Packer Volume Returned (L): —
Confirm Packer Valve Open: [✓ Yes] / No
Comments:

O = Off, I = Inflate , C= Close **Tool Information**

WL ( )	OCI (psi)		TPP		Clock	Tag	OCI			TPP		Comments
	Open	Close	(mA)	(psi)			O	I	C	Off	On	
/	30.58	30.40	—	1306	15:14		✓			/		Load / REC
	116.0	35.87	—	1299	15:16							Shoe out OCI Pot 18
					—			✓				
	1310	30.40	—	1295	15:17							
					—							
	183	30.55	-	196	15:22							Valve open ✓
					—							
					—							Shoe down 18
	31.38	31.47		189	15:23							
												End

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Project No: WB 777 Client: LANL By: AB Date: March 31/11 Location: LANL
Well No. R-15-3 Borehole Dia: — Computer Data File: .WD3
Packer No: 4 MP129 Depth: 638 ft

OCI Tool No: 3076 TPP Tool No: 4
Zone Pressure (Pre-Deflation Profile,(Po)): —
Inside Casing Pressure (Before Def,(P i)): —
Inside Casing Pressure (After Def,(P i)): —

Initial Packer Volume Pumped (L): — Packer Volume Returned (L): —
Confirm Packer Valve Open: [✓ Yes] No)
Comments: Bottle @ 1500psi

O = Off, I = Inflate , C= Close **Tool Information**

WL ( )	OCI (psi)		~~TPP~~		Clock	Tag	OCI			TPP		Comments
	Open	Close	(mA)	(psi)			O	I	C	Off	On	
/	9.04	9.11	/	1500	15:38		✓					Landed / Rec
	9.75	9.46	/	"	15:40							Close out OCI Rot (18)
	340	9:46	—	—	15:41			✓				
	153.7	"	—	—								
	151.6	9.56	—	—	15:42		✓					
	8.53	9.27	—	—								Shoved OCI Rot (18)
	9.01	9.13	—	—								Pressures bouncing
	9.01	9:14	—	—	15:44							Valve Open ✓
												END

APPENDIX 3

Monitoring Well CDV-R-37-2

Summary Casing Log	- 6 pages
Pre-deflation Piezometric Pressure/Levels	
Field Data and Calculation Sheet (March 25, 2011)	- 4 pages
Post Deflation Piezometric Pressure/Levels	
Field Data and Calculation Sheet (April 4, 2011)	- 4 pages
Packer Deflation Records	- 14 pages

Summary Casing Log

Company: Los Alamos National Lab
Well: CDV-R-37-2
Site: LANL
Project: Hydrogeology Study

Job No: WB777
Author: GG

Well Information

Reference Datum: Ground Level
Elevation of Datum: 0.00 ft.
MP Casing Top: 0.00 ft.
MP Casing Length: 1582.64 ft.

Borehole Depth: 1587.00 ft.
Borehole Inclination: vertical
Borehole Diameter: 5.00 in.

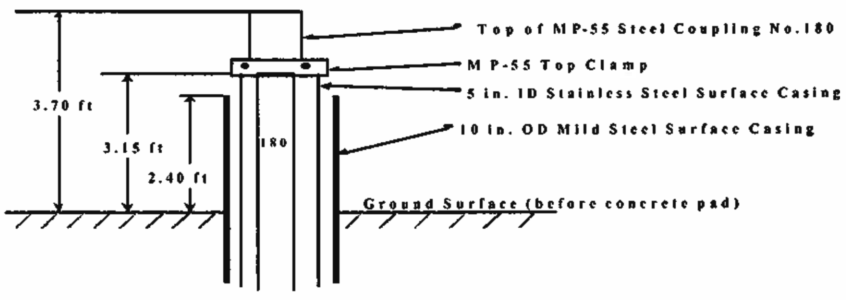
Well Description:
PlasticMP55
Other References:
Pipe-based wire-wrapped screens.
BF and screens after LANL 08/29/01

File Information

File Name: CDVR37_S.WWD
Report Date: Tue Oct 23 13:39:28 2001

File Date: Oct 23 11:51:10 2001

Sketch of Wellhead Completion



MP55 System Casing: CdV_R37-3

Legend

(Qty) MP Components

(Library - WD Library 7/27/00)

| |	(23)	0601M15 - MP55 Casing, 1.5 m, PVC
| |	(141)	0601M30 - MP55 Casing, 3.0 m, PVC
⬡	(14)	0612 - MP55 Packer, Stiffened, SS
| |	(2)	0601M10 - MP55 Casing, 1.0 m, PVC
▬	(1)	0603 - MP55 End Plug
—	(159)	0602 - MP55 Regular Coupling
●	(18)	0605 - MP55 Measurement Port
○	(4)	0607 - MP55 Hydraulic Pumping Port
◆M	(7)	0608 - MP55 Magnetic Location Collar

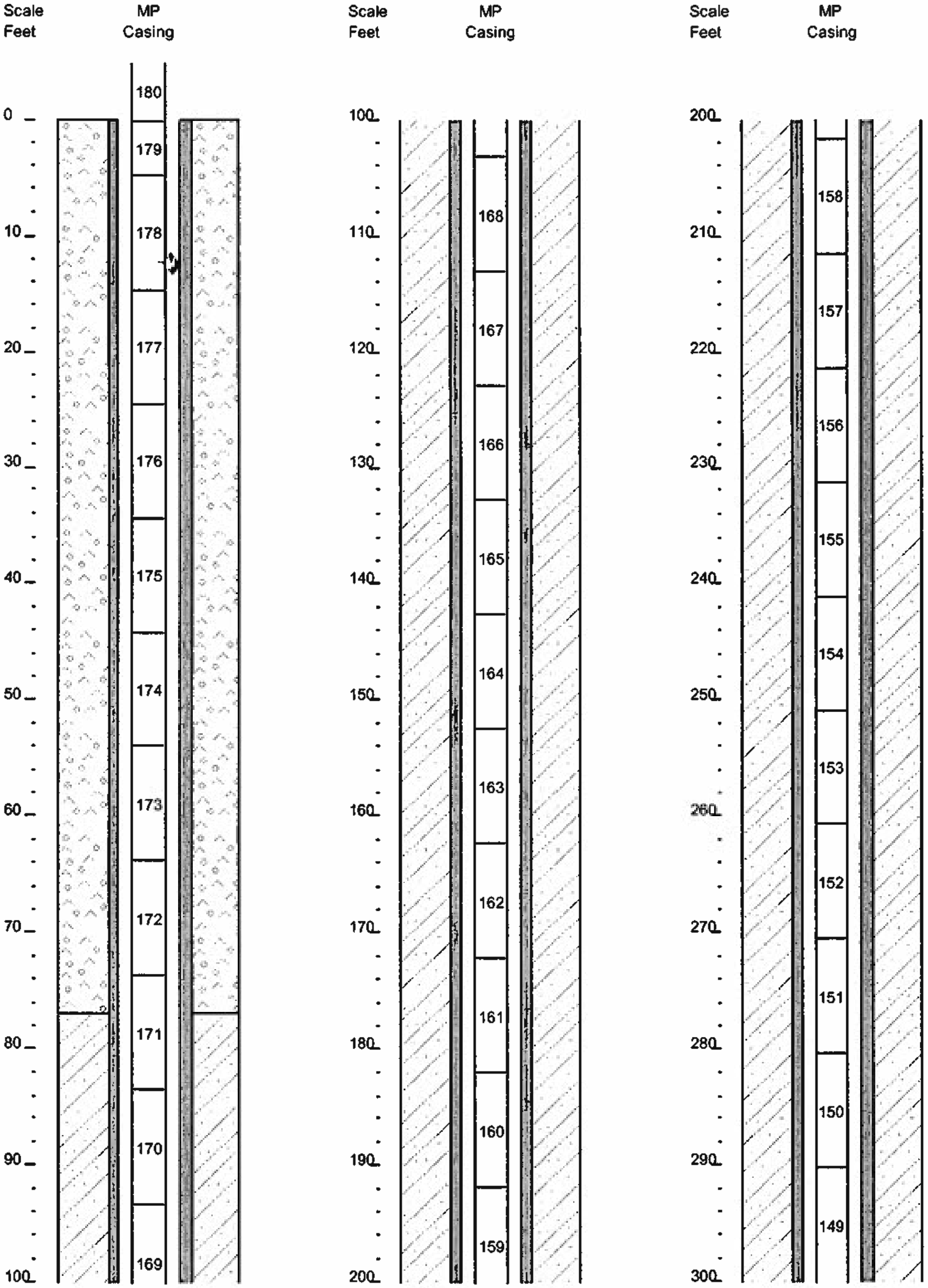
Geology

Backfill/Casing

░	Concrete
▨	Bentonite, Sand
░	Sand Coarse
▓	Stainless Steel
☰	Well Screen

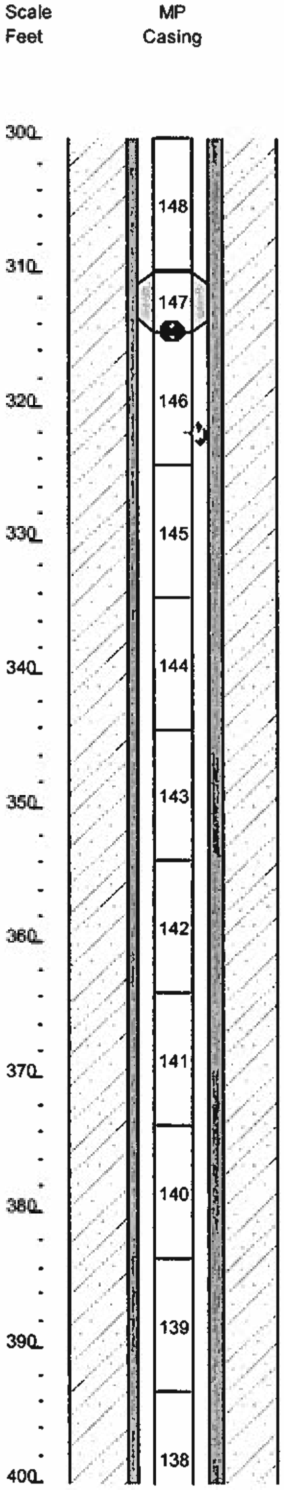
Summary MP Casing Log
Los Alamos National Lab

