LA-UR-15-26789

Title:	Multiple Activities Work Plan for the Treatment and Land Application of Groundwater From Mortandad and Sandia Canyons, DP-1793 WP#2
Author(s):	Beers, Robert Stephen
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Los Alamos
NATIONAL LABORATORY
EST. 1943

Environmental Protection Division
Environmental Compliance Programs (ENV-CP)
PO Box 1663, K490
Los Alamos, New Mexico 87545
(505) 667-0666

Environmental Management
Los Alamos Field Office, A316
3747 West Jemez Road
Los Alamos, New Mexico, 87545
(505) 665-5658/Fax (505) 606-2132

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Ms. Michelle Hunter, Bureau Chief
Ground Water Quality Bureau
New Mexico Environment Department
Harold Runnels Building, Room N2261
1190 St. Francis Drive
P.O. Box 26110
Santa Fe, NM 87502

Dear Ms. Hunter:

Subject: Multiple Activities Work Plan for the Treatment and Land Application of Groundwater from Mortandad and Sandia Canyons, DP-1793 WP#2

On July 27, 2015, the New Mexico Environment Department (NMED) issued a Discharge Permit (DP-1793) to the U.S. Department of Energy and Los Alamos National Security, LLC (DOE/LANS) for the land application of treated groundwater from covered activities. Pursuant to the requirements of Discharge Permit DP-1793, on August 13, 2015, DOE/LANS submitted a work plan for the treatment and land application of groundwater produced from Chromium Project activities (ENV-DO-14-0221). On August 18, 2015, NMED informed DOE/LANS [written communication, Ms. Hunter (NMED) to Ms. Dorries (LANS) and Ms. Gelles (DOE)] that the workplan, as submitted, failed to meet the requirements of Condition No. 3 of the above-referenced Discharge Permit and was therefore rejected. Subsequently, on August 21, 2015, NMED and DOE/LANS staff met to discuss modifications to the August 13th work plan that would be incorporated into a new submittal. The enclosed Work Plan incorporates NMED's recommendations.

This Multiple Activities Work Plan (Work Plan) is for the proposed discharge of treated regional aquifer groundwater from three activities conducted under the Chromium Project:

- ✓ pumping at extraction well CrEX-1,
- ✓ new monitoring well and piezometer development and aquifer testing, and
- ✓ routine monitoring well purging during sampling.

The activities listed above are conducted for chromium plume monitoring as specified in the 2013 Interim Measures Work Plan for the Evaluation of Chromium Mass Removal; NMED's February 19, 2014 Approval with Modifications letter for Phase II Investigation Report for Sandia Canyon; and NMED-approved annual Interim Facility-Wide Groundwater Monitoring Plans. Produced groundwater will be treated and discharged in accordance with the enclosed Work Plan and supporting information:

- ✓ Enclosure 1: Multiple Activities Work Plan for the Treatment and Land Application of Groundwater From Mortandad and Sandia Canyons
- ✓ Enclosure 2: Interim Measures Work Plan for the Evaluation of Chromium Mass Removal
- ✓ Enclosure 3: Topographical map showing required features and approved land application areas
- ✓ Enclosure 4: Table 3.4-1, Interim Monitoring Plan for Chromium Investigation Monitoring Group
- ✓ Enclosure 5: Well and Piezometer Fact Sheets
- ✓ Enclosure 6: Water quality data from Well CrEX-1
- ✓ Enclosure 7: Ion Exchange (IX) Treatment System Schematic and IX Technical Specifications
- ✓ Enclosure 8: Map of project components: wells, treatment, piping, storage, and irrigation areas
- ✓ Enclosure 9: Land application sites signage

Pumping at extraction well CrEX-1 is scheduled to begin in October 2015, contingent on NMED approval of the enclosed Work Plan (Enclosure 1), and continue until December 31, 2015, or until field conditions prohibit land application, whichever comes first. Technical staff from DOE/LANS are available at your convenience to brief you on the details of the project and answer questions.

Please contact Robert S. Beers by telephone at (505) 667-7969 or by email at bbeers@lanl.gov if you have questions regarding this work plan.

Sincerely,

Alison M. Dorries
Division Leader
Environmental Protection Division
Los Alamos National Security, LLC

Sincerely,

Christine M. Gelles
Acting Manager
Environmental Management
Los Alamos Field Office
U.S. Department of Energy

AMD:CMG:MTS:RSB/lm

Enclosures:

1. Enclosure 1: Multiple Activities Work Plan for the Treatment and Land Application of Groundwater from Mortandad and Sandia Canyons
2. Enclosure 2: Interim Measures Work Plan for the Evaluation of Chromium Mass Removal
3. Enclosure 3: Topographical map showing required features and approved land application areas
4. Enclosure 4: Table 3.4-1, Interim Monitoring Plan for Chromium Investigation Monitoring Group
5. Enclosure 5: Well and Piezometer Fact Sheets

6. Enclosure 6: Water quality data from Well CrEX-1
7. Enclosure 7: Ion Exchange (IX) Treatment System Schematic and IX Technical Specifications
8. Enclosure 8: Map of project components: wells, treatment, piping, storage, and irrigation areas
9. Enclosure 9: Land application sites signage

Cy: James Hogan, NMED/SWQB, Santa Fe, NM, (E-File)
John E. Kieling, NMED/HWB, Santa Fe, NM, (E-File)
Stephen M. Yanicak, NMED/DOE/OB, (E-File)
Cheryl L. Rodriguez, EM-SG, (E-File)
Gene E. Turner, LASO-NS-LP, (E-File)
Kirsten Laskey, LASO-SUP, (E-File)
Jordan Arnswald, LASO-NS-PI, (E-File)
Craig S. Leasure, PADOPS, (E-File)
Amy E. De Palma, PADOPS, (E-File)
Michael T. Brandt, ADESH, (E-File)
Raeanna Sharp-Geiger, ADESH, (E-File)
Alison M. Dorries, ENV-DO, (E-File)
Randall M. Erickson, ADEP, (E-File)
Raymond Martinez, Pueblo of San Ildefonso, (E-File)
Enrique Torres, ADEP, (E-File)
Bruce Robinson, ER, (E-File)
Stephanie F. Swickley, ER, (E-File)
Danny Katzman, ER, (E-File)
Alan S. Macgregor, ER, (E-File)
Michael T. Saladen, ENV-CP, (E-File)
Robert S. Beers, ENV-CP, (E-File)
lasomailbox@nnsa.doe.gov, (E-File)
emla.docs@em.doe.gov, (E-File)
locatesteam@lanl.gov, (E-File)
epccat@lanl.gov, (E-File)
env-correspondence@lanl.gov, (E-File)

ENCLOSURE 1

Multiple Activities Work Plan for the Treatment and
Land Application of Groundwater from Mortandad
and Sandia Canyons

ENV-DO-15-0245

LA-UR-15-26789

Date: September 3, 2015

ENCLOSURE 1

Multiple Activities Work Plan for the Treatment and Land Application of Groundwater From Mortandad and Sandia Canyons, DP-1793 WP#2

Introduction. Chromium (Cr) concentrations exceed the New Mexico Water Quality Control Commission (NMWQCC) Regulation 3103 groundwater standard of 50 µg/L in regional aquifer groundwater beneath Mortandad and Sandia Canyons within Los Alamos National Laboratory (the Laboratory). Investigations have identified the probable Cr(VI) source as cooling-tower effluent released near the head of Sandia Canyon between 1956 and 1972. Hexavalent chromium was transported down the canyon in surface-water flow where it eventually infiltrated the vadose zone into the regional aquifer. Some chromium is present in the Sandia Canyon wetland and sediments as stable trivalent chromium. Hexavalent chromium is also still present in the vadose zone (including in perched-intermediate groundwater) beneath Sandia and Mortandad Canyons.

The chromium plume is approximately 1 mi by 0.5 mi in size and is estimated to be situated in the upper 100 ft of the aquifer. Several wells along the downgradient edge of the plume in the regional aquifer are showing increases in chromium concentrations, suggesting potential expansion of the plume. Because of these recent increases, the Laboratory proposed to conduct interim measures (IM) in accordance with Section VII.B.1 of the March 1, 2005, Compliance Order on Consent (Consent Order). The Interim Measures Work Plan for the Evaluation of Chromium Mass Removal (IMWP) was submitted on April 30, 2013, in response to requirements in a letter from the New Mexico Environment Department (NMED), dated January 25, 2013, which directed that the IMWP assess the potential for active long-term removal of chromium from the regional aquifer via pumping with a pilot extraction test well in Mortandad Canyon. **Enclosure 2** is a copy of the monitoring year 2015 (MY15) IMWP. In addition to IMWP activities, in its letter dated February 19, 2014, NMED required the installation of a two new aquifer monitoring wells to further define the expansion of the plume. Ongoing quarterly monitoring of the fate and transport of the chromium plume from the Chromium Investigation Monitoring Group monitoring wells is implemented in accordance with NMED-approved annual Interim Facility-Wide Groundwater Monitoring Plans (IFGMPs).

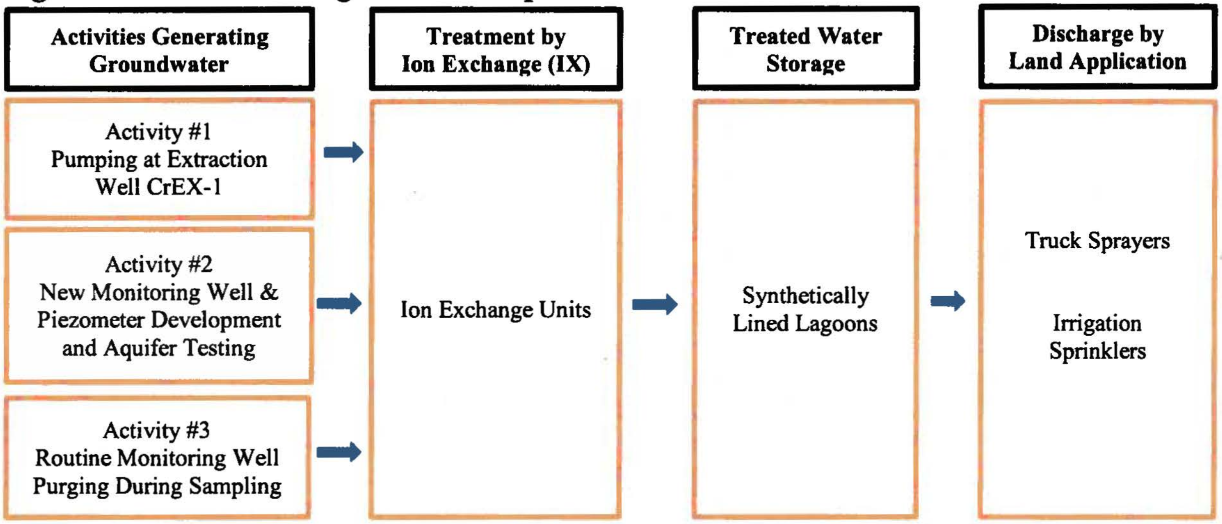
This DP-1793 Work Plan (Work Plan) is for the proposed discharge of treated groundwater from three activities planned as part of the overall Chromium Project and more specifically for the IMWP and IFGMP activities: (1) past and planned pumping at extraction well CrEX-1 to test for the potential for hydraulic control of the plume, (2) development and aquifer testing at new monitoring wells and piezometers, and (3) routine monitoring well purging during sampling under the IFGMP. Although generated from three activities, the integrated treatment of the groundwater will be conducted through two separate treatment units and combined into a series of lagoons before land application. Groundwater produced during these three activities will be treated to less than 90% of the NMWQCC groundwater standard of 50 µg/L, stored in synthetically lined lagoons, and discharged by land application in accordance with this Work Plan and the NMED-issued Discharge Permit DP-1793 (July 27, 2015). Figure 1 shows the treatment, storage, and land-application systems. This Work Plan is limited to land application in calendar year (CY) 2015.