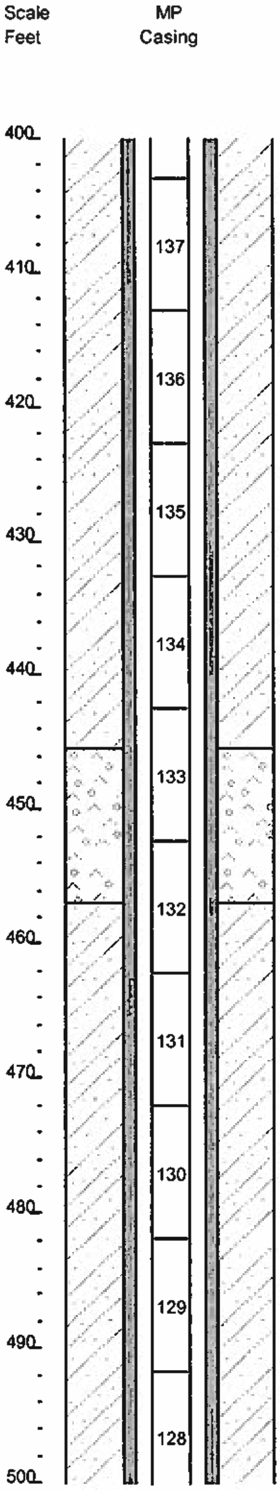
Job No: WB777
Well: CDV-R-37-2

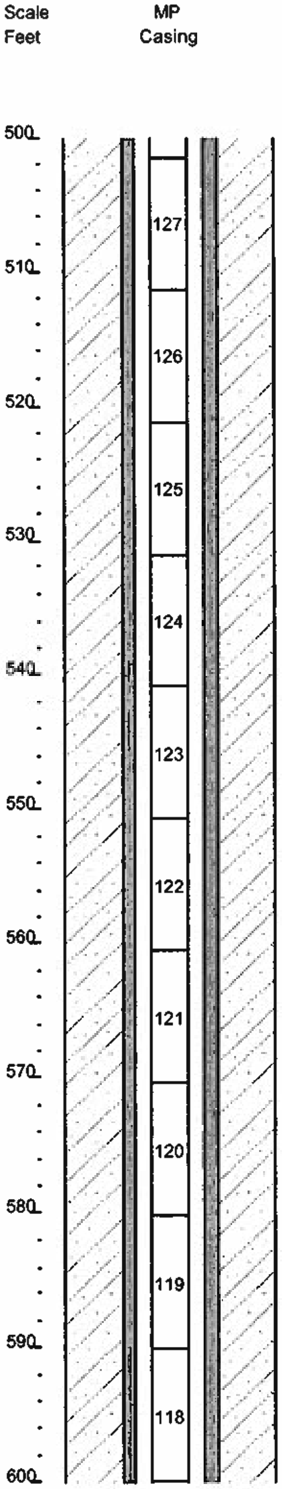


Summary MP Casing Log
Los Alamos National Lab

Job No: WB777
Well: CDV-R-37-2



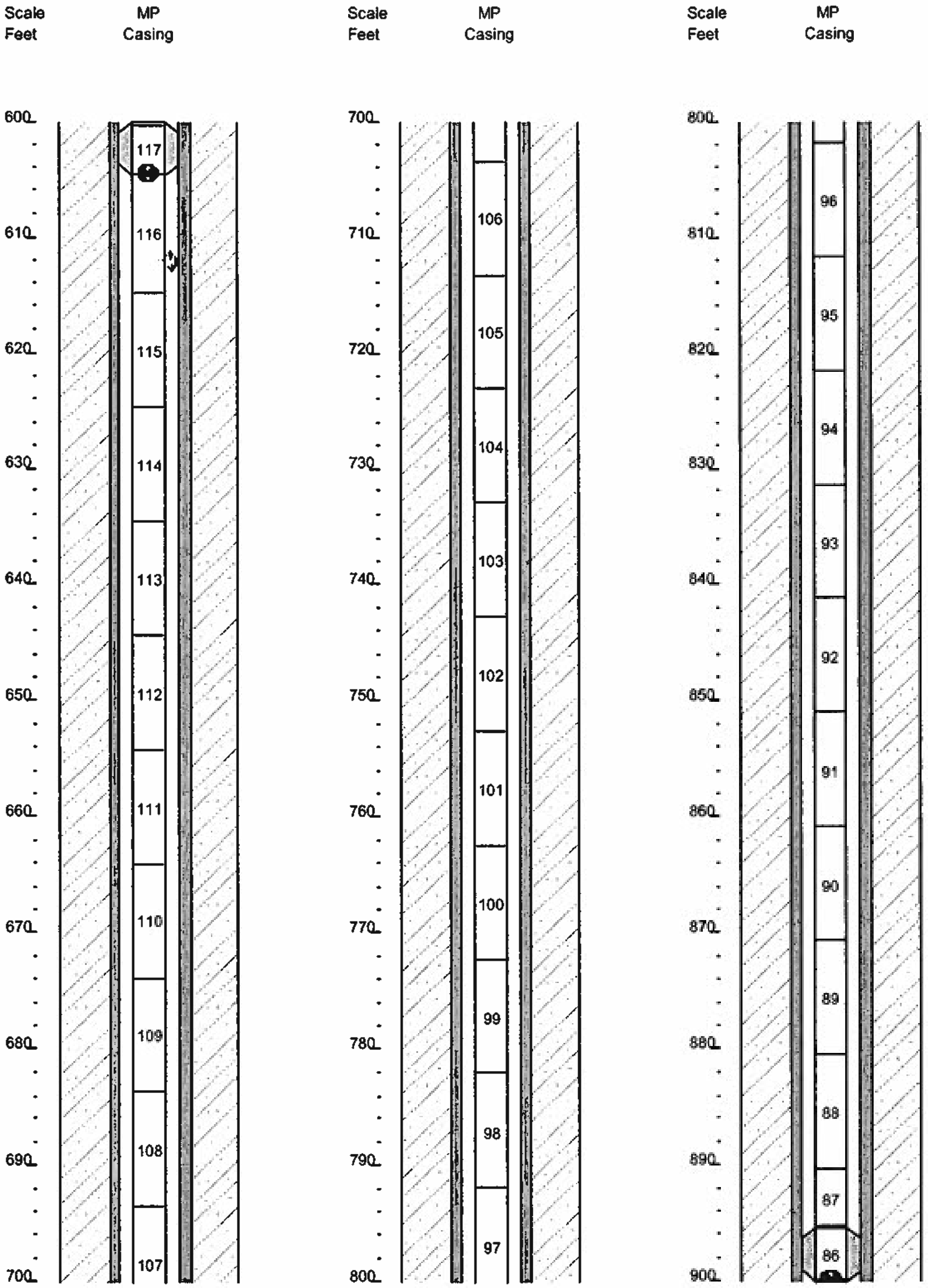


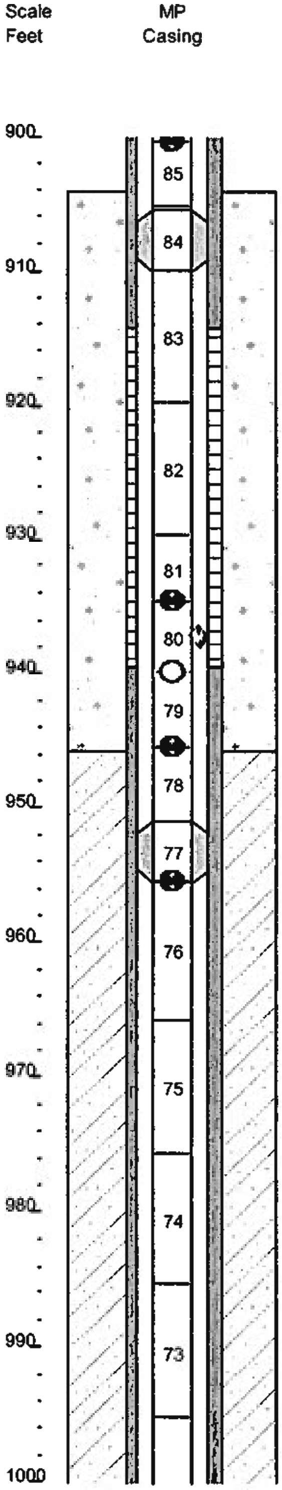


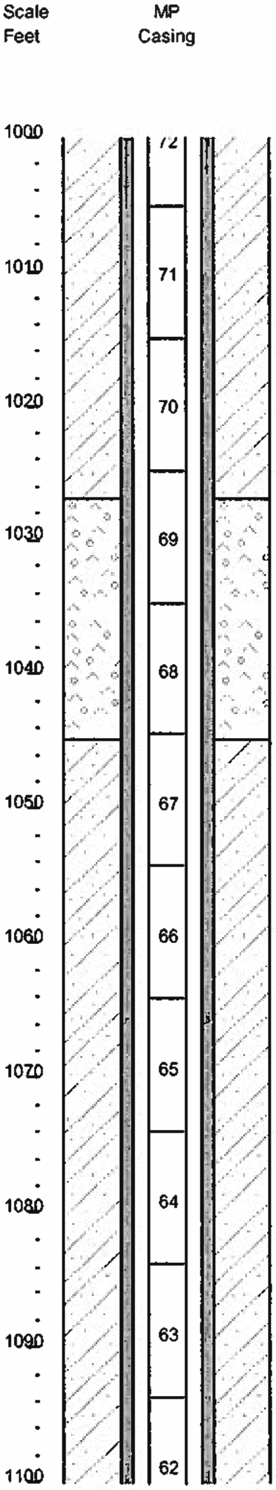
Tue Oct 23 11:51:11 2001

Summary MP Casing Log
Los Alamos National Lab

Job No: WB777
Well: CDV-R-37-2




Scale
Feet
MP
Casing
900
910
920
930
940
950
960
970
980
990
1000
85
84
83
82
81
80
79
78
77
76
75
74
73


Scale
Feet
MP
Casing
1000
1010
1020
1030
1040
1050
1060
1070
1080
1090
1100
72
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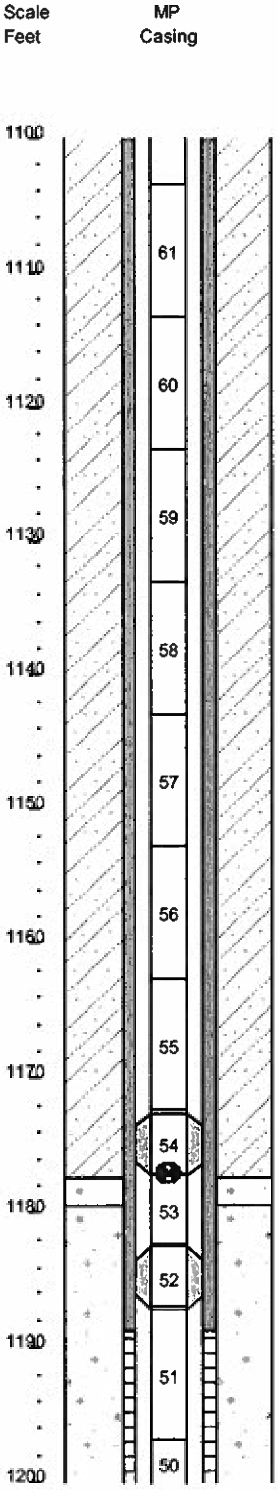
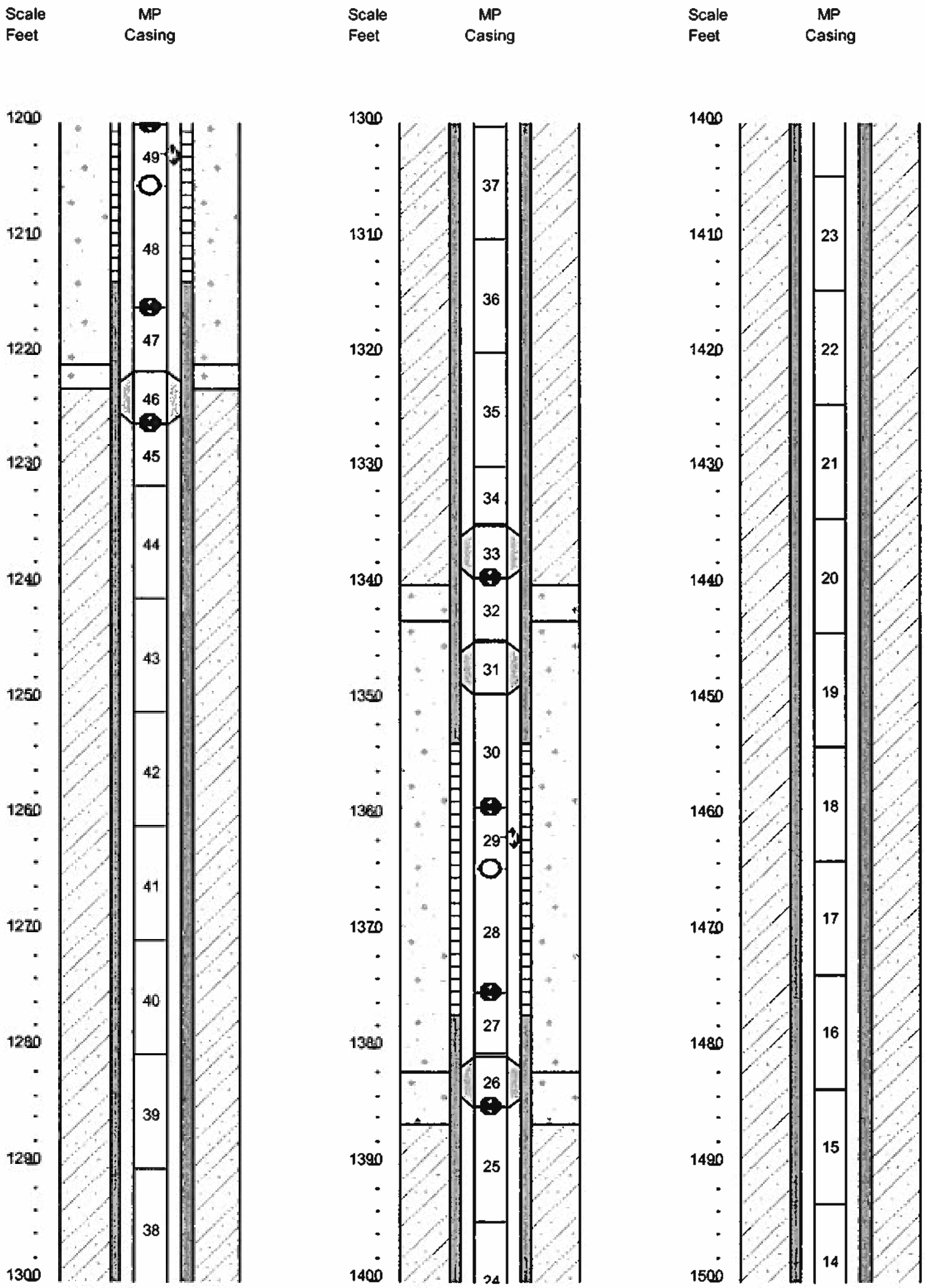
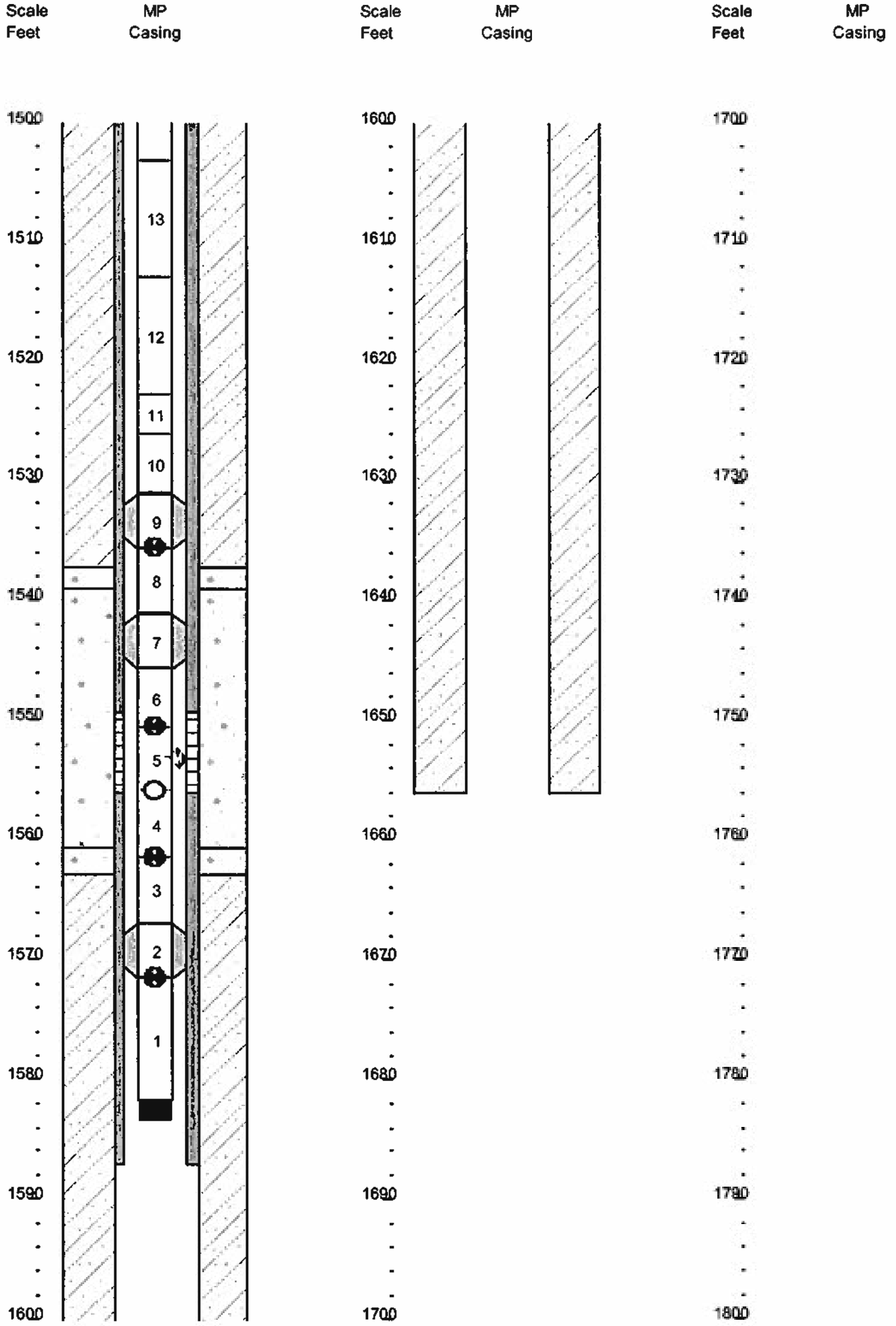
68
67
66
65
64
63
62


Scale
Feet
MP
Casing
1100
1110
1120
1130
1140
1150
1160
1170
1180
1190
1200
61
60
59
58
57
56
55
54
53
52
51
50


Scale
Feet
MP
Casing
1200
49
48
1210
47
1220
46
45
1230
44
1240
43
1250
42
1260
41
1270
40
1280
39
1290
38
1300
Scale
Feet
MP
Casing
1300
37
1310
36
1320
35
1330
34
33
1340
32
31
1350
30
1360
29
1370
28
27
1380
26
25
1390
1400
24
Scale
Feet
MP
Casing
1400
23
1410
22
1420
21
1430
20
1440
19
1450
18
1460
17
1470
16
1480
15
1490
14
1500


Scale
Feet
MP
Casing
1500
1510
1520
1530
1540
1550
1560
1570
1580
1590
1600
13
12
11
10
9
8
7
6
5
4
3
2
1
Scale
Feet
MP
Casing
1600
1610
1620
1630
1640
1650
1660
1670
1680
1690
1700
Scale
Feet
MP
Casing
1700
1710
1720
1730
1740
1750
1760
1770
1780
1790
1800

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WATER SERVICES

Westbay Piezometric Pressures/Levels
Field Data and Calculation Sheet

Well No.: **Cdv-R-37-2**
Datum:
Elev. G.S.:
Height of Westbay above G.S.:
Elev. top of Westbay Casing:
Reference Elevation:
Borehole angle:

Probe Type: **EMS**
Serial No.:
Probe Range:
Westbay Casing Type: **MP55**
Sampler Valve Position:

Date: March 25/2011
Client: **LNAL**
Job No.: **WB 777**
Location:
Weather:
Operator: **AB**

Ambient Reading (P_{atm}) (pressure, temperature, time)

Start: Pressure 11.27
Temp 16.47
Time 10:23

Finish:

Note: "Port position" in angled boreholes refer to position along drillhole. True depth (Dp) needs to be calculated using borehole angle and deviation data to calculate zone piezometric level (Dz).

P_{atm} 11.27 psi

Port No.	Port Position From Log ( )	Port Position From Cable ( )	True Port Depth "Dp" ( )	Fluid Pressure Readings					Pressure Head Outside Port ( ) H = (P2-Patm)/w	Piez. Level Outside Port ( ) Dz = Dp - H	Comments
				Inside Casing (P1)	Outside Casing (P2)	Time H:M:S	Probe Temp. (°C)	Inside Casing (P1)			
SQA5	3 157[illegible].6	/	/	125.06	174.68	10:44	/	125.06	376.79	1194.81	1576
MP4B	1561.6	/	/	120.76	170.30	10:48	/	120.76	366.69	1194.91	
MP4A	M 1550.6	/	/	115.92	165.51	10:51	/	115.92	355.64	1194.96	Collar @ 1557 / + 1555
SQA4	1535.7	-	-	109.50	159.21	10:54	-	109.50	341.11	1194.59	
LQA5	1385.2	/	/	44.38	93.92	11:00	/	44.38	190.50	1194.70	
MP3B	1375.2	-	-	40.08	89.93	11:02	-	40.08	181.29	1193.91	
MP4A	M 1359.3	-	-	33.14	83.13	11:07	-	33.14	165.61	1193.69	
SQA3	1339.5	-	-	24.67	73.56	11:09	-	24.67	143.53	1195.97	1306 DTW Est
LQA4	1226.2	-	-	11.73	25.47	11:14	-	11.79	32.60	1193.61	
MP2B	1216.2	-	-	11.79	21.48	11:15	-	11.79	23.39	1192.81	
MP2A	M 1200.3	-	-	11.78	14.61	11:18	-	11.78	7.54	1192.76	1206 + Collar
SQA2	1177.3	-	-	11.78	11.72	11:21	-	11.78	0.88	1176.42	Dry
LQA3	955.8	-	-	11.77	11.77	11:26	-	11.77	0.99	954.88	〃
MP1B	945.9	-	-	11.69	11.75	11:30	-	11.69	0.95	944.95	〃
MP1A	M 934.9	-	-	11.69	11.80	11:32	-	11.69	1.06	933.84	〃

Notes: w = 0.4335 psi/ft (1.422psi/m) of H_2O Dz = piezometric level in zone Patm = atmospheric pressure H = pressure head of water in zone Dp = true depth of measurement port

2/2

Schlumberger WATER SERVICES

Westbay Piezometric Pressures/Levels

Field Data and Calculation Sheet

Well No.: **Cdv-R-37-2**
Datum:
Elev. G.S.:
Height of Westbay above G.S.:
Elev. top of Westbay Casing:
Reference Elevation:
Borehole angle:

Probe Type: **EMS**
Serial No.:
Probe Range:
Westbay Casing Type: **MP55**
Sampler Valve Position:

Date: March 25/2011
Client: **LNAL**
Job No.: **WB 777**
Location:
Weather:
Operator: **AB**

Ambient Reading (P_{atm}) (pressure, temperature, time)
Start: Pressure
Temp
Time
Finish:

Note: "Port position" in angled boreholes refer to position along drillhole. True depth (Dp) needs to be calculated using borehole angle and deviation data to calculate zone piezometric level (Dz).

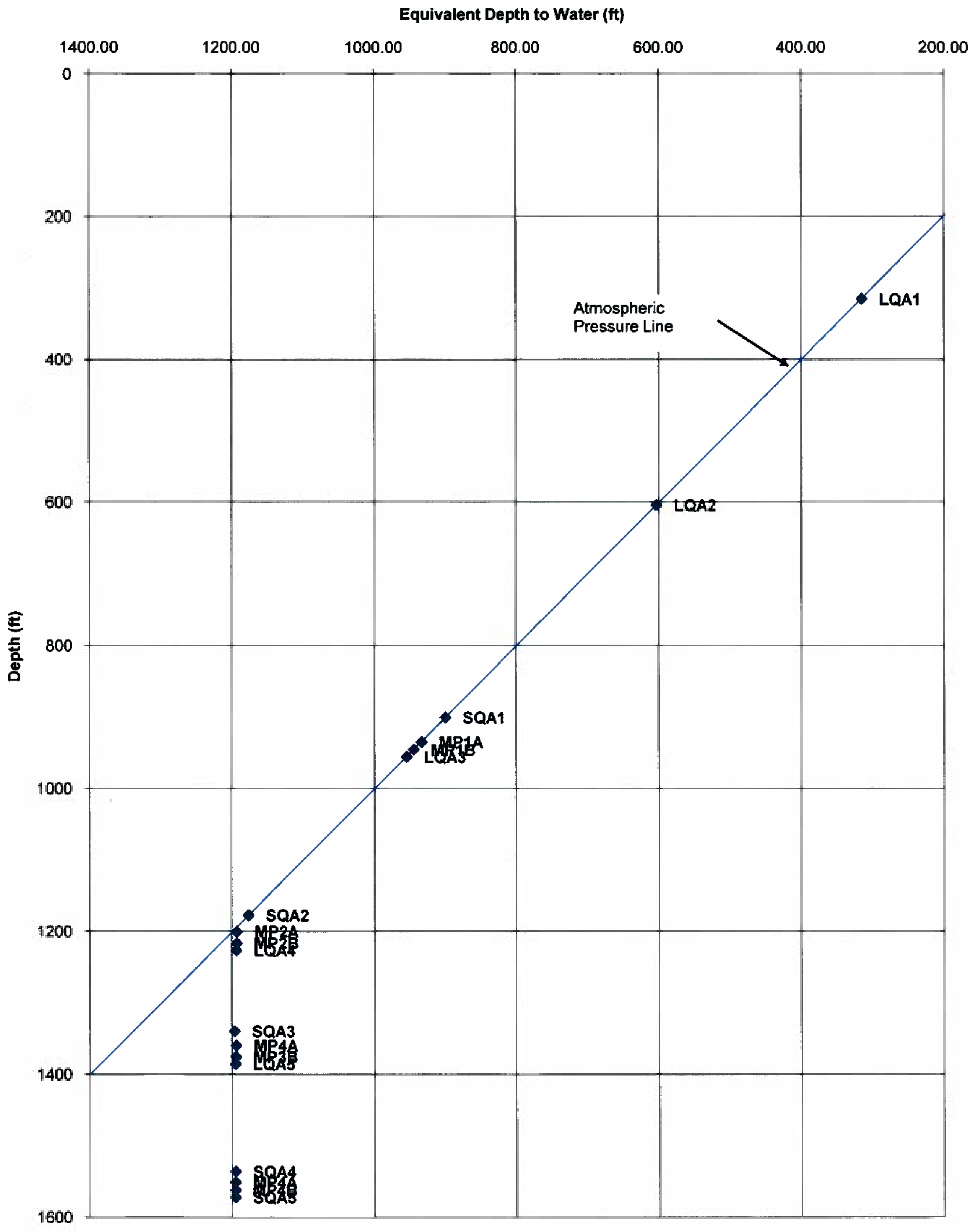
P_{atm} psi

Port No.	Port Position From Log ( )	Port Position From Cable ( )	True Port Depth "Dp" ( )	Fluid Pressure Readings					Pressure Head Outside Port ( ) H = (P2-Patm)/w	Piez. Level Outside Port ( ) Dz = Dp - H	Comments
				Inside Casing (P1)	Outside Casing (P2)	Time H:M:S	Probe Temp. (°C)	Inside Casing (P1)			
SQA1	900.4	—	—	11.66	11.41	11:37	—	11.71	0.16	900.24	Dry
LQA2	M 604.3	—	—	11.48	11.66	11:45	—	11.48	0.74	603.56	Dry
LQA1	M 315.6	—	—	11.40	11.52	11:49	—	11.40	0.42	315.18	Dry

Notes: w = 0.4335 psi/ft (1.422psi/m) of H_2O Dz = piezometric level in zone Patm = atmospheric pressure H = pressure head of water in zone Dp = true depth of measurement port

Piezometric Profile:
Monitoring Well: CDV-R-37-2

Profile Date:March 25/2011
Comments:Pre-deflation



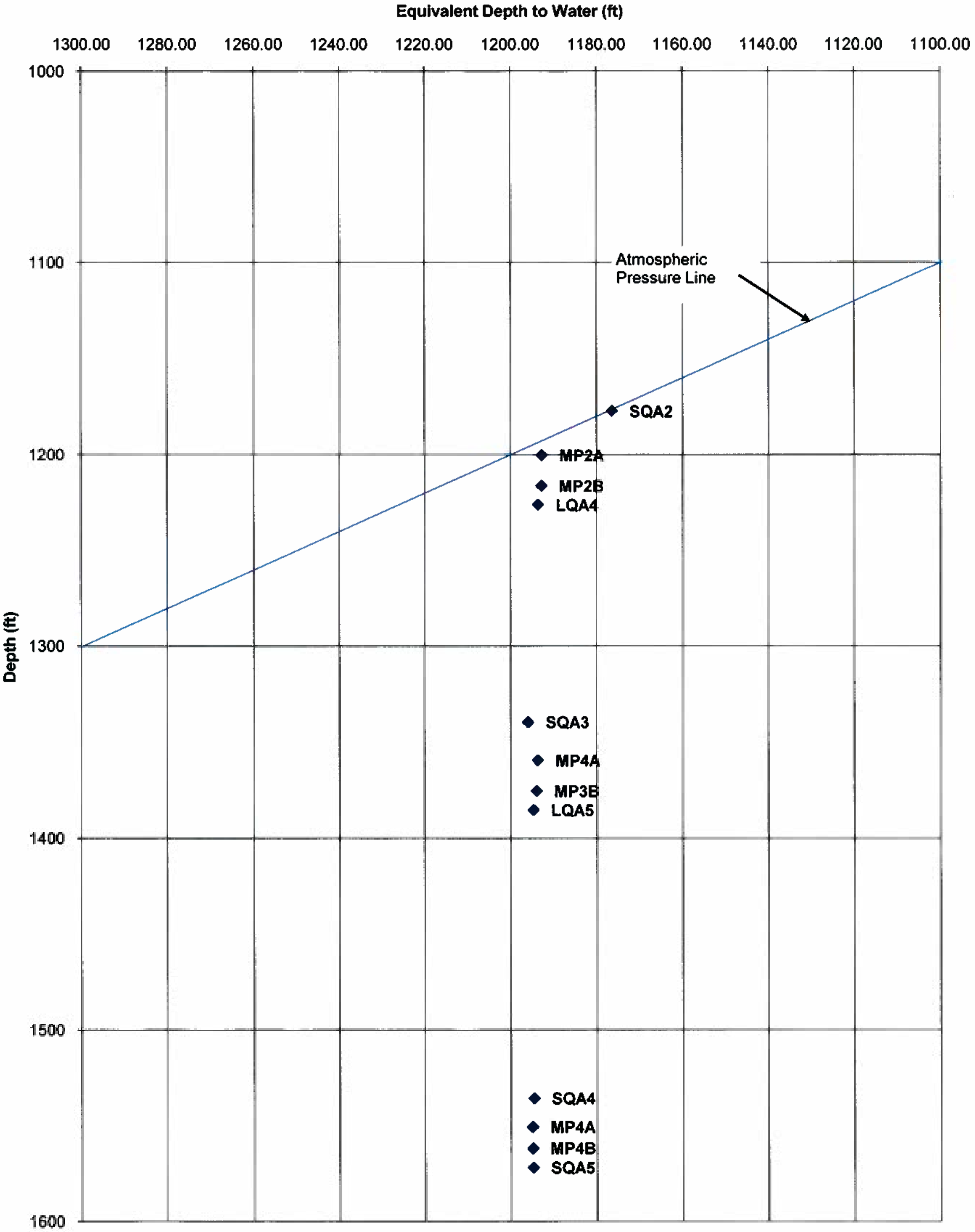
Client:TPMC
Site:LANL
Datum:gsfc

Figure 1

Plote By:____Date:____
Checked By:____Date:____
Westbay Project: WB 777

Piezometric Profile:
Monitoring Well: CDV-R-37-2

Profile Date:March 25/2011
Comments:Pre-deflation



Client:TPMC
Site:LANL
Datum:gsfc

Plote By:____Date:____
Checked By:____Date:____
Westbay Project: WB 777

Figure 1

1/2

Schlumberger
WATER SERVICES

Westbay Piezometric Pressures/Levels
Field Data and Calculation Sheet

Well No.: **Cdv-R-37-2**
Datum: —
Elev. G.S.: —
Height of Westbay above G.S.: —
Elev. top of Westbay Casing: —
Reference Elevation: —
Borehole angle: —

Probe Type: **EMS**
Serial No.: 2653
Probe Range: 2000
Westbay Casing Type: **MP55**
Sampler Valve Position: —

Date: 04/02/2011
Client: ~~LNAL~~ LANL
Job No.: **WB 777**
Location: —
Weather: —
Operator: **AB**

Ambient Reading (P_{atm}) (pressure, temperature, time)
Start: Pressure ______ Finish: ______
Temp ______ ______
Time ______ ______

Note: "Port position" in angled boreholes refer to position along drillhole. True depth (Dp) needs to be calculated using borehole angle and deviation data to calculate zone piezometric level (Dz).

P_{atm} 11.34 psi

Port No.	Port Position From Log ( )	Port Position From Cable ( )	True Port Depth "Dp" ( )	Fluid Pressure Readings					Pressure Head Outside Port ( )	Piez. Level Outside Port ( )	Comments
				Inside Casing (P1)	Outside Casing (P2)	Time H:M:S	Probe Temp. (°C)	Inside Casing (P1)	H = (P2-Patm)/w	Dz = Dp - H	
SQA5	1571.6	—	—	138.82	174.63			—	376.68	1194.92	
MP4B	1561.6			132.33	170.30			—	366.69	1194.91	
MP4A	1550.6			129.76	165.59			—	355.82	1194.78	
SQA4	1535.7			123.39	159.21			—	341.11	1194.59	
LQA5	1385.2			58.24	94.27			—	191.35	1193.85	
MP3B	1375.2			53.94	90.06			—	181.59	1193.61	
MP4A	1359.3			47.07	83.13			—	165.61	1193.69	
SQA3	1339.5			38.48	74.61			—	145.95	1193.55	
LQA4	1226.2			11.85	25.71			—	33.15	1193.05	
MP2B	1216.2			11.84	21.42			—	23.25	1192.95	
MP2A	1200.3			11.84	14.60			—	7.52	1192.78	
SQA2	1177.3			11.95	11.95			—	1.41	1175.89	Air
LQA3	955.8			11.95	11.75			—	1.41	954.39	"
MP1B	945.9			11.88	11.88			—	1.25	944.49	"
MP1A	934.9			11.87	11.87			—	1.22	933.65	"

Notes: w = 0.4335 psi/ft (1.422psi/m) of H_2O Dz = piezometric level in zone Patm = atmospheric pressure H = pressure head of water in zone Dp = true depth of measurement port

2/2

Schlumberger
WATER SERVICES

Westbay Piezometric Pressures/Levels
Field Data and Calculation Sheet

Well No.: **Cdv-R-37-2**
Datum:
Elev. G.S.:
Height of Westbay above G.S.:
Elev. top of Westbay Casing:
Reference Elevation:
Borehole angle:

Probe Type: **EMS**
Serial No.:
Probe Range:
Westbay Casing Type: **MP55**
Sampler Valve Position:

Date:
Client: **LNAL**
Job No.: **WB 777**
Location:
Weather:
Operator: **AB**

Ambient Reading (P_{atm}) (pressure, temperature, time)
Start: Pressure
Temp
Time
Finish:

Note: "Port position" in angled boreholes refer to position along drillhole. True depth (Dp) needs to be calculated using borehole angle and deviation data to calculate zone piezometric level (Dz).

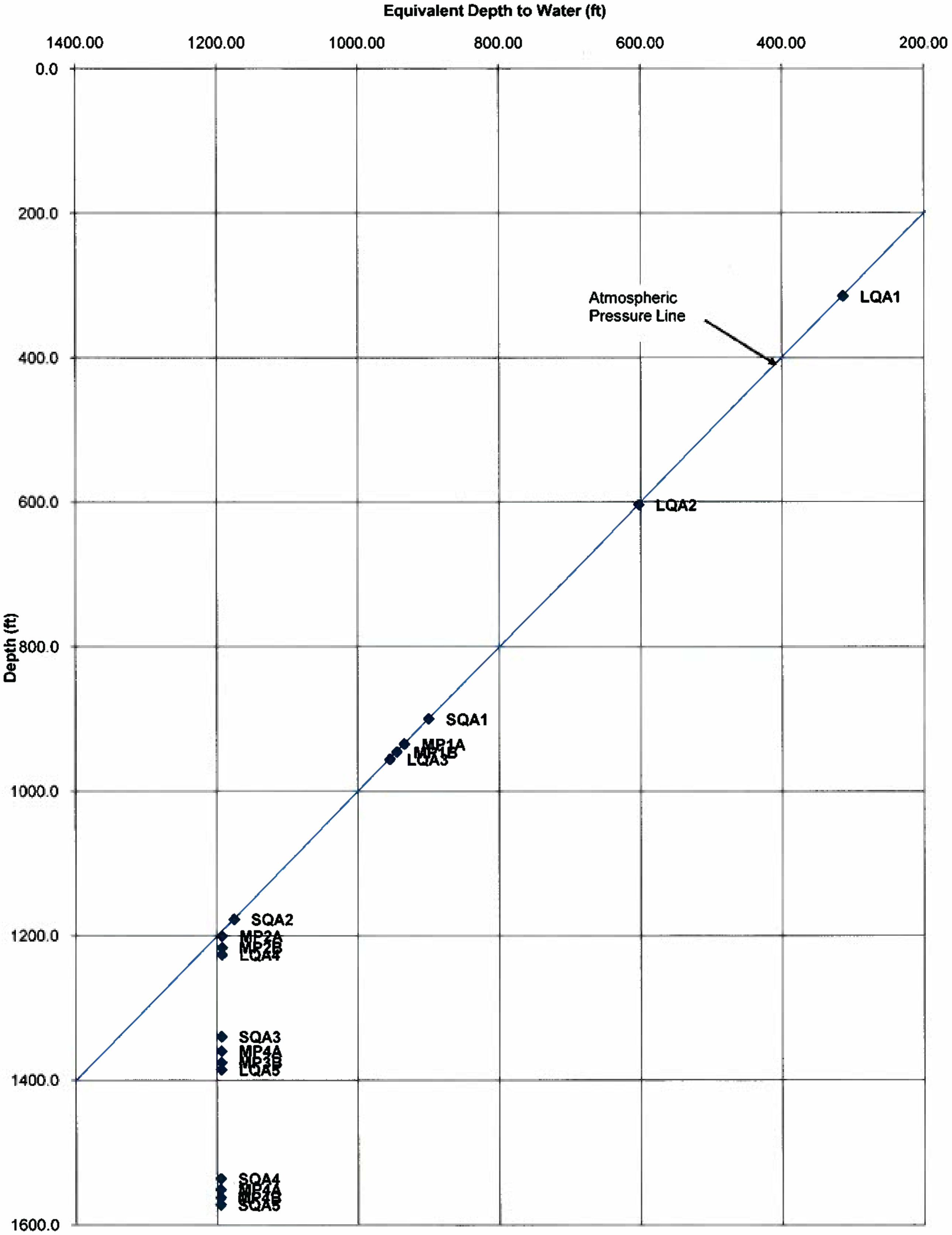
P_{atm} psi

Port No.	Port Position From Log ( )	Port Position From Cable ( )	True Port Depth "Dp" ( )	Fluid Pressure Readings					Pressure Head Outside Port ( )	Piez. Level Outside Port ( )	Comments
				Inside Casing (P1)	Outside Casing (P2)	Time H:M:S	Probe Temp. (°C)	Inside Casing (P1)	H = (P2-Patm)/w	Dz = Dp - H	
SQA1	900.4			11.87	11.87			—	1.22	899.18	Air
LQA2	604.3			11.87	11.87			—	1.22	603.08	Air
LQA1	315.6			11.86	11.86			—	1.20	314.40	Air