ENCLOSURE 1

Multiple Activities Work Plan for the Treatment and Land Application of Groundwater From Mortandad and Sandia Canyons, DP-1793 WP#2

Objectives. The activities proposed under this Work Plan address water generated from the Chromium Project focus on (1) assessment of the potential for long-term removal and hydraulic control of chromium contamination in the regional aquifer via pumping (development) with a extraction well, CrEX-1, located in Mortandad Canyon; (2) development and aquifer testing of existing piezometers and new wells to refine the understanding of the properties of the aquifer with respect to chromium distribution and attenuation; and 3) ongoing quarterly monitoring in groundwater monitoring wells in the area of the chromium plume.

Figure 1. Block Flow Diagram of Multiple Activities Work Plan



Proposed Activities.

Activity No. 1: Pumping at an Extraction Well. Under the Chromium Project, pumping at an extraction well is conducted to evaluate (1) the characteristics of both the aquifer and the pumping-induced capture zone, and (2) the hydraulically controlled chromium migration within the aquifer. Because of pumping rates estimated at 60–100 gallons per minute (gpm) and extended durations, extraction well pumping produces the largest volume of groundwater requiring treatment and land application under this Work Plan. Approximately 99% by volume of the water proposed for land application under this Work Plan is from pumping at extraction well CrEX-1 (9,040,000 gal. from CrEx-1; 71,973 gal. from other wells and piezometers).

Activity No. 2: New Monitoring Well and Piezometer Development and Aquifer Testing. Following construction, new wells and piezometers are pumped (developed) to remove introduced drilling and construction water and any naturally occurring fine-grained material to enhance hydraulic connection between the well and the aquifer. After development, wells and piezometers typically undergo aquifer testing to evaluate the hydraulic properties of the aquifer. Groundwater produced during an aquifer test is representative of water in the aquifer.

ENCLOSURE 1

Multiple Activities Work Plan for the Treatment and Land Application of Groundwater From Mortandad and Sandia Canyons, DP-1793 WP#2

Activity No. 3: Routine Monitoring Well Purging during Sampling. The Laboratory conducts periodic sampling from groundwater wells to monitor the nature and extent and fate and transport of contaminants. Before a sample is collected from a groundwater monitoring well, it is necessary to purge the well to ensure that the sample collected is representative of water in the aquifer. Typically, three casing volumes are purged from a monitoring well before sample collection. Accordingly, each monitoring well sampled by the Laboratory generates a volume of purge water after sampling. Purge water is stored at the well site pending the availability of analytical data characterizing the quality of the water in storage. If the purge water in storage meets the requirements of the NMED-approved 2010 Los Alamos National Laboratory Drilling, Development, Rehabilitation, and Sampling Purge Water Decision Tree, then the purge water may be land-applied without treatment. Purge water with contaminant concentrations exceeding Decision-Tree limits must be treated before land application or dispositioned off-site, as is the case with all wells listed in this Work Plan.

Listed below are the sources of water to be treated and land-applied as a result of the above activities.

Activity No. 1: Sources of Water from Pumping at Extraction Wells. Pumping at extraction well CrEX-1 will be conducted in CY2015 to continue to test feasibility of hydraulic control of chromium migration and to assess the potential for long-term removal of chromium from the regional aquifer. Groundwater generated from extraction well CrEX-1 in CY2014 and CY2015 is proposed for treatment and land application under this Work Plan.

- **CrEX-1 water generated in 2015**. The U.S. Department of Energy (DOE) and Los Alamos National Security, LLC (LANS) propose to pump from extraction well CrEX-1 during fourth quarter of CY2015 (October—December) for approximately 60 days. Regional aquifer groundwater produced during the test will be treated and land-applied in accordance with this Work Plan. Table 1 provides information on the pumping rate, duration, and volume.

- **CrEX-1 water generated in 2014.** Pumping at extraction well CrEX-1 was conducted in CY2014 under the NMED-approved Temporary Permission to Discharge (August 8, 2014). While most of the produced water was treated and land-applied in CY2014, approximately 400,000 gal. of regional aquifer groundwater was treated and placed into the synthetically lined lagoons for storage. Table 1 provides information on the volume of water in storage from CY2014 pumping at CrEX-1.

Table 1. Sources and volumes of water from pumping at extraction well CrEX-1.

Well	Pumping Rate (gpm)	Maximum Daily Volume Pumped (gpd)	Estimated Pumping Period (days)	Total Volume Treatment and Land Application CY2015 (gal.)
CrEX-1: 2015 pumping[1]	100	144,000	60[1]	8,640,000
CrEX-1: 2014 water in storage[2]	na[3]	na	na	400,000
Total volume from pumping at CrEX-1 extraction well				**9,040,000**

Notes: [1]Continous pumping is expected to begin October 15, 2015, and conclude by December 15, 2015.
[2]Treated water stored in the six synthetically lined lagoons. [3]na means not applicable.

Activity No. 2: Sources of Water from New Monitoring Well and Piezometer Development and Aquifer Testing

- Six piezometers—CrPZ-1, CrPZ-2a, CrPZ-2b, CrPZ-3, CrPZ-4, CrPZ-5—were constructed in Mortandad Canyon in CY2015. Following construction, the piezometers were developed and the produced groundwater was placed into storage. One of the piezometers, CrPZ-4, contains perchlorate (ClO_4) concentrations exceeding the NMED Risk Assessment Guidance for Site Investigations, Table A-1, Tap Water Soil Screening Level (SSL) of 13.8 µg/L. As a result, development water in storage from CrPZ-4 (approximately 1900 gal.) will be dispositioned off-site for disposal.

  Under this Work Plan, the development water in storage from the five above-referenced piezometers will be treated by ion exchange (IX) to remove Cr to less than 90% of the NMWQCC groundwater standard of 50 µg/L, temporarily stored in synthetically lined lagoons, and discharged by land application in accordance with this Work Plan. No additional development water will be generated from the five piezometers in CY2015. Table 2 provides a list of the piezometers and the volumes of development water in storage.

- New regional aquifer monitoring well R-67 was constructed in Sandia Canyon in CY2015. Well development and aquifer testing of R-67 is planned for September or October 2015. Table 2 provides an estimate of the volume of groundwater expected from well development and aquifer testing activities. Under this Work Plan, the well development and aquifer test water will be treated by IX, temporarily stored in the six synthetically lined lagoons, and land-applied.

Table 2. Sources and volumes of water from well and piezometer development and aquifer testing.

Well	Source of Groundwater	Current Volume in Storage (gal.)	Additional Volume Expected CY2015 (gal.)	Total Volume Treatment and Land Application CY2015 (gal.)
CrPZ-1	Piezometer development	825	0	825
CrPZ-2a	Piezometer development	2,550	0	2,550
CrPZ-2b	Piezometer development	2,550	0	2,550
CrPZ-3	Piezometer development	2,050	0	2,050
CrPZ-5	Piezometer development	1,700	0	1,700
R-67	Well development and aquifer testing	0	60,000	60,000
Total well and piezometer development and aquifer test water				**69,675**

Activity No. 3: Sources of Water from Routine Monitoring Well Purging during Sampling

- Groundwater monitoring wells at the Laboratory are routinely sampled in accordance with the NMED-approved IFGMP. Numerous monitoring wells in the Chromium Investigation Monitoring Group in Sandia and Mortandad Canyons are monitored quarterly. Six of these wells—R-28, R-42, R-43 screen 1 (S1), R-50 S1, R-62, and SCI-2—show concentrations above the NMWQCC Regulation 3103 groundwater standard of 50 µg/L for Cr (total) and require treatment before disposition via land application.

Purge water from sampling at these six wells was placed into temporary storage. Table 3 lists the wells and associated volumes. Additional purge water will be generated during fourth quarter 2015 sampling of these six monitoring wells. Under this Work Plan the routine monitoring well sample purge water will be treated by IX to less than 90% of the NMWQCC groundwater standard for chromium, temporarily stored in the six synthetically lined lagoons, and land-applied.

Table 3. Sources and volumes of routine monitoring well purging during sampling.

Well	Source of Groundwater	Current Volume in Storage (gal.)	Additional Volume Expected CY2015 (gal.)	Total Volume Treatment and Land Application CY2015 (gal.)
R-28	Sampling purge water	260	260	520
R-42	Sampling purge water	210	210	420
R-43 S1	Sampling purge water	238	238	476
R-50 S1	Sampling purge water	223	223	446
R-62	Sampling purge water	185	185	370
SCI-2	Sampling purge water	33	33	66
Total purge water from well sampling				**2,298**

Below is additional information, common to all three of activities identified above, on the proposed discharge.

1. **Location.** Although Discharge Permit DP-1793 references 55 sections within the NM State Plane Coordinate System at Los Alamos National Laboratory where treated groundwater may be discharged, the wells, piezometers, and proposed land application sites referenced in this Work Plan are all located within the following four sections: (Township/Range/Section) T19N/R06E/S22, S23, S24, and S25. These four sections were selected because of their proximity to the Chromium Project sources referenced in this Work Plan.

   Enclosure 3 is a topographic map of the project site including the location of all site monitoring areas (SMAs), solid waste management units (SWMUs), National Pollution Discharge Elimination System (NPDES) outfalls, groundwater discharge permits, areas of concern (AOCs) identified in the 2005 NMED Consent Order, drinking water wells, surface impoundments, and surface drainage features in the vicinity of the Chromium Project.

2. **Groundwater Monitoring.** Groundwater monitoring is conducted on a quarterly basis within a group of monitoring wells contained in the Chromium Investigation Monitoring Group under the annual IFGMP. Annual submittal of the IFGMP is a requirement under the Consent Order. The wells comprising the Chromium Investigation Monitoring Group are situated within Sandia and Mortandad Canyons. Sampling during CY2015 is being carried out in accordance with the approved 2014 IFGMP. The monitoring locations, analytical suites, and frequency of monitoring reflect the technical and regulatory status of each area and are updated annually in the IFGMP.

The Chromium Investigation Monitoring Group focuses on the characterization and fate and transport of chromium contamination in intermediate-perched groundwater and within the regional aquifer. The distribution of wells in the monitoring group also addresses past releases from NPDES Outfall 051, which discharges from the Radioactive Liquid Waste Treatment Facility in the Mortandad Canyon watershed. The monitoring plan for the Chromium Investigation Monitoring Group for 2015 (October 2014–September 2015) is provided as **Enclosure 4.** The plan lists the rationale for well selection, the applicable analytical suites, and the sampling frequency.

3. **Depth to Groundwater and Groundwater Flow Direction.** Three alluvial groundwater monitoring wells are located in the vicinity of the land-application sites in Mortandad Canyon: MCO-9, MCO-12, and MCA-9 (see **Enclosure 3**). These alluvial groundwater wells are effective first indicators of whether infiltration from land application is occurring. The direction of alluvial groundwater flow is downcanyon to the southeast.

   The depth to perched-intermediate groundwater at well MCOI-5, in the vicinity of the proposed land-application sites in Mortandad Canyon, is approximately 650 ft. The depth to regional groundwater beneath the proposed land-application sites in Mortandad Canyon is approximately 1000 ft. The direction of groundwater flow in the regional aquifer beneath the proposed land-application sites is also generally to the southeast.

   The Laboratory proposes to conduct monthly water-level measurements at Mortandad Canyon alluvial wells MCO-9, MCO-12, and MCA-9, both during and up to 3 mo following termination of land application. If sufficient water is present, then a sample will be collected and analyzed for Cr, nitrate+nitrite (NO_3+ NO_2-N), total dissolved solids (TDS), chloride (Cl), and ClO_4 by an off-site, independent, National Environmental Laboratory Accreditation Program– (NELAP-) accredited analytical laboratory. The water level in a monitoring well must be within the screened interval to meet the criteria for sample collection.

4. **Well Specifications. Enclosure 5** provides the as-built specifications for all wells and piezometers referenced in this Work Plan, with the exception of monitoring well R-67, for which the proposed design is included because it is still being constructed.