Notes: w = 0.4335 psi/ft (1.422psi/m) of H_2O Dz = piezometric level in zone Patm = atmospheric pressure H = pressure head of water in zone Dp = true depth of measurement port

Piezometric Profile:
Monitoring Well:CDV-R-37-2

Profile Date: April 04/2011
Comments:Post-deflation Profile



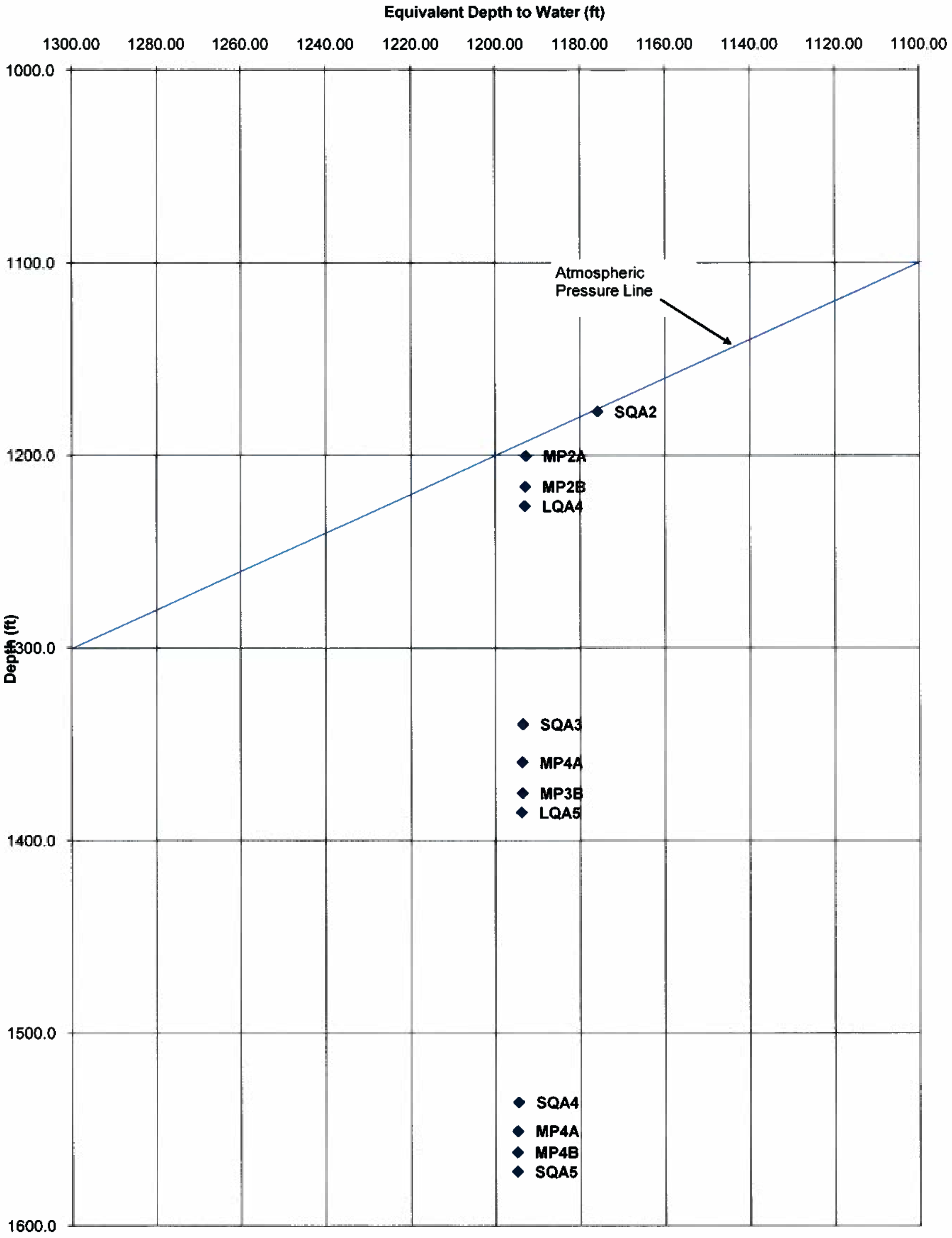
Client:TPMC
Site:LANL
Datum:gsfc

Figure 2

Plot By:____Date:______
Checked By:____Date:_____
Westbay Project:WB777

Piezometric Profile:
Monitoring Well:CDV-R-37-2

Profile Date: April 04/2011
Comments:Post-deflation Profile



Client:TPMC
Site:LANL
Datum:gsfc

Plot By:____Date:______
Checked By:____Date:_____
Westbay Project:WB777

Figure 2

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WATER SERVICES

Westbay System MP55 Packer Deflation
OCI/TPP Field Record

Page No: 1 of 1

Project No: WB 777 Client: LANL
Well No. CDV-R-37-2 Borehole Dia: —
Packer No: MP 86 Depth: 896 ft

By: AB Date: March 31/11 Location: LANL
Computer Data File: — .WD3

OCI Tool No: OCI 4253 TPP Tool No: —
Zone Pressure (Pre-Deflation Profile,(Po)): —
Inside Casing Pressure (Before Def,(Pi)): —
Inside Casing Pressure (After Def,(Pi)): —

Initial Packer Volume Pumped (L): — Packer Volume Returned (L): —
Confirm Packer Valve Open: [✓ Yes] / No
Comments: Sample Bottle @ 1500 psi

O = Off, I = Inflate , C= Close **Tool Information**

WL	OCI (psi)		TPP		Clock	Tag	OCI			TPP		Comments
( )	Open	Close	(mA)	(psi)			O	I	C	Off	On	
—	8.80	8.88	—	1500	13:48		✓			✓		Land / Record
—	10.65	9.13	—	1500	13:49							
	300							✓				Shoe out 18
	122.22	9:46	—	—	13:50							
							✓					Valve open —
	120.34	9:32	—	—	13:51							
												Shoe out 18
	8.95	8.99			13:52							
												End Trip out

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WATER SERVICES

Westbay System MP55 Packer Deflation
OCI/TPP Field Record

Page No: 1 of 1

Project No: WB 777 Client: LANL
Well No. COV-R-37-2 Borehole Dia: —
Packer No: MP 74 Depth: 905 ft

By: AB Date: Mar 31/2011 Location: LANL
Computer Data File: — .WD3

OCI Tool No: 4253 TPP Tool No: —
Zone Pressure (Pre-Deflation Profile,(Po)): —
Inside Casing Pressure (Before Def,(Pi)): —
Inside Casing Pressure (After Def,(Pi)): —

Initial Packer Volume Pumped (L): —
Packer Volume Returned (L): —
Confirm Packer Valve Open: [✓ Yes] No)
Comments: Sample Bottle @ 1500

O = Off, I = Inflate , C= Close **Tool Information**

WL ( )	OCI (psi)		TPP		Clock	Tag	OCI			TPP		Comments
	Open	Close	(mA)	(psi)			O	I	C	Off	On	
/	8.78	9.20	—	1500	15:30	—	✓			✓		Land Rec
	10.98	9.22	—	1500	15:32							Shraout 18
	300							✓				
	112.5	9.07	—	—	15:33							Valve open ✓
							✓					
	109.9	8.88	—	—	15:34							
												Shoe in 18
	8.79	8.98	—	—	15:35							
												Fmo Thpout 15:36

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WATER SERVICES

Westbay System MP55 Packer Deflation
OCI/TPP Field Record

Page No: 1 of 1

Project No: WB 777 Client: LANL By: AB Date: Mar 31/11 Location: LANL
Well No. CDV-R-37-2 Borehole Dia: — Computer Data File: .WD3
Packer No: MP52 Depth: 182ft

OCI Tool No: 4253 TPP Tool No: —
Zone Pressure (Pre-Deflation Profile,(Po)): —
Inside Casing Pressure (Before Def,(Pi)): —
Inside Casing Pressure (After Def,(Pi)): —

Initial Packer Volume Pumped (L): — Packer Volume Returned (L): —
Confirm Packer Valve Open: [✓ Yes] / No)
Comments: Sample Bottle @ 1500 psi

O = Off, I = Inflate , C= Close **Tool Information**

WL ( )	OCI (psi)		TPP		Clock	Tag	OCI			TPP		Comments
	Open	Close	(mA)	(psi)			O	I	C	Off	On	
✓	8.85	9.12	—	1500	14:58	✓	✓			✓		Landed / Rec
												Shoe out 14
	13.16	9.23	—	1500	15:00							
	400							✓				Valve open ✓
	~~400~~											
	127.59	9:19	—	—	15:01							
	125.23	9.04	—	—	15:02		✓					
												Shoe in 14
	8:44	9:33	—	—	15:04							
	8:46	9:15	—	—	15:05							
												Exit Trip out

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WATER SERVICES

Westbay System MP55 Packer Deflation
OCI/TPP Field Record

Page No: 1 of 1

Project No: WB 777 Client: LANL
Well No. CdV-R-37-2 Borehole Dia: —
Packer No: MP 147 Depth: 310 ft
By: AB Date: Apr 1/2011 Location: LANL
Computer Data File: ______.WD3

OCI Tool No: 4253 TPP Tool No: —
Zone Pressure (Pre-Deflation Profile,(Po)): —
Inside Casing Pressure (Before Def,(P_i)): —
Inside Casing Pressure (After Def,(P_i)): —

Initial Packer Volume Pumped (L): — Packer Volume Returned (L): —
Confirm Packer Valve Open: [✓ Yes] / No
Comments: Sample Bottle @ 1500 psi

O = Off, I = Inflate, C= Close **Tool Information**

WL ( )	OCI (psi)		TPP		Clock	Tag	OCI			TPP		Comments
	Open	Close	(mA)	(psi)			O	I	C	Off	On	
/	8.67	8.64	—	1500	8:48		✓			✓		Landed Rec
												Shoe out (14)
	12.30	8.66	—	1500	8:50							
	375							✓				
	167.58	8.55	—	—	8:51							Valve open ✓
							✓					
	163.36	8.49	—	—	8:52							
												Shoe in (14)
	8.60	8.65	—	—	8:53							
												End

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Westbay System MP55 Packer Deflation
OCI/TPP Field Record

Page No: 1 of 1

Project No: WB 777 Client: LANL By: AB Date: Apr 1/2011 Location: LANL
Well No. CdV-R-37-2 Borehole Dia: — Computer Data File: — .WD3
Packer No: MP 117 Depth: 600ft

OCI Tool No: 4253 TPP Tool No: —
Zone Pressure (Pre-Deflation Profile,(Po)): —
Inside Casing Pressure (Before Def,(P_i)): —
Inside Casing Pressure (After Def,(P_i)): —

Initial Packer Volume Pumped (L): — Packer Volume Returned (L): —
Confirm Packer Valve Open: [✓ Yes] / No
Comments: Sample bottle @ 1500 psi

O = Off, I = Inflate , C= Close **Tool Information**

WL	OCI (psi)		TPP		Clock	Tag	OCI			TPP		Comments
( )	Open	Close	(mA)	(psi)			O	I	C	Off	On	
✓	9.10	8.80	—	1500	9:13		✓			—		Landed / Rec
												Shoe out (14)
	14.43	8.90	—	1500	9:14							
	250							✓				Valve open ✓
	55.31	8.70	—	—	9:15							
							✓					
	55.16	8.74	—	—	9:16							
												Shoe in (14)
	9.10	8.80	—	—	9:19							
												END

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Westbay System MP55 Packer Deflation
OCI/TPP Field Record

Page No: / of /

Project No: WB 777 Client: LANL
Well No. COV-~~R~~-37-2 Borehole Dia: —
Packer No: MP 31 Depth: 1345 ft

By: AB Date: Apr 1/11 Location: LANL
Computer Data File: — .WD3

OCI Tool No: 4253 TPP Tool No: —
Zone Pressure (Pre-Deflation Profile,(Po)): —
Inside Casing Pressure (Before Def,(P$_i$)): —
Inside Casing Pressure (After Def,(P$_i$)): —

Initial Packer Volume Pumped (L): —
Packer Volume Returned (L): —
Confirm Packer Valve Open: [✓ Yes] No
Comments: Sample Bottle @ 1500 psi

O = Off, I = Inflate , C= Close **Tool Information**

WL	OCI (psi)		TPP		Clock	Tag	OCI			TPP		Comments
( )	Open	Close	(mA)	(psi)			O	I	C	Off	On	
/	27.96	27.94	—	1500	9:45		✓			—		Landed / Rec
												Shoe out Ⓑ
	57.90	28.01	—	1500	9:47							
	380							✓				OCI I — Valve open ✓
	182.8	27.83	—	—	9:48							
							✓					
	175.60	28.87	—	—	9:51							Shoe in Ⓑ
	28.54	28.64										End
	28.84	28.85										
	29.05	29.12			9:52							WL↑

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WATER SERVICES

Westbay System MP55 Packer Deflation
OCI/TPP Field Record

Page No: 1 of 1

Project No: WB 777 Client: LANL
Well No. CdV-R-37-2 Borehole Dia: —
Packer No: mp 2 Depth: 1567 ft

By: AB Date: Apr 1/11 Location: LANL
Computer Data File: ________ .WD3

OCI Tool No: 4253 TPP Tool No: —
Zone Pressure (Pre-Deflation Profile,(Po)): —
Inside Casing Pressure (Before Def,(Pi)): —
Inside Casing Pressure (After Def,(Pi)): —

Initial Packer Volume Pumped (L): —
Packer Volume Returned (L): —
Confirm Packer Valve Open: [✓ Yes] / No
Comments: Sample Bottle @ 1500 psi

O = Off, I = Inflate , C= Close **Tool Information**

WL ( )	OCI (psi)		TPP		Clock	Tag	OCI			TPP		Comments
	Open	Close	(mA)	(psi)			O	I	C	Off	On	
—	125.31	125.60	—	1500	13:53	—	✓			—		Lowered / Rec
												Shoe out (18)
	235	135	—	1500	13:55	—						
	400							✓				OCI I
	209.86	125.60	—	~~1500~~	13:56							Valve open ✓
							✓					
	209.59	125.46	—	—	13:57							
												Shoe in (18)
	126.44	126.63	—	—	13:58							WL ↑
	126.64	126.84	—	—	13:59							
												End

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Westbay System MP55 Packer Deflation
OCI/TPP Field Record

Page No: 1 of 1

Project No: WB 777 Client: LANL

Well No. CdV-R-37-2 Borehole Dia: —

Packer No: MP 7 Depth: 1541 ft

By: AB Date: Apr 1/11 Location: LANL

Computer Data File: — .WD3

OCI Tool No: 4253 TPP Tool No: —

Zone Pressure (Pre-Deflation Profile,(Po)): —

Inside Casing Pressure (Before Def,(P$_i$)): —

Inside Casing Pressure (After Def,(P$_i$)): —

Initial Packer Volume Pumped (L): —

Packer Volume Returned (L): —

Confirm Packer Valve Open: [✓ Yes] / No)

Comments: Sample Bottle @ 1500 psi

O = Off, I = Inflate , C= Close **Tool Information**

WL ( )	OCI (psi)		TPP		Clock	Tag	OCI			TPP		Comments
	Open	Close	(mA)	(psi)			O	I	C	Off	On	
✓	115.47	115.91	—	1500	14:43		✓			—		Land / Rec
	190.00	127.98	—	1500	14:45							Shoe out 18
	350							✓				
	215	115.58	—	—	14:46							Valve open ✓
	214.4	115.78	—	—	14:47		✓					
												Shoe in 18
	116.63	116.71	—	—	14:48							

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Westbay System MP55 Packer Deflation
OCI/TPP Field Record

Page No: 1 of 1

Project No: WB 777 Client: LANL
Well No. CdV-R-37-2 Borehole Dia: —
Packer No: MP9 ~~153ft~~ Depth: 1531 ft

By: AB Date: Apr 1/11 Location: LANL
Computer Data File: — .WD3

OCI Tool No: 4253 TPP Tool No: —
Zone Pressure (Pre-Deflation Profile,(Po)): —
Inside Casing Pressure (Before Def,(P$_i$)): —
Inside Casing Pressure (After Def,(P$_i$)): —

Initial Packer Volume Pumped (L): —
Packer Volume Returned (L): —
Confirm Packer Valve Open: [✓ Yes] / No)
Comments: Sample Bottle @ 1500psi