5. **Expected Contaminants.** The source of groundwater generated from all activities listed in this Work Plan is the intermediate and regional aquifer. By volume, more than 99% of the water proposed for treatment and land application is from pumping at extraction well CrEX-1 (9,040,000 gal. from CrEx-1; 71,973 gal. from other wells and piezometers). Accordingly, the quality of groundwater from CrEX-1 best represents the quality of the discharge.

   Enclosure 6 contains water-quality data from CrEX-1 for general inorganics, metals, polychlorinated biphenyls, volatile organic compounds, and semivolatile organic compounds. Table 4 below provides the maximum concentrations of Cr, NO_3+ NO_2-N, TDS, Cl, and ClO_4 from all wells and piezometers listed in Tables 1, 2, and 3 in 2014 and 2015.

Chromium is the only contaminant expected to exceed the NMWQCC Regulation 3103 groundwater standards at the above-referenced wells and piezometers. Nitrate (NO_3-N) concentrations may become elevated before anionic equilibrium is reached in the IX vessel because of flooding; the maximum concentration expected is two times the influent concentration. Treated water monitoring conducted under this Work Plan (see Section 8) and operational monitoring conducted by the Laboratory using Hach® methods for real-time field results will closely track NO_3-N concentrations in the treated water.

Table 4. Maximum concentrations of Cr, NO_3+ NO_2-N, TDS, Cl and ClO_4 in wells and piezometers, 2014–2015.

Well Type by Activity	Cr (µg/L)	NO_3+NO_2-N (mg/L)	TDS[2] (mg/L)	Cl (mg/L)	ClO_4 (µg/L)
Activity #1					
CrEX-1	181	3.4	280	30.4	0.80
Activity #2					
CrPZ-1	na[3]	na[3]	na[3]	na[3]	2.1
CrPZ-2a	114	na[3]	na[3]	62	0.9
CrPZ-2b	19	na[3]	na[3]	7	0.4
CrPZ-3	356	na[3]	na[3]	22	1.2
CrPZ-5	274	na[3]	na[3]	22	0.5
Activity #3					
R-28	422	4.3	509	152	1.2
R-42	972	6.7	394	182	1.3
R-43 S1	71	6.0	189	9	1.0
R-50 S1	126	2.0	173	11	0.6
R-62	261	1.5	153	18	0.8
SCI-2	459	4.6	734	87	0.97
NMWQCC GW Std[1]	**50**	**10**	**1000**	**250**	**13.8[2]**

Notes: [1]The NMWQCC Regulation 3103 standards for groundwater, except as noted.
[2]The NMED Risk Assessment Guidance for Site Investigations and Remediation, Table A-1, Tap Water SSL.
[3]na means that no results are available for this constituent.

6. **Raw Water Storage.** The type, quantity, and capacity of tanks storing untreated groundwater from all activities are listed in Table 5.

Table 5. Type, quantity, and capacity of storage tanks receiving untreated groundwater[1].

Well	Type of Storage	Quantity	Tank Capacity (gal.)
All sources listed in Tables 1, 2, 3	21,000 gal metal storage tank	18	~378,000

Note: [1]Water stored in poly tanks at individual well sites will be transferred to the tanks listed in Table 5 before treatment.

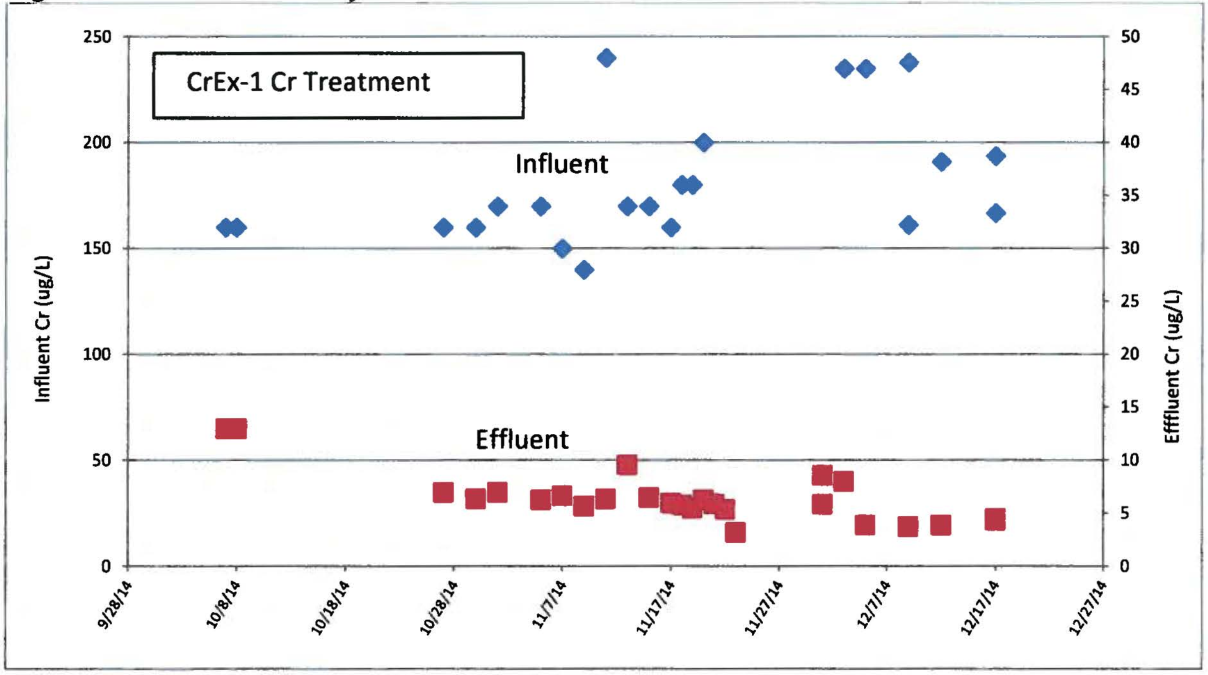
7. **Treatment System.** Groundwater produced from all activities referenced in this Work Plan will be treated by IX to reduce Cr concentrations to below 45 µg/L, 90% of the NMWQCC Regulation 3103 groundwater standard. **Enclosure 7** provides a schematic of the IX treatment system and technical specifications of the IX vessels and resin. Treatment vessels will be configured in series for optimal chromium removal and nitrate control. Sample collection ports are located at all stages of treatment.

The treatment system design is based on an influent chromium concentration of up to 1,000 µg/L. Spare vessels will be staged on-site for replacement, as needed.

Groundwater pumped from extraction well CrEX-1 will be treated at the CrEX-1 well site and then transferred across Mortandad Canyon in a single-wall, 4-in.-diameter high-density polyethylene pipeline to the synthetically lined lagoons for storage before land application (see **Enclosure 8**). Groundwater produced from the wells and piezometers listed in Tables 2 and 3 will be transported by truck to the treatment system located near well R-28; treated water will be comingled with water from CrEX-1 in the synthetically lined lagoons before land application.

The performance and removal efficiency of the proposed IX treatment system was demonstrated previously during pumping tests conducted under NMED-issued temporary permissions in 2012, 2013, and 2014. The proposed IX treatment system will remove Cr to concentrations below 45 µg/L, less than 90% of the NMWQCC groundwater standard of 50 µg/L. Figure 2 below shows Cr concentrations in the influent (untreated water) and effluent (treated water) from CrEX-1 during aquifer tests in 2014. Effluent concentrations did not exceed 13 µg/L, 26% of the 50 µg/L groundwater standard during the 45-d pumping of CrEX-1.

Figure 2. CrEX-1 treatment system, influent and effluent Cr concentrations, 2014.



The IX vessels and resins will be sampled and characterized before shipment back to the vendor for regeneration. It is the responsibility of the vendor to manage the vessels and resins in accordance with all applicable federal, state, and local regulations.

8. **Sampling Plan.** As a contingency against the discharge of Cr and NO_3-N in excess of NMWQCC Regulation 3103 groundwater standards, grab samples will be collected routinely and throughout the entirety of the pumping test from the sample port downstream of the last IX treatment vessel at both treatment sites. Treated water samples will be collected twice per week for analysis by an off-site, independent, NELAP-accredited analytical laboratory. Table 6 summarizes the proposed sampling plan.

Table 6. Proposed sampling plan for treated water from all Work Plan activities.

Parameter	Sample Type	Analytical Method	TAT[1]	Frequency	MDL[2]
NO_3-N	Grab, unfiltered	§20.6.2.3107.B	5 days	2 times/wk	0.033 mg/L
Total Cr	Grab, unfiltered	§20.6.2.3107.B	5 days	2times /wk	2 µg/L

Notes: [1]TAT means the analytical turnaround time. [2]MDL means the method or instrument detection limit.

The following contingencies will be applied under this sampling plan:

- ✓ If Cr and NO_3-N concentrations collected under the above sampling plan are less than 45 µg/L or 9 mg/L, respectively, then treated groundwater from CrEX-1 and the other contributing sources will move directly from treated water storage to land application.
- ✓ If Cr and NO_3-N concentrations collected under the above sampling plan exceed 45 µg/L or 9 mg/L, respectively, then land application will stop immediately and a representative sample(s) from the lagoon(s) receiving treated water will be collected for Cr and NO_3-N analysis.
- ✓ If the contents of the sampled lagoon does not meet the above-referenced criteria for land application, then it will be re-treated and reanalyzed to verify that concentrations meet land-application criteria.
- ✓ If Cr concentrations in the effluent stream exceed the above-referenced criteria, then the upstream IX vessel will be replaced by the downstream vessel and a new downstream vessel will be installed.

Operational samples will be collected routinely and measured for Cr and NO_3-N using Hach® methods for real-time field results to monitor the IX treatment system's performance.

9. **Treated Water Storage.** Treated groundwater from all sources will be stored in six synthetically lined lagoons before land application. **Enclosure 8** shows the location and types of pipelines transferring water from the IX treatment units to the treated water storage lagoons. Table 7 provides additional information on the capacity of these lagoons.

Table 7. Type, quantity, and capacity of storage lagoons receiving treated groundwater.

Location	Type of Storage (year installed)	Quantity	Capacity Each (gal.)	Total Capacity (gal.)
Mortandad Canyon	Synthetically lined lagoon (2013)	3	140,000+/-	420,000+/-
Mortandad Canyon	Synthetically lined lagoon (2014)	3	210,000+/-	630,000+/-

Three of the six synthetically lined lagoons proposed for use under this work plan were constructed in 2013 and approved by NMED Ground Water Quality Bureau (GWQB) for storing treated water during the 2013 and 2014 Chromium Project aquifer tests. Design criteria for these three lagoons were submitted to the NMED in the following document: Additional Information, Request for Temporary Permission to Discharge Treated Groundwater from a Pumping Test at Well R-28, DP-1793 (ENV-RCRA-13-0059). In April 2014, an inspection report was submitted to NMED (ENV-DO-14-0084) for the synthetically lined storage lagoons.

Three additional treated water storage lagoons were constructed in 2014 southeast of the three 2013 lagoons. The 2014 lagoons were constructed in accordance with the design criteria submitted to NMED in the Discharge Permit DP-1793 Amended Application on January 7, 2014 (ENV-DO-13-0343). Record drawings of the 2014 lagoons were submitted to the NMED in October 2014 (ENV-DO-14-0310).

10. **Land Application.** Treated groundwater from all activities and sources referenced in this Work Plan will be land-applied in accordance with requirements of Discharge Permit DP-1793 (July 2015) and the conditions listed below. The following three sections—**Planning, Operational Controls, and Inspections**—provide additional information on the land-application component of this Work Plan.