O = Off, I = Inflate , C= Close **Tool Information**

WL ( )	OCI (psi)		TPP		Clock	Tag	OCI			TPP		Comments
	Open	Close	(mA)	(psi)			O	I	C	Off	On	
✓	112.44	112.73	—	1500	15:24	—	✓			—		Landed Rec
	432	140.8	—	1500	15:25							Shoe out ⑭
	202.97	112.65	—	—	15:26			✓				OCI I
							✓					Valve open ✓
	201.90	112.65	—	—	15:27							
							✓					Shoe in ⑭
	112.96	113.24	—	—	15:28							
	113.13	113.24	—	—								
	113.38	113.54	—	—	15:29							
												End

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Westbay System MP55 Packer Deflation
OCI/TPP Field Record

Page No: 1 of 1

Project No: WB 777 Client: LANL
Well No. CDV-R-37-2 Borehole Dia: —
Packer No: MP26 Depth: 1380ft

By: AB Date: Apr 2/11 Location: LANL
Computer Data File: .WD3

OCI Tool No: 4253 TPP Tool No: —
Zone Pressure (Pre-Deflation Profile,(Po)): —
Inside Casing Pressure (Before Def,(P$_i$)): —
Inside Casing Pressure (After Def,(P$_i$)): —

Initial Packer Volume Pumped (L): —
Packer Volume Returned (L): —
Confirm Packer Valve Open: [✓ Yes] / No)
Comments: Sample Bottle @ 1500psi

O = Off, I = Inflate , C= Close **Tool Information**

WL ( )	OCI (psi)		TPP		Clock	Tag	OCI			TPP		Comments
	Open	Close	(mA)	(psi)			O	I	C	Off	On	
✓	48.99	49.02	—	1500	8:53	—	✓			—		Land / Rec
												Shoe out 18
	76.82	51.32	—	1500	8:56	—		✓				
	300											Valve open ✓
	152.81	48.87	—	—	8:57							
	152.22	48.87	—	—	8:58		✓					
												Shoe in 18
	50.14	50.19	—	—	8:59							WL↑

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WATER SERVICES

Westbay System MP55 Packer Deflation
OCI/TPP Field Record

Page No: 1 of 1

Project No: WB 777 Client: LANL By: AB Date: Apr 2/11 Location: LANL

Well No. CdV-R-37-2 Borehole Dia: — Computer Data File: ________ .WD3

Packer No: MP33 Depth: 1335 ft

OCI Tool No: 4253 TPP Tool No: —

Zone Pressure (Pre-Deflation Profile,(Po)): —

Inside Casing Pressure (Before Def,(Pi)): —

Inside Casing Pressure (After Def,(Pi)): —

Initial Packer Volume Pumped (L): —

Packer Volume Returned (L): —

Confirm Packer Valve Open: [✓ Yes] / No)

Comments: Sample Bottle @ 1500 psi

O = Off, I = Inflate , C= Close **Tool Information**

WL	OCI (psi)		TPP		Clock	Tag	OCI			TPP		Comments
( )	Open	Close	(mA)	(psi)			O	I	C	Off	On	
—	30.48	30.53	—	1500	9:37	—	✓			—		Land Sleeve
												Shoe out 18
	36.80	31.55	—	1500	9:39							
	250							✓				Valve open ✓
	151.53	30.38	—	—	9:40							
							✓					
	150.20	30.53	—	—	9:43							
												Shoeout 18
	31.34	31.41	—	—	9:42							WL↑
												END

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Westbay System MP55 Packer Deflation
OCI/TPP Field Record

Page No: 1 of 1

Project No: WB 777 Client: LANL
Well No. CdV-R-37-2 Borehole Dia: —
Packer No: MP 46 Depth: 1222 ft
By: AB Date: Apr 2/11 Location: LANL
Computer Data File: .WD3

OCI Tool No: 4253 TPP Tool No: —
Zone Pressure (Pre-Deflation Profile,(Po)): —
Inside Casing Pressure (Before Def,(Pi)): —
Inside Casing Pressure (After Def,(Pi)): —

Initial Packer Volume Pumped (L): —
Packer Volume Returned (L): —
Confirm Packer Valve Open: [✓ Yes] No
Comments: Sample Valve @1500psi

O = Off, I = Inflate , C= Close **Tool Information**

WL ( )	OCI (psi)		TPP		Clock	Tag	OCI			TPP		Comments
	Open	Close	(mA)	(psi)			O	I	C	Off	On	
—	8.93	9.09	—	1500	10:17	—	✓			—	—	Land / Rec
												Shoe out 18
	10.77	9:08	—	1500	10:19	—						
	300							✓				Valve open ✓
	112.96	9:33	—	—	10:19$_{30}$	—						
	111.90	9:43	—	—	10:20		✓					
												Shoe out 18
	8.90	9:09	—	—	10:21							
												End

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Westbay System MP55 Packer Deflation
OCI/TPP Field Record

Page No: 1 of 1

Project No: WB 777 Client: LANL By: AB Date: Apr 2/11 Location: LANL
Well No. CDV-R-37-2 Borehole Dia: — Computer Data File: .WD3
Packer No: MP54 Depth: 1174 ft

OCI Tool No: 4253 TPP Tool No: —
Zone Pressure (Pre-Deflation Profile,(Po)): —
Inside Casing Pressure (Before Def,(P$_i$)): —
Inside Casing Pressure (After Def,(P$_i$)): —

Initial Packer Volume Pumped (L): — Packer Volume Returned (L): —
Confirm Packer Valve Open: [✓ Yes] No)
Comments: Sample Bottle @ 1500 psi

O = Off, I = Inflate , C= Close **Tool Information**

WL ( )	OCI (psi)		TPP		Clock	Tag	OCI			TPP		Comments
	Open	Close	(mA)	(psi)			O	I	C	Off	On	
—	8.61	—	—	1500	12:11		✓			—		Land/Non Rec
												Shoe out (CLEANOUT)
	11.10	—	—	1500	12:21							
	209							✓				Valve open
	77.26	—	—	—	12:22							
							✓					
	76.79	—	—	—	12:22							
												Shoe in —
	8.69	—	—	—	12:29							
												End

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Westbay System MP55 Packer Deflation
OCI/TPP Field Record

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Project No: WB 777 Client: LANL
Well No. CDV-R-37-2 Borehole Dia: —
Packer No: mp 77 Depth: 952 ft

By: AB Date: Apr 2/11 Location: LANL
Computer Data File: .WD3

OCI Tool No: 4253 TPP Tool No: —
Zone Pressure (Pre-Deflation Profile,(Po)): —
Inside Casing Pressure (Before Def,(Pi)): —
Inside Casing Pressure (After Def,(Pi)): —

Initial Packer Volume Pumped (L): — Packer Volume Returned (L): —
Confirm Packer Valve Open: [✓ Yes] / No
Comments: Sample Bottle @ 1500 psi

O = Off, I = Inflate , C= Close **Tool Information**

WL ( )	OCI (psi)		TPP		Clock	Tag	OCI			TPP		Comments
	Open	Close	(mA)	(psi)			O	I	C	Off	On	
—	9.00	—	—	1500	12:42		✓			—		Land / Non Rec
		—	—									Shoe out (Clean [illegible])
	.	—	—	1500	12:56			✓				
	210	—	—									Valve open ✓
	108.9	—	—	—	12:57		✓					
		—	—				✓					
	106.03	—	—	—	12:58							
	105.93	—	—									
					12:59							Shoe in
	9.00	—	—	—								
												END

Appendix B

Video Logs of CdV-R-15-3, CdV-R-37-2, and R-26
after Westbay Sampling System Removal
(on DVDs included with this document)

Appendix C

Well Development, Specific Capacity Testing and Cross-flow Calculations

CONTENTS

C-1.0 INTRODUCTION

This appendix describes the well development operations and specific capacity testing applied during the reliability assessment. Both specific capacity testing and thorough well development procedures were applied to CdV-R-37-2 and CdV-R-15-3, while only well development was performed on R-26 (no specific capacity testing).

In CdV-R-37-2 and CdV-R-15-3, well development was restricted to the uppermost saturated regional aquifer screen in each well – screen 2 in CdV-R-37-2 and screen 4 in CdV-R-15-3. In R-26, following Westbay sampling system removal, for a determination was made to abandon screen 2 in the regional aquifer and retain only screen 1 in a shallow perched intermediate zone. Thus, development was limited to screen 1. Development consisted of three activities – 1) initial and final purging, 2) swabbing and bailing, and 3) high velocity jetting with simultaneous pumping. (In R-26, no initial purging was performed. Purging was limited to pumping following swabbing and jetting.)

In CdV-R-37-2, initial specific capacity testing was performed on all three saturated screens (screens 2, 3 and 4). This provided the information needed to understand and quantify the cross flow that occurred among the three screens during the reliability assessment so that appropriate purge volumes could be calculated in support of groundwater sampling of the three zones. Similarly, in CdV-R-15-3, initial specific capacity testing also was performed on all three saturated screens (screens 4, 5 and 6). No specific capacity testing or hydraulic analysis was planned for R-26.

C-2.0 WELL DEVELOPMENT

The uppermost saturated screen in each well was developed by initial purging (except R-26), swabbing and bailing, high-velocity jetting with simultaneous pumping, and final purging. Pumping the developed screens in CdV-R-37-2 (screen 2) and CdV-R-15-3 (screen 4) was performed 1) prior to swabbing and bailing; 2) halfway through swabbing and bailing; 3) at the conclusion of swabbing and bailing; and 4) following jetting, in order to collect water samples for analytical analysis and evaluate the effectiveness of the development effort.

CdV-R-37-2 Screen 2 Development

Screen 2 in CdV-R-37-2 was swabbed using a surge block built by sandwiching a 4.25-inch 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 raising the tool upward and downward through the screen. Bailing was performed prior to, during, and following swabbing to remove any sediment loosened by the swabbing operation.

The initial swabbing and bailing of screen 2 was performed for nearly 4 h on April 19. Then the tools were pulled from the well and a test pump was installed to obtain water samples and measure specific capacity. After removing the test pump, the final round of swabbing and bailing was performed for about 4 h on April 21. At this point the test pump was rerun to obtain water samples and measure the specific capacity.

High velocity jetting was accomplished by operating a 10-horsepower 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 being 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 jetting effectiveness was enhanced by assuring 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 having four nozzles, each 5/64-inch in diameter. Based on the water depth (1195 ft bgs), the estimated jetting pressure (hydraulic lift to point of discharge at top of storage tank) was 520 psi and the yield of the pump was expected to be about 22 gpm. At the prevailing jetting pressure it was estimated that approximately 15 gpm would be delivered to the well screen through the jetting nozzles, with the balance of about 7 gpm discharged from the well.

The saturated portion of screen 2 extended from the static water level at about 1195 ft bgs to the bottom of the screen at 1213.8 ft bgs. Because future sample pumping was expected to dewater the top few feet of screen, jetting was performed from a depth of about 1198 ft bgs to a couple of feet below the bottom of the screen. This allowed the jetting operation to proceed at a single setting depth with a stroke length of about 18 ft. (Whenever possible, it is desirable to reverse the vertical direction of the pump and jetting tool in a blank casing section rather than within the well screen. That way, if the tool stops momentarily and focuses the jet on a single spot, there will be no risk of screen damage. Running the jetting tool a short distance below screen 2 into the blank casing allowed stopping and reversing the jet within the blank zone rather than within the base of the well screen.)

Jetting with simultaneous pumping was performed for 3 h on April 23. After removing the jetting equipment, the sample pump was run again for final water sampling and specific capacity measurement.

CdV-R-15-3 Screen 4 Development

Screen 4 in CdV-R-15-3 was swabbed and bailed initially for more than 3 h on May 5. After sampling the well and monitoring the specific capacity, final swabbing and bailing was performed for more than 3 h on May 7. Then the test pump was rerun to obtain water samples and measure the specific capacity.

The saturated portion of screen 4 extended from the static water level at about 1240 ft bgs to the bottom of the screen at 1278.9 ft bgs. As a pragmatic approach, jetting was applied in two 18-ft lifts covering the interval from a few feet beneath the static water level to the bottom of the screen.

Initially, the jetting tool incorporated four nozzles, each 1/16-inch in diameter. Based on the water depth, the estimated jetting pressure (hydraulic lift) was 540 psi and the yield of the pump was expected to be about 17 gpm. At the prevailing jetting pressure it was estimated that approximately 10 gpm would be delivered to the well screen through the jetting nozzles, with the balance of about 7 gpm discharged from the well. The upper portion of the screen was jetted using this configuration for about 3 h on May 9.

Toward the end of the jetting/pumping effort at this depth, the flow to the surface began to increase indicating that clogging of the jetting nozzle(s) was restricting the amount of flow delivered to the well screen. Therefore, before jetting the bottom portion of the screen, the jetting tool was pulled and modified.

After cleaning the jet orifices, two of the four jets were drilled out to 5/64-inch diameter. It was estimated that this design would increase the jetting volume to about 12.5 gpm, with the balance of about 4.5 gpm discharged from the well. Jetting was performed on the lower portion of the screen for 3 h on May 10. Slight clogging of the jets recurred during the second jetting episode, but the effect on the operation was considered minor. After removing the jetting equipment, the sample pump was run again for final water sampling and specific capacity measurement.

R-26 Screen 1 Development

R-26 screen 1 was redeveloped to remove a substantial quantity of bentonite that was smeared through the screen interval when the Westbay equipment was removed from the well. A video inspection of the screen had shown plugs of solid bentonite pushed into the drilled holes in the pipe base well screen. The video also indicated that the bentonite did not extend to the outer, wire-wrapped portion of the screen. Development procedures were similar to those applied to the other wells. In addition, jetting was used to clean the inside of the blank well casing between the static water level and 700 ft bgs, because video inspection had shown presence of bentonite on portions of the inner surface of the casing.

Screen 1 in R-26 was swabbed and bailed in one operation for 3 h on May 24. Then the jetting pump was run to begin jetting the well screen with simultaneous pumping.

Screen 1 was developed using a jetting tool having four nozzles, two with a 7/64-inch diameter and two having a 1/8-inch diameter. Based on the water depth (static water level of roughly 609 ft plus drawdown while jetting and pumping), the jetting pressure (hydraulic lift) was expected to approach 300 psi with a total pump production rate of about 37 gpm. At the prevailing jetting pressure it was estimated that approximately 25 gpm would be delivered to the well screen through the jetting tool, with the balance of about 13 gpm discharged from the well. Slight clogging of the jetting nozzles resulted in less water directed through the jetting tool and into the screen and more water discharged to the surface. Therefore, a valve in the discharge line was partially closed to increase the backpressure to various levels, averaging about 100 psi This modification increased the effective jetting pressure to near 400 psi and restored the desired balance between jetting volume and discharge from the well.

R-26 screen 1 extends from 651.8 to 669.9 ft bgs, a length of 18.1 ft. Thus, it would have been possible to jet the screen at a single depth setting, given a vertical stroke length of about 18 ft. However, because of the large amount of bentonite locked in the screen apertures, it was desired to dislodge this material gradually in order to minimize the rate of bentonite recirculation through the pump and jetting tool and, thus, back into the screen. To accommodate this need, screen 1 was jetted in two lifts so that, at each of the two depth settings, a portion of the jetting time would occur within blank casing where the jet would periodically cease dislodging bentonite from the screen.

On May 25, the upper portion of screen 1 and adjacent blank casing were jetted a little more than 2 h, and the lower portion for a similar duration.

Additional jetting was performed to clean bentonite from the surface of the blank casing between the static water level and the targeted level of backfill anticipated during subsequent abandonment of screen 2. On May 26, jet cleaning was performed on the blank sections from 609 ft bgs to the top of the screen and from the bottom of the screen to 700 ft bgs.

C-3.0 HYDRAULIC TESTING

Hydraulic testing was performed by installing a 5-horsepower shrouded 4-inch 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 from the pumped interval for specific capacity determination. In addition, transducers were set above the upper packer and below the lower packer to monitor the non-pumped zones. Transducers were used only in CdV-R-37-2 and CdV-R-15-3.

The great setting depths below the static water levels in these wells dictated using transducers with a large pressure recording range to avoid overloading the transducers and losing data. The best available option was to use 300-psi transducers. In-Situ LevelTROLL 700 non-vented units were selected for the testing. The immense pressure range of these transducers meant that accuracy and precision would not be as high as obtainable with lower-range transducers, as shown in the data described below.

Specific capacity measurements were performed on the three saturated zones in each well initially. These data were used along with relative static water levels of the zones to calculate the cross-flow volumes of the receiving screens. This information helped guide decisions regarding purge volumes during the sampling events.

Subsequently, specific capacity measurements were repeated in the developed screens (CdV-R-37-2 screen 2 and CdV-R-15-3 screen 4) at the midpoint of swabbing and bailing, at the conclusion of swabbing and bailing, and following jetting and simultaneous pumping. These progress points had been identified for collecting water samples, thus affording the opportunity to obtain hydraulic data as well.

CdV-R-37-2 Initial Hydraulic Data

Relative water levels in the three saturated screen intervals were obtained by isolating the zones with the inflatable packers, allowing equilibration to occur, deflating the packers and observing the change in water level in each zone. Figure C-1 shows the hydraulic response from CdV-R-37-2 screen 2 observed before and after packer deflation. The transducer noise is evident in the data plot. To smooth the plot, a rolling average was calculated and is included on the graph. To obtain the corresponding water level change, pressure data were averaged for an interval prior to packer deflation and another interval beginning several minutes following deflation. The difference between these averages was deemed to be the water level change. Mathematical averaging of the relevant data from screen 2 showed a water level decline of 0.1155 ft.

Figures C-2 and C-3 show the corresponding responses in screens 3 and 4. Calculations showed that the water level in screen 3 declined an average of 0.0672 ft, while that in screen 4 rose 0.0439 ft.

It is notable that the data showed small water level differences, spanning a range of less than 2 in. Data collected from the Westbay system implied a spread in water levels an order of magnitude greater (nearly 2 ft). The Westbay data rely on physical length measurements of the installed piping that provide a reference point for knowing the depth of the pressure transducers. It is possible that the common helix shape/orientation of the boreholes and well casings in these deep wells leads to a discrepancy between the physical pipe length and the vertical elevation difference between two arbitrary points, causing slight water level reporting errors. Transient data in Westbay-recorded water levels would accurately reflect changes in levels over time, but the absolute elevations could be a little off.

Specific capacity data were obtained by pumping each zone and observing the corresponding change in water level. In CdV-R-37-2, the water level changes were determined using the recovery data at the end of the tests. Figures C-4 through C-6 show the recovery responses observed in screens 2, 3 and 4, respectively. The pumping rates and drawdowns (averaged recovery distances) are summarized in Table C-1, along with the calculated specific capacities.

The specific capacity for screen 2 had to be corrected for the effects of dewatering because the static water level fell within the screen and ensured that aquifer dewatering occurred during pumping. This was done using the following formula (Kruseman and de Ridder, 1991):

Equation C-1

$$s_c = s_a - \frac{s_a^2}{2b}$$

Where, s_c = corrected drawdown, in ft
s_a = observed drawdown, in ft
b = saturated aquifer thickness, in ft

Assumptions required for validity of Equation C-1 are 1) homogeneous hydraulic conductivity, 2) full penetration of the producing zone by the well screen, and 3) no head loss associated with vertical flow. This last assumption is satisfied by one of two extremes – either zero permeability in the vertical direction so that there is no flow (and therefore no head loss) vertically, or infinite vertical permeability. Failure to meet any of these three assumptions leads to errors in application of the drawdown correction equation.

As shown in Table C-1, the observed drawdown of 2.66 ft was corrected to 2.48 ft, increasing the actual specific capacity of 1.50 gpm/ft to a theoretical value 1.60 gpm/ft.

Water levels showed that when the well was open and all three screens comingled, water entered the well from screens 2 and 3 and exited through screen 4. The specific capacity data and head differences among the zones were used to calculate cross-flow rates and volumes for this condition.

As shown in Table C-1, the corrected specific capacity of screen 2 was 1.60 gpm/ft. The difference between its water level and that in the open well was 0.1155 ft. Thus, the cross flow contribution from screen 2 was computed as 0.1155 x 1.60 = 0.19 gpm. The specific capacity of screen 3 was 23.9 gpm/ft and the difference between its water level and that in the open well was 0.0672 ft. The cross-flow contribution from screen 3 was computed as 0.0672 x 23.9 = 1.61 gpm. Summing these contributions implied a total influx rate of 1.80 gpm when all three screens were open.

This result was checked by computing inflow to screen 4. The specific capacity of screen 4 was 44.5 gpm/ft and the difference between its water level and that in the open well was 0.0439 ft. Thus, the flux exiting at screen 4 was computed as 0.0439 x 44.5 = 1.95 gpm.

The calculations produced a slightly greater flow into screen 4 than out of screens 2 and 3. The discrepancy was minor and could have been related to the precision limitations of the high-pressure transducers used in the tests. As a conservative measure, the greater of the two values, 1.95 gpm, was used in the cross-flow calculations.

All three screens comingled for a total of 9959 min during the preliminary reliability-study work tasks leading up to the purging and sampling of screen 4. The corresponding cross-flow volume was computed as 1.95 x 9959 = 19,420 gallons. The comingling time and cross-flow rate and volume are shown in Table C-2.

Calculations were made also for times when only two screens comingled – screens 2 and 3 together and screens 3 and 4 together. Analysis showed that the flux from screen 2 to 3 was negligible and more than offset during subsequent open-hole episodes. The only concern was flux from screen 3 to 4.

Cross flow between two screens is calculated using the following formula:

Equation C-2

$$Q = h\frac{c_3 c_4}{c_3 + c_4}$$

where,

Q = cross flow rate, in gpm
c_3 = specific capacity of screen 3, in gpm/ft
c_4 = specific capacity of screen 4, in gpm/ft
h = head difference between screens 3 and 4, in ft

The head difference between screens 3 and 4 was 0.111 ft. Applying Equation C-2 using this head difference and the specific capacity values from Table C-1 yielded a cross-flow rate of 1.73 gpm.

Screens 3 and 4 comingled for a total of 300 min during the preliminary reliability-study work tasks leading up to the purging and sampling of screen 4. The cross-flow volume was computed as 1.73 x 300 = 519 gallons. The comingling time and cross-flow rate and volume are shown in Table C-2.

As shown in the table, summing the cross-flow contributions yielded a total volume of 19,939 gallons exiting the well at screen 4. The decision was made to purge at least 25% more than this, or 24,924 gallons. The actual purge volume obtained from screen 4 prior to sampling was 26,330 gallons.

No cross-flow purging was required for screens 2 and 3.

C-3.0 DEVELOPMENT RESULTS

CdV-R-37-2 Development Results

Following purging and sampling of each of the three screen zones, development procedures were applied to screen 2 as described above. At various stages, the screen was sampled, affording the opportunity to reassess the specific capacity response.

Table C-3 shows pumping rate, drawdown and specific capacity data for three different times – prior to development, at the conclusion of swabbing and bailing, and at the conclusion of jetting and simultaneous pumping.

Note that the specific capacity shown prior to well development differs from that in Table C-1. The value shown in Table C-3 was obtained during the initial purging and sampling of screen 2 (conducted after the initial specific capacity testing phase of the work). This value was selected because it was obtained at a discharge rate having about the same magnitude as rates applied during subsequent tests. The similarities of the pumping rates shown in Table C-3 obviated the need to correct any of the data for dewatering using the approximate equation introduced above. This allowed an “apples-to-apples” comparison of the specific capacity data to be made.

Table C-3 shows that the initial specific capacity of 1.35 gpm/ft was increased to 1.47 gpm/ft by swabbing and bailing (9%) and was increased again to 2.23 gpm/ft (additional 52% and 65% total) by jetting with simultaneous pumping.

CdV-R-15-3 Initial Hydraulic Data

Relative water levels in the three saturated screen intervals in CdV-R-15-3 were obtained by isolating the zones with the inflatable packers, allowing equilibration to occur, deflating the packers and observing the change in water level in each zone, similar to procedures applied to CdV-R-37-2. Figures C-7 through C-10 show the hydraulic responses obtained from CdV-R-15-3 observed before and after packer deflation. The transducer noise is evident in the plots where the head changed only slightly.

The figures showed that the difference between the screen 4 water level and that in the open well averaged 0.0906 ft. The corresponding data from screen 5 showed a head decline of 0.0350 ft while that from screen 6 showed a head rise of 32.77 ft.

A similar set of observations (not illustrated) was made immediately following initial specific capacity testing of the three zones. The results were different than those obtained prior to specific capacity testing, showing head declines of 0.119 and 0.0575 ft (compared to 0.0906 and 0.0350 ft) in screens 4 and 5, respectively. This was attributed to partial development of screen 6 during the specific capacity tests. Simply pumping the zone had removed clogging material, enabling screen 6 to receive a greater volume of water (increased cross flow) than before specific capacity testing. The water level in screen 6 is about 33 ft beneath the levels in the overlying screens. Thus, it would have received water, and possibly some sediment, from screens 4 and 5 (1) during well construction, (2) throughout most or all of the development period when the well was new, and (3) during Westbay installation. It is possible also that biological growth over the years contributed to clogging screen 6. The improved permeability at screen 6 meant that cross flow rates increased following specific capacity testing. It was necessary to account for this when computing cross-flow volumes, as discussed below.

Specific capacity data were obtained by pumping each zone and observing the corresponding change in water level. Figures C-10 through C-12 show the drawdown and recovery responses observed at screens 4, 5 and 6, respectively. The pumping rates and drawdown are summarized in Table C-4, along with the calculated specific capacities.

Note that each of the zones was pumped at multiple discharge rates. The specific capacity data listed in Table C-4 were based on the lowest rate in order to most closely approximate performance during cross flow when rates were low. Further, the drawdown at screen 4 was small enough that dewatering effects were negligible and correction calculations were not required.

Note also, on Figure C-12, that during each pumping step applied to screen 6, the specific capacity steadily increased (drawdown decreased). This reflected ongoing development of screen 6 in response to pumping the zone. It is possible that when the well was drilled in 2000, development pumping was performed without the use of inflatable packers. (It is more likely that pumping would have occurred in the open hole.) If that is the case, water would not have been produced from screen 6 because, when pumping from the open hole, all of the pumped water is produced from screens 4 and 5, while screen 6 continues to *receive* water. Thus, the pumping event illustrated on Figure C-12 may represent the first time that screen 6 has ever been pumped.

Water levels showed that when the well was open and all three screens comingled, water entered the well from screens 4 and 5 and exited through screen 6. The specific capacity data and head differences among the zones were used to calculate cross-flow rates and volumes for this condition.

As shown in Table C-4, the specific capacity of screen 4 was 10.77 gpm/ft. Prior to specific capacity testing, the difference between its water level and that in the open well was 0.0906 ft. Thus, the cross flow contribution from screen 4 was computed as 0.0906 x 10.77 = 0.976 gpm. The specific capacity of screen 5 was 1.00 gpm/ft and the difference between its water level and that in the open well was 0.0.0350 ft. The cross flow contribution from screen 5 was computed as 0.0350 x 1.00 = 0.035 gpm. Summing these contributions implied a total influx rate of 1.011 gpm when all three screens were open. This cross-flow rate applied to the time intervals when all three screens were open prior to specific capacity testing.

This result was checked by computing the flow rate into screen 6. The specific capacity of screen 6 was 0.132 gpm/ft and the difference between its water level and that in the open well was 32.77 ft. This led to a calculated flux rate exiting the well of 32.77 x 0.132 = 4.33 gpm, much different than the calculated flow rate into the well. There were two reasons for the inconsistent results. First, the very act of testing the screen improved its specific capacity, providing a misleading indication of what the performance would have been prior to testing. Second, it is common for the specific capacity of a well to be greater when pumping than when injecting, because of clogging that occurs during injection. Because of this, the hydraulic performance of screen 6 was not used to estimate cross flow. Instead, computations were based on flux rates into the well from the overlying screens.

All three screens comingled for a total of 6384 min during the preliminary reliability-study work tasks prior to specific capacity testing. The corresponding cross-flow volume was computed as 1.011 x 6384 = 6454 gallons. The comingling time and cross-flow rate and volume are shown in Table C-5.

Cross-flow calculations were performed for the period between specific capacity testing and sampling screen 6. The contribution from screen 4 was computed as 0.119 x 10.77 = 1.282 gpm. The cross flow contribution from screen 5 was computed as 0.0575 x 1.00 = 0.0575 gpm. Summing these contributions implied a total influx rate of 1.34 gpm when all three screens were open.

All three screens comingled for a total of 734 min during the period between specific capacity testing and sampling screen 6. The corresponding cross-flow volume was computed as 1.34 x 734 = 984 gallons. The comingling time and cross-flow rate and volume are shown in Table C-5.

Calculations were made also for times when only two screens comingled – screens 4 and 5 together and screens 5 and 6 together. Analysis showed that the flux from screen 4 to 5 was negligible and more than offset during subsequent open-hole episodes. The only concern was flux from screen 5 to 6.

Equation 2 could not be used to compute the cross-flow rate from screen 5 to 6 because of indications that the screen-6 injection specific capacity was lower than the pumping specific capacity. However, the head rise at screen 6 when screens 5 and 6 were open would have been nearly identical to that when all three screens were open. (This condition results from the similarity of the static water levels of screens 4 and 5 combined with the relatively low specific capacity of screen 6.) Therefore, the flux rate from screen 5 to 6 was considered to be the same as that from screens 4 and 5 to 6.

Screens 5 and 6 comingled for a total of 147 min during the preliminary reliability-study work tasks leading up to specific capacity testing. The cross-flow volume for that time period was computed as 1.011 x 147 = 149 gallons. The comingling time and cross-flow rate and volume are shown in Table C-5.

Screens 5 and 6 comingled for a total of 365 min during the time period between specific capacity testing and sampling screen 6. The cross-flow volume for that time period was computed as 1.34 x 365 = 489 gallons. The comingling time and cross-flow rate and volume are shown in Table C-5.

As shown in the table, summing the cross-flow contributions yielded a total volume of 8076 gallons exiting the well at screen 6. The decision was made to purge at least 25% more than this, or 10,094 gallons. The actual purge volume obtained from screen 6 prior to sampling was 10,732 gallons.

No cross-flow purging was required for screens 4 and 5.

CdV-R-15-3 Development Results

Following purging and sampling of each of the three screen zones, development procedures were applied to screen 4 as described above. At various stages, the screen was sampled, affording the opportunity to reassess the specific capacity response.

Table C-6 shows pumping rate, drawdown and specific capacity data for three different times – prior to development, at the conclusion of swabbing and bailing, and at the conclusion of jetting and simultaneous pumping. Specific capacity data were selected for similar discharge rates to facilitate a valid comparison.

Table C-6 shows that the initial specific capacity of 9.69 gpm/ft was increased to 11.91 gpm/ft by swabbing and bailing (23%) and was increased again to 12.24 gpm/ft (additional 3% and 26% total) by jetting with simultaneous pumping.

R-26 Development Results

No formal testing and analysis were scheduled for R-26 screen 1. Nevertheless, it was possible to infer indirectly the level of pumping performance following well development and compare it to pumping data measured in 2004 when the well was new.

During post-development purging to clean up the well, the pump was operated at several horizons. At one point, it was set above the screen, shallow enough to induce cavitation by pulling the pumping water level down to the pump intake. This was done to try to purge water standing in the blank casing above the well screen. When cavitation occurred, the pumping water level was known to be at the pump intake and, therefore, drawdown and specific capacity could be determined.

Table C-7 shows pumping rate and drawdown data obtained in 2004 along with the information inferred from the post-development pump cavitation episode. As indicated, on February 19, 2004 screen 1 produced 6.8 gpm with 23.72 ft of drawdown for a specific capacity of 0.287 gpm/ft. On May 27, 2011 it produced 5.1 gpm with the pump intake set 16.76 ft below the static water level. This implied a specific capacity of 0.304 gpm/ft.

This result showed about a 6% increase in yield above the original level. Differences in discharge rate and pumping duration between the two pumping events could account for some difference in specific capacity. Nevertheless, the results showed that removal of the bentonite by the development procedures was effective, essentially restoring the well yield. Subsequent video examination of screen 1 confirmed no visible solids in the screen apertures.

C-4.0 REFERENCES

Kruseman, G. P. and N. A. de Ridder, 1991. “Analysis and Evaluation of Pumping Test Data” International Institute for Land Reclamation and Improvement, The Netherlands.