   - **Planning.** Land application zones 1–8 identified in **Enclosure 3** were selected and will be utilized based on the following criteria specified in Condition No. 4 of Discharge Permit DP-1793:
     - ✓ Avoidance of watercourses, water bodies, and wetlands;
     - ✓ Avoidance of AOCs, with the exception of the following canyon-bottom AOCs: C-00-001 through C-00-019 and C-00-021;
     - ✓ Avoidance of SWMUs and SMAs;
     - ✓ Avoidance of cultural sites; and
     - ✓ Application on areas with slopes <2% when groundcover is <50% and slopes <5% when groundcover is >50%.

     Treated groundwater will be land-applied by (1) water trucks (3,000–10,000 gal. capacity) equipped with both standard rear-mounted dust control sprayers and multiple high-pressure water sprayers, and (2) by irrigation-type sprinklers. Zones 1–6 are unpaved roads and road shoulders; zone 7 is an irrigation site. Each type of land-application zone is discussed below.

Water trucks will be filled with treated water from the six synthetically lined lagoons located near the well R-28 site (see **Enclosure 8**). A totalizing meter will record the volume of treated water loaded into each truck. Land application zones 1–6 consist of approximately 3 mi of unpaved road receiving treated water for dust suppression. As much as 30% of the treated water discharged will be land-applied for dust control.

The frequency and volume of treated water land-applied for dust control will be based on field conditions. The field superintendent will determine when an application of dust-suppression water is required. Maintaining a low-dust environment for field personnel is an important health and safety objective for the field superintendent. **Enclosure 3** shows the location of unpaved roads in zones 1–6.

The road shoulders in zones 1, 4, 5, and 6 have been identified as suitable terrain for the land application of treated water by high-pressure water sprayers. When deployed by the truck driver, the high-pressure sprayer can land-apply treated water up to 100 ft from the center of the road for zones 4, 5, and 6. Zone 1 will be limited to land application by the high-pressure sprayers to 25 ft on either side of the center line of the road. The frequency and volume of land application to the road shoulders in zones 1, 4, 5, and 6 will be directed by the field superintendent based on the history of discharges to each zone and a field assessment of soil moisture. The field superintendent's objective is to achieve an equitable distribution of treated water across zones 1, 4, 5, and 6. **Enclosure 3** shows the location of road shoulder land-application zones 1, 4, 5, and 6.

Zone 7 is the area approved for receiving treated water by irrigation-type sprinklers. Treated groundwater from the six synthetically lined lagoons will be pumped to the irrigation sprinklers and the volume measured by a totalizing meter. Field personnel will supervise the land application and engage/disengage individual sprinklers units, as necessary. The field superintendent will direct the frequency of use and volume discharge to each land-application zone based on previous use and soil-moisture conditions.

- ➢ **Operational Controls.** Condition No. 4 of Discharge Permit DP-1793 establishes the following conditions for the land application of treated groundwater:
  - ✓ Land application cannot result in water flowing from an approved land-application site.
  - ✓ Land application cannot create ponds or pools or standing water.
  - ✓ Land application must be conducted in a manner that maximizes infiltration and evaporation.
  - ✓ Land application is restricted to daylight hours and for a maximum of 10 h/d.
  - ✓ Land application must be supervised.
  - ✓ Land application cannot extend off Laboratory property without written permission from the land owner.
  - ✓ Land application will be stopped if leaks in the land-application system are detected.
  - ✓ Land application is prohibited while precipitation is occurring or when temperatures are below freezing.

To ensure compliance with the conditions listed above, the Laboratory will implement the following operational controls:

a. All field personnel involved with land application will complete training to the following standard operating procedure and regulatory documents:
   - ENV-RCRA-QP-010.3, Land Application of Groundwater;
   - NMED-issued Discharge Permit DP-1793, LANL Groundwater Projects (July 27, 2015);
   - DP-1793 WP#2, Multiple Activities Work Plan for the Treatment and Land Application of Groundwater from Mortandad and Sandia Canyons, and
   - NMED GWQB Approval of DP-1793 WP#2 (pending)

b. All field personnel will participate in pre-job briefings and morning tailgate talks that will provide field personnel with critical information on the following: daily weather reports, daily land-application activities, system maintenance and repairs scheduled, and daily inspection schedule.

c. Signs identifying the beginning and end of each land-application zone will be installed (e.g., ZONE 1, 25 ft; ZONE 4, 100 ft), areas where land application is permitted (green signs designating "SPRAY") and not permitted (red signs designating "NO SPRAY"). **Enclosure 9** provides an illustration of the signage.

d. Field personnel will maintain written records of the volume and date of treated water land applied to each zone.

➢ **Inspections.** The following inspections will be conducted to ensure compliance with the land-application criteria specified in Condition No. 4 of Discharge Permit DP-1793 and this Work Plan:

- ✓ Daily inspection of dust-suppression sprayers, high-pressure sprayers, transfer pumps, transfer hoses, and all equipment associated with land application by water truck;
- ✓ Daily inspection of transfer pumps, transfer hoses, fittings, couplings and all components of the irrigation sprinkler system;
- ✓ Daily inspection of the land application zones for evidence of standing or flowing water;
- ✓ Daily inspection of the six synthetically lined lagoons for minimum 2 ft freeboard;

11. **Maximum Daily Discharge.** The maximum daily discharge proposed under this Work Plan is 192,000 gallons per day (gpd). This rate is based on the following infrastructure capacity:

✓ Land application by truck:	120 gpm
✓ Land application by irrigation sprinklers:	200 gpm
✓ Maximum land-application rate (combined):	320 gpm
✓ Maximum hours of land application per day:	10 h/gpd
✓ Maximum daily discharge (320 gpm @ 10 h/d):	192,000 gpd

12. **Water Conservation and Reuse Options.** In lieu of using potable water for dust suppression, as much as 30% of the treated water discharged will be land-applied to approximately 3 mi of dirt road in Mortandad Canyon. Given the project's location, other reuse options—such as using treated water at Laboratory cooling towers—would require transporting the treated water by truck; the resulting environmental impact was deemed unacceptable because of the carbon dioxide emissions generated.

13. **Project Schedule.** Land application will commence following NMED approval of this Work Plan and will continue until December 31, 2015, or when field conditions prohibit land application, whichever comes first (see Section 10).