Table C-1. CdV-R-37-2 Initial Specific Capacities
Los Alamos National Laboratory Los Alamos, New Mexico

Date	Zone	Pumping Rate(gpm)	Drawdown (feet)	Specific Capacity(gpm/ft)
4/9/2011	Screen 2	3.98	2.66	1.50
	Screen 2 Corrected	3.98	2.48	1.60
4/8/2011	Screen 3	3.78	0.158	23.9
4/8/2011	Screen 4	3.78	0.085	44.5

Table C-2. CdV-R-37-2 Screen 4 Cross Flow,
Los Alamos National Laboratory, Los Alamos, New Mexico

Screens Open	Time (minutes)	Cross Flow Rate to Screen 4 (gpm)	Cross Flow Volume to Screen 4 (gallons)
2, 3 and 4	6384	1.011	6,454
2, 3 and 4	734	1.324	972
3 and 4	147	1.011	149
3 and 4	365	1.324	483
		Total Volume:	8,058
		Total Volume x 1.25:	10,072
		Volume Purged:	10,732

Table C-3. CdV-R-37-2 Screen 2 Development Results,
Los Alamos National Laboratory, Los Alamos, New Mexico

Date	Development Stage	Pumping Rate (gpm)	Drawdown (feet)	Specific Capacity (gpm/ft)
4/17/2011	Predevelopment	6.20	4.60	1.35
4/22/2011	After Swabbing	6.15	4.17	1.47
4/24/2011	After Jetting/Pumping	6.23	2.80	2.23

Table C-4. CdV-R-15-3 Initial Specific Capacities, Los Alamos National Laboratory, Los Alamos, New Mexico

Date	Zone	Pumping Rate (gpm)	Drawdown (feet)	Specific Capacity (gpm/ft)
4/29/2011	Screen 4	3.08	0.286	10.77
4/28/2011	Screen 5	3.00	3.00	1.00
4/28/2011	Screen 6	2.86	21.73	0.132

Table C-5. CdV-R-15-3 Screen 6 Cross Flow, Los Alamos National Laboratory, Los Alamos, New Mexico

Screens Open	Time (minutes)	Cross Flow Rate to Screen 6 (gpm)	Cross Flow Volume to Screen 6 (gallons)
2, 3 and 4	6384	1.011	6,454
2, 3 and 4	734	1.324	972
3 and 4	147	1.011	149
3 and 4	365	1.324	483
		Total Volume:	8,058
		Total Volume x 1.25:	10,072
		Volume Purged:	10,732

Table C-6. CdV-R-15-3 Screen 4 Development Results, Los Alamos National Laboratory, Los Alamos, New Mexico

Date	Development Stage	Pumping Rate (gpm)	Drawdown (feet)	Specific Capacity (gpm/ft)
4/29/2011	Predevelopment	9.01	0.93	9.69
5/8/2011	After Swabbing	9.05	0.76	11.91
5/11/2011	After Jetting/Pumping	9.13	0.746	12.24

Table C-7. R-26 Screen 1 Development Results, Los Alamos National Laboratory, Los Alamos, New Mexico

Date	Development Stage	Pumping Rate (gpm)	Drawdown (feet)	Specific Capacity (gpm/ft)
2/19/2004	Original Yield	6.8	23.72	0.287
5/27/2011	After Development	5.1	16.76	0.304

Figure C-1 Well CdV-R-37-2 Screen 2 Packer Deflation

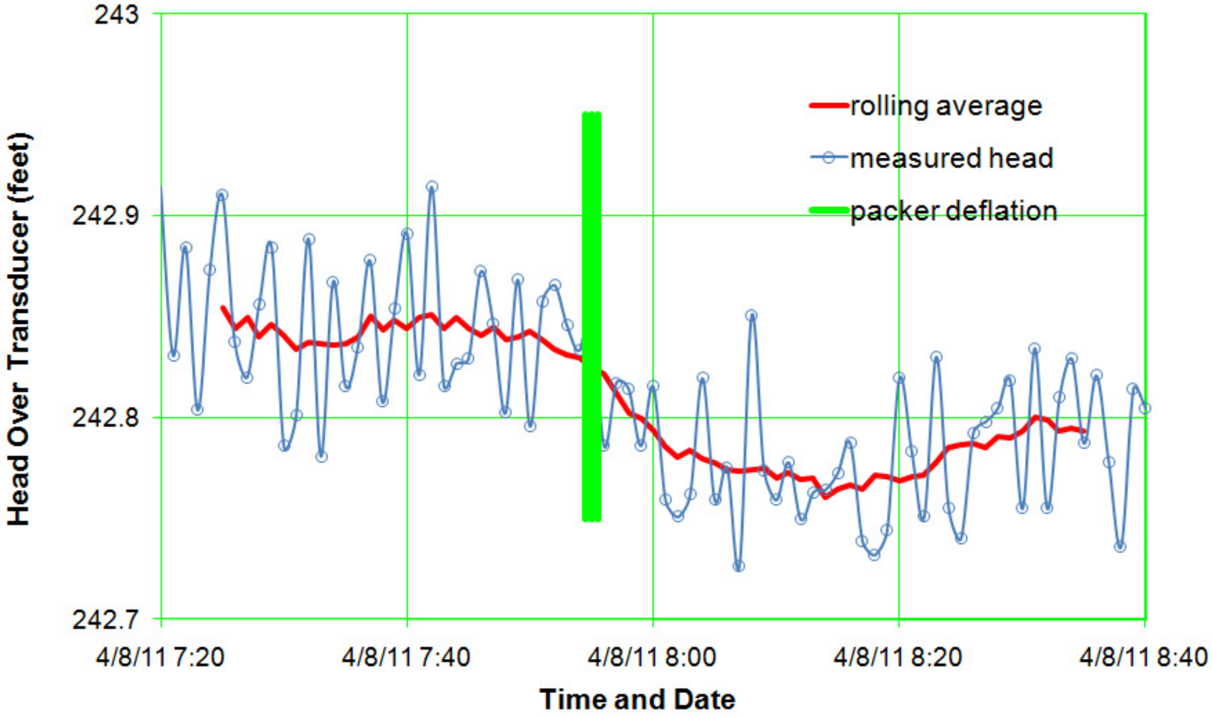

Figure C-2 Well CdV-R-37-2 Screen 3 Packer Deflation

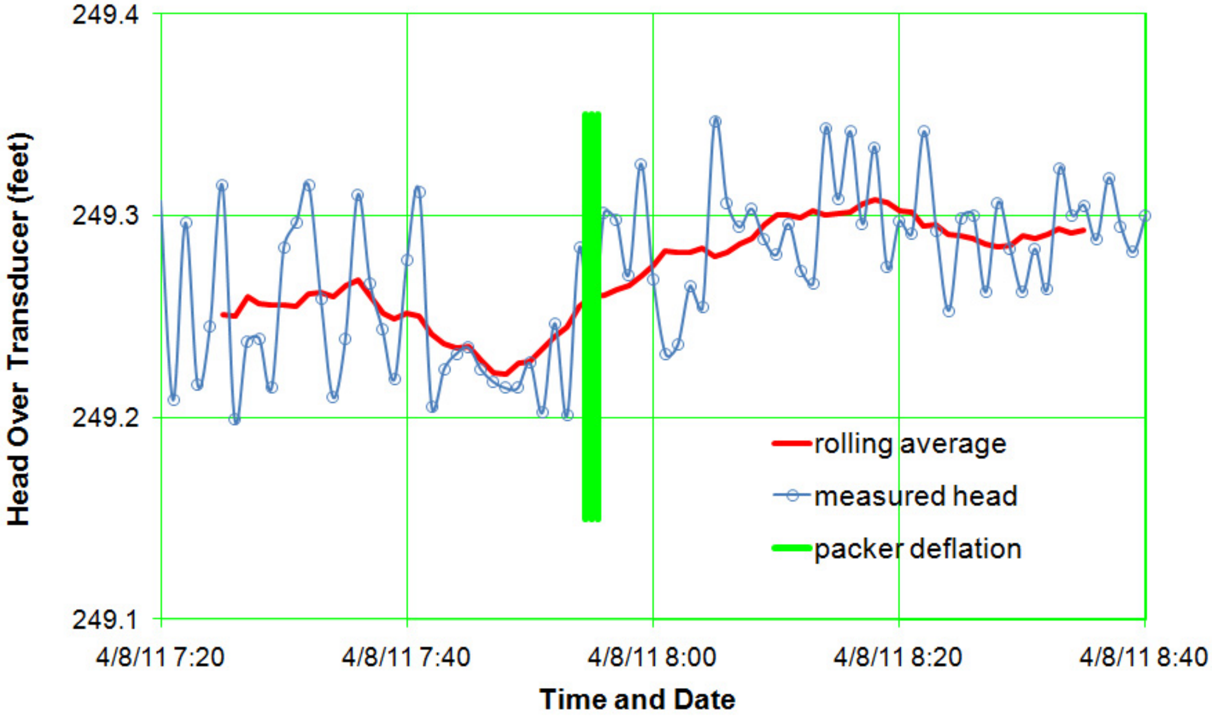

Figure C-3 Well CdV-R-37-2 Screen 4 Packer Deflation

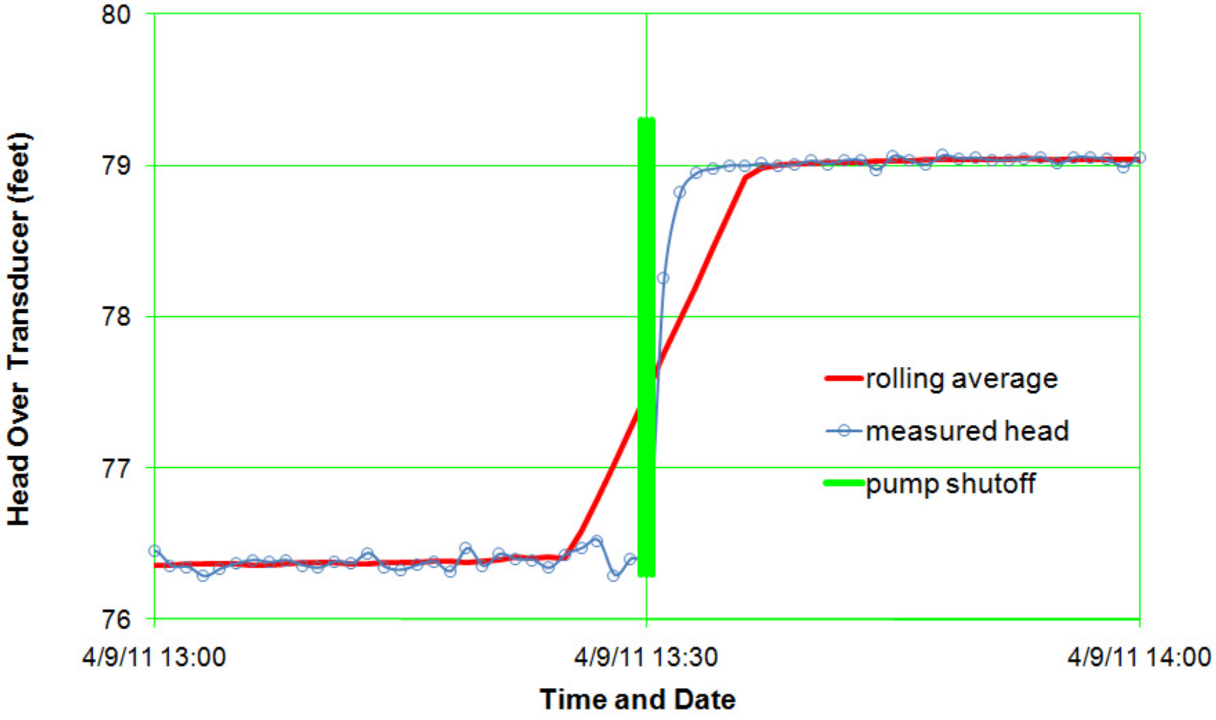

Figure C-4 **Well CdV-R-37-2 Screen 2 Pump Shutoff Response**

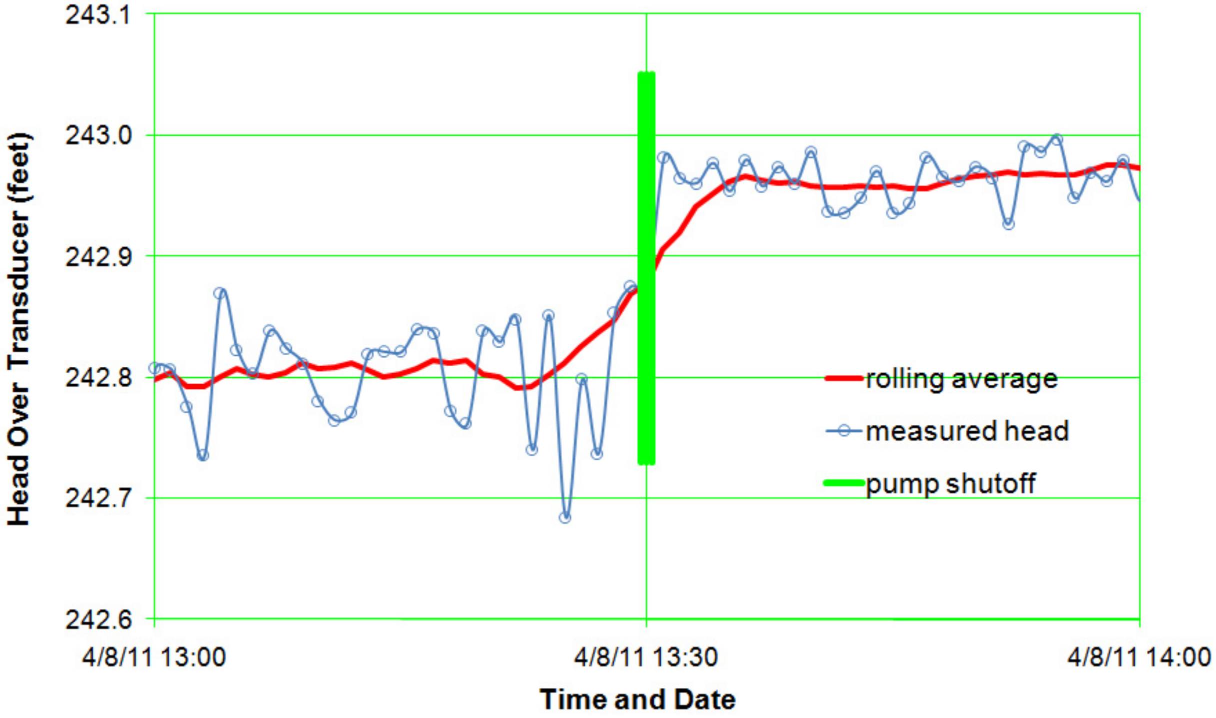

Figure C-5 **Well CdV-R-37-2 Screen 3 Pump Shutoff Response**

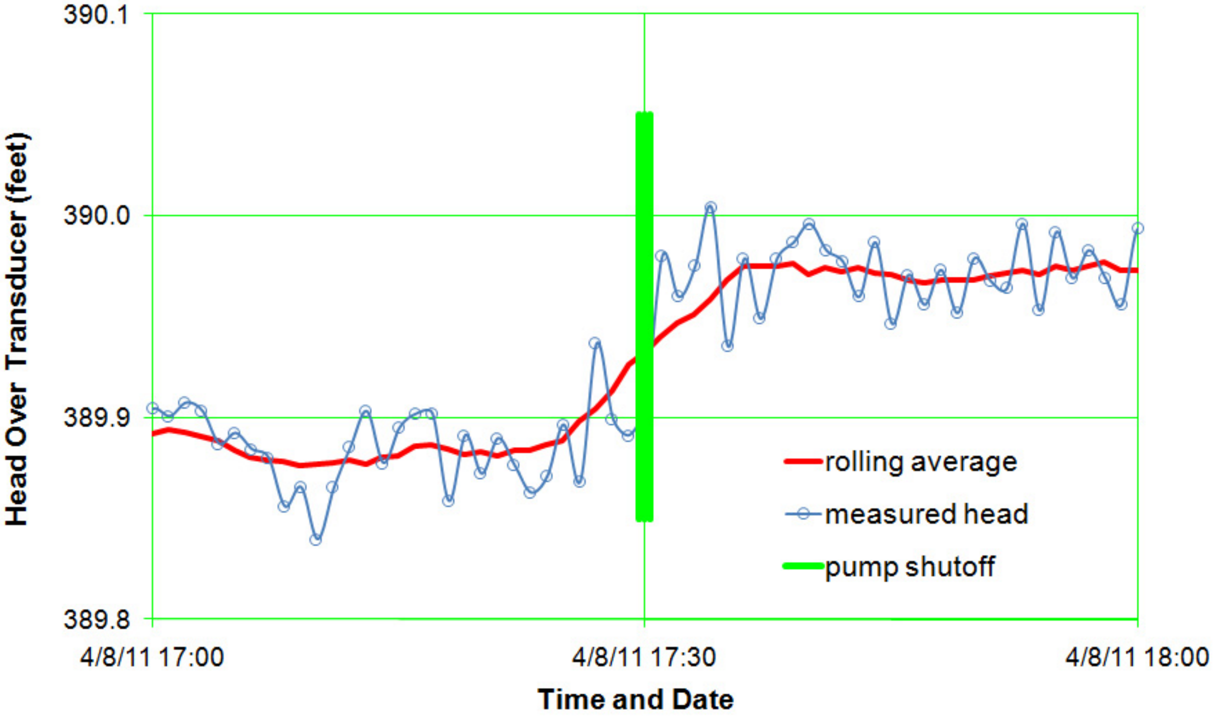

Figure C-6 **Well CdV-R-37-2 Screen 4 Pump Shutoff Response**

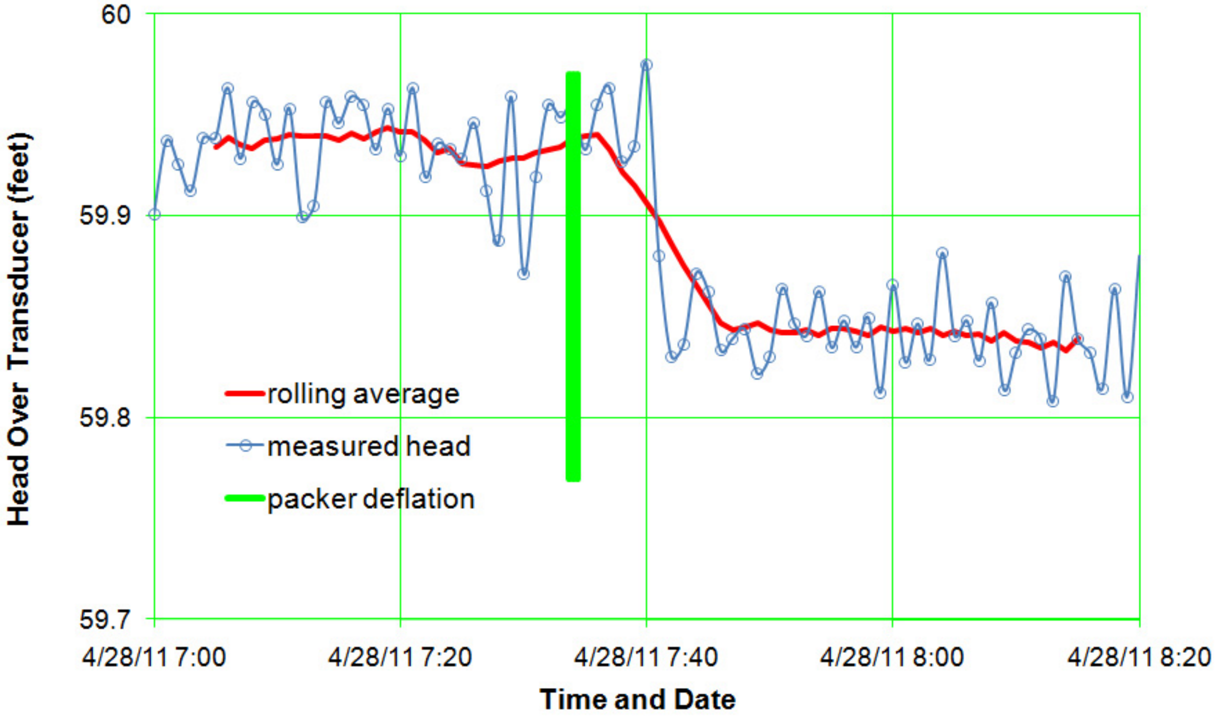

Figure C-7 **Well CdV-R-15-3 Screen 4 Packer Deflation**

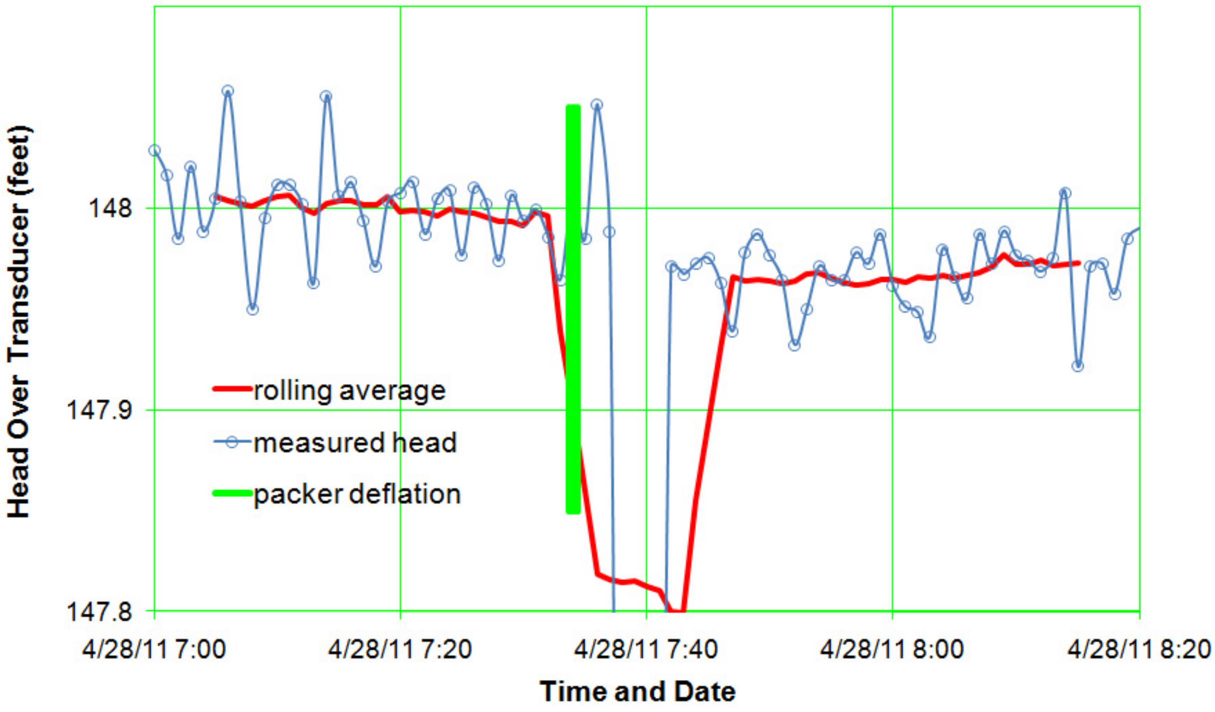

Figure C-8 Well CdV-R-15-3 Screen 5 Packer Deflation

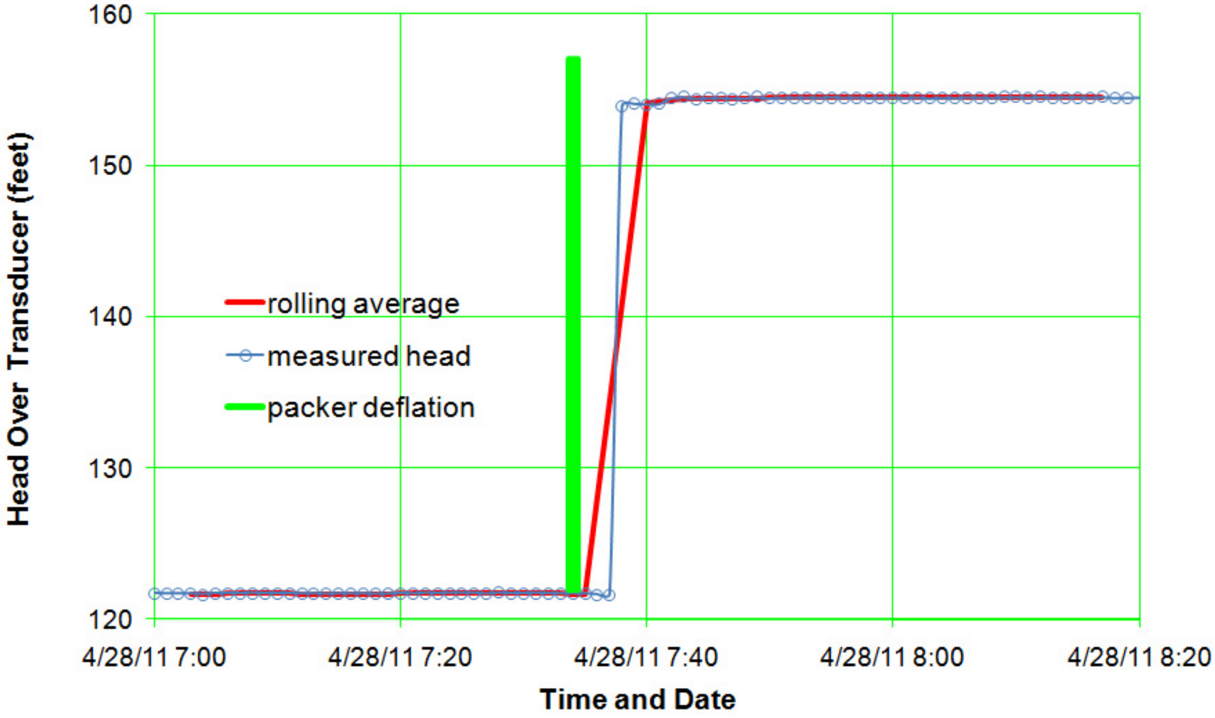

Figure C-9 Well CdV-R-15-3 Screen 6 Packer Deflation

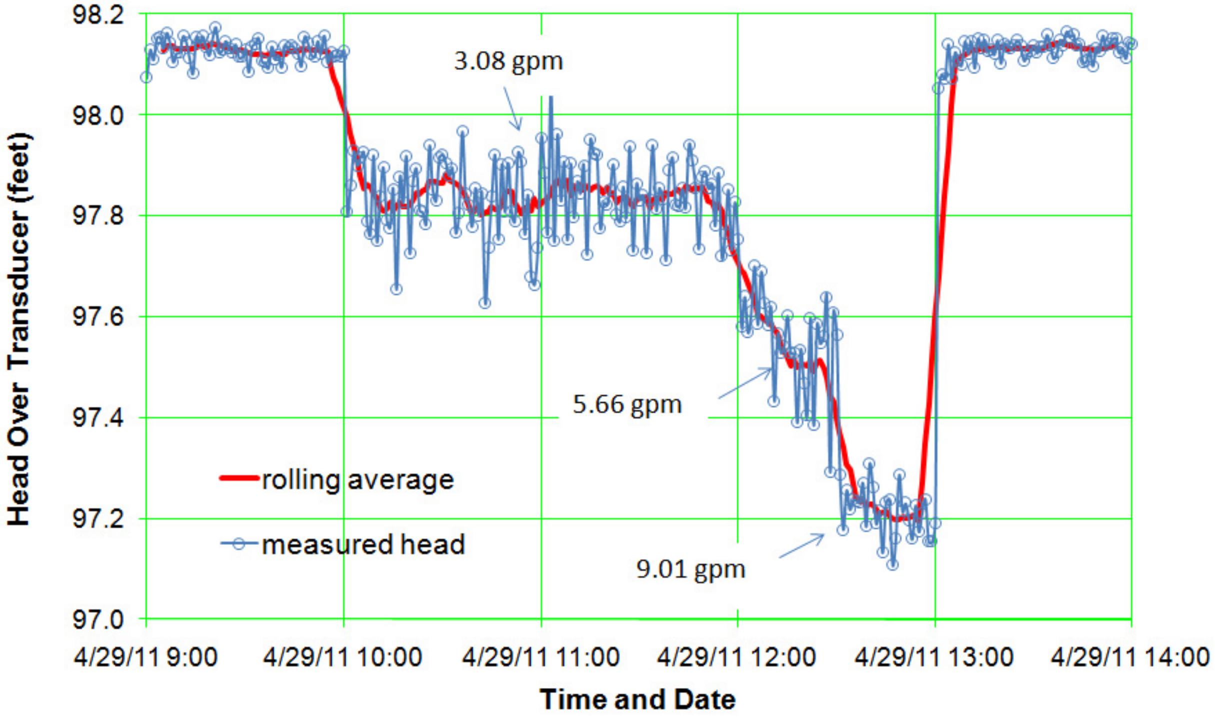

Figure C-10 **Well CdV-R-15-3 Screen 4 Pumping Response**

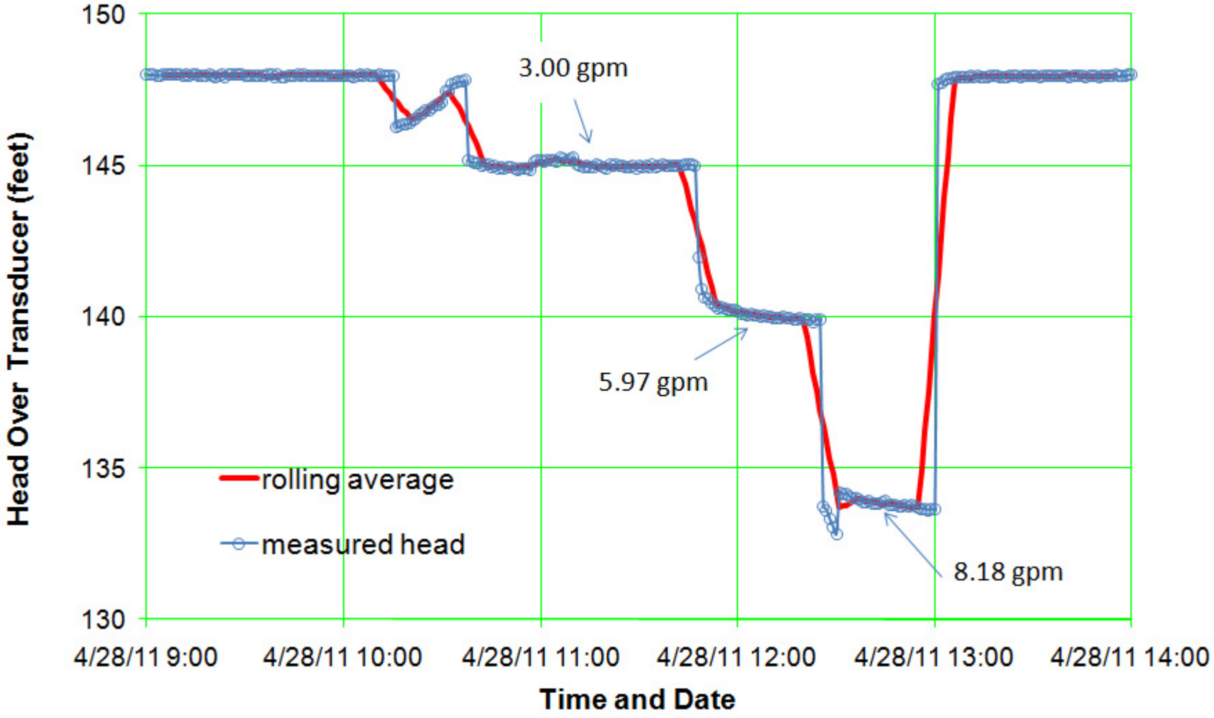

Figure C-11 **Well CdV-R-15-3 Screen 5 Pumping Response**

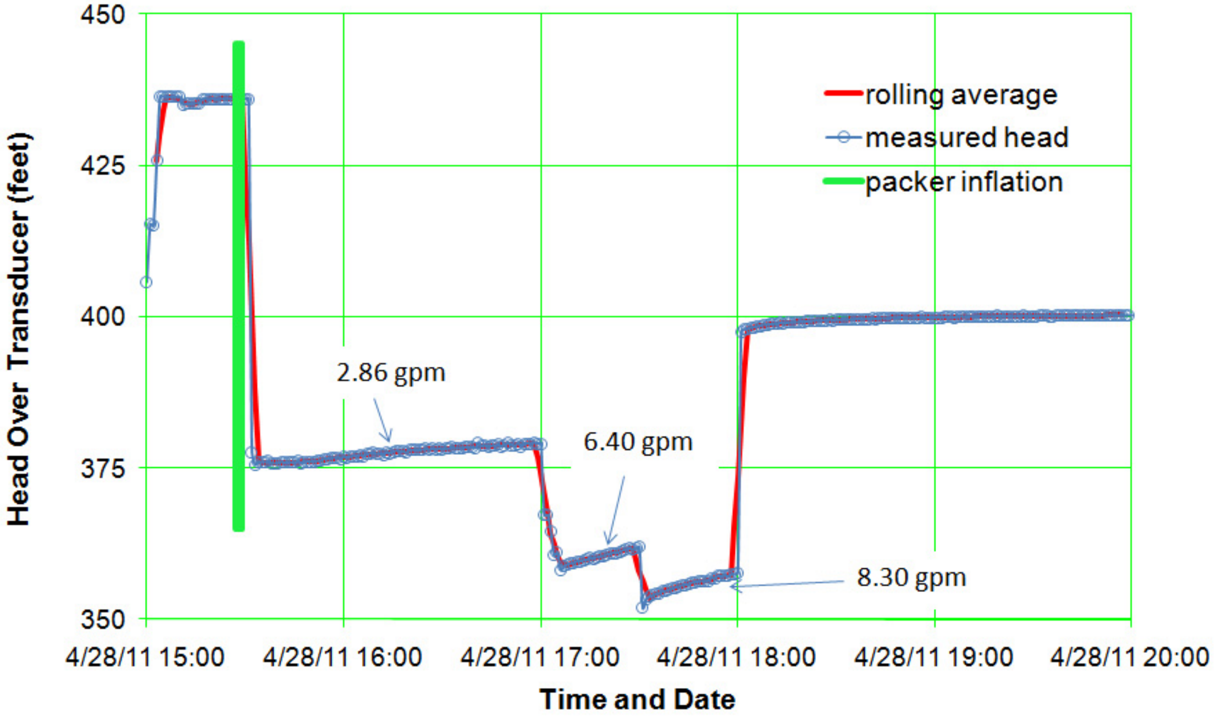

Figure C-12 **Well CdV-R-15-3 Screen 6 Pumping Response**