14. **Reporting.** In accordance with requirements B.8 and B.9 of Discharge Permit DP-1793 (July 27, 2015), DOE/LANS will submit to NMED annual monitoring reports by March 1 of each year and a final completion report within 60 d of completing discharges under this Work Plan.

ENCLOSURE 2

Interim Measures Work Plan for the Evaluation of
Chromium Mass Removal

ENV-DO-15-0245

LA-UR-15-26789

Date: September 3, 2015

LA-UR-13-22534
April 2013
EP2013-0073

Interim Measures Work Plan for the Evaluation of Chromium Mass Removal

Los Alamos
NATIONAL LABORATORY
EST. 1943

Prepared by the Environmental Programs Directorate

EP2013-0073

Interim Measures Work Plan for the Evaluation of Chromium Mass Removal

April 2013

Responsible project manager:

Printed Name	Signature	Title	Organization	Date
John Bennett		Project Manager	Environmental Programs	

Responsible LANS representative:

Printed Name	Signature	Title	Organization	Date
Jeff Mousseau		Associate Director	Environmental Programs	

Responsible DOE representative:

Printed Name	Signature	Title	Organization	Date
Peter Maggiore		Assistant Manager	DOE-NA-00-LA	

CONTENTS

Figures

1.0 INTRODUCTION

This interim measures work plan (IMWP) describes proposed activities to address chromium contamination in groundwater beneath Los Alamos National Laboratory (LANL or the Laboratory). The Laboratory proposes to conduct interim measures in accordance with Section VII.B.1 of the March 1, 2005, Compliance Order on Consent (the Consent Order). The IMWP is being prepared in response to requirements in a letter from the New Mexico Environment Department (NMED), dated January 25, 2013 (NMED 2013, 521862), which directed that the IMWP assess the potential for active long-term removal of chromium from the regional aquifer via pumping with a pilot extraction test well. This IWMP describes the work that will be conducted to determine whether a pilot extraction well can achieve active long-term chromium removal from the regional aquifer; further, it describes additional work to support the overall approach to remediation of chromium contamination. The results of the first portion of the work conducted under this IMWP will be included in a supplemental IMWP (SIMWP) that will describe additional interim measures activities that may include the installation of a pilot pumping well to evaluate chromium mass removal from the regional aquifer. Additional details are discussed in section 2.3, and a proposed schedule is discussed in section 3.0.

Investigations related to chromium contamination are summarized in a number of reports, including the Investigation Report for Sandia Canyon (LANL 2009, 107453) and the Phase II Investigation Report for Sandia Canyon (LANL 2012, 228624). These investigations have identified the probable Cr(VI) source was cooling tower effluent released near the head of Sandia Canyon between 1956 and 1972. Chromium was transported down the canyon in surface-water flow. Chromium is present in the Sandia Canyon wetland and sediments; it is also present in the subsurface in the vadose zone (including in perched-intermediate groundwater) and in the regional aquifer beneath Sandia and Mortandad Canyons. Figure 1.0-1 illustrates the transport paths taken by chromium from the surface to the regional aquifer, an estimated initial source volume of Cr(VI), the estimated present-day distribution of both Cr(III) and Cr(VI) along the pathway, and the extent of the Cr(VI) plume (>50 ppb) within the regional aquifer beneath Sandia and Mortandad Canyons. Much of the initial Cr(VI) released has been reduced to less mobile and less toxic Cr(III) in wetland sediments and by iron Fe(II)-bearing minerals within sediment and rocks as water has encountered these media.

Figure 1.0-2 shows the extent of the Cr(VI) plume within the regional aquifer. Chromium(VI) concentrations are highest at regional wells R-28 and R-42. Chromium concentrations at these wells have varied by as much as 25% across multiple quarterly sampling rounds but overall are relatively stable over the period of record for these wells. At the distal portions of the plume, particularly at regional wells R-43 and R-50, recent groundwater data indicate increasing chromium concentrations over the last several sampling rounds. These wells do not have the same period of record as R-28 and R-42, and therefore, the longer-term trends are not known.

2.0 OBJECTIVES AND APPROACH

The activities proposed under this IMWP focus on evaluating the potential for mass removal within the regional aquifer beneath Mortandad Canyon and in perched-intermediate groundwater beneath Sandia Canyon. Wells selected for this evaluation are generally situated near the center of mass within the chromium plume. Activities are also proposed to further refine the understanding of the properties of the aquifer with respect to chromium distribution and attenuation. The data collected based on this IMWP will enable the locating and designing of a pilot pumping well, which is specifically designed to further evaluate the potential for source removal. These data will help to characterize the expected performance of long-term pumping for source removal and the natural processes within the subsurface flow medium that may affect chromium migration. The proposed activities described below will reduce several key uncertainties related to the potential role of subsurface hydrogeological and geochemical processes in the aquifer on the distribution, potential for mass removal, and long-term stability of chromium.

The objective of the first set of activities, hydraulic and tracer field tests, is to provide additional details of aquifer and contaminant-plume behavior under extended pumping periods using several existing monitoring wells as pumping and observation locations. The hydraulic and contaminant transient data derived from pumping these wells are expected to provide the information necessary to optimize the location and design of a pilot pumping well as part of the SIMWP to further evaluate the potential for chromium mass removal from the regional aquifer through a pump-and-treat system. Pumping at these wells will also result in some contaminant mass removal from the regional and perched-intermediate aquifers.

In situ geochemical studies (tracer push/pull tests) coupled with the pumping tests will provide information on the role of advection, dispersion, and diffusion on the contaminant distribution and behavior during pumping. The impact of some of these processes is expected to be affected by complex fine-scale stratigraphy in regional aquifer sediments (Figure 2.0-1) that may have highly heterogeneous hydrogeologic properties (Figure 2.0-1). Complex aquifer heterogeneity that includes zones of relatively low aquifer porosity and permeability could potentially manifest as a secondary source of contamination during pumping for source removal if contaminant concentrations and mass in the zone of more active groundwater flow are reduced. The aquifer heterogeneity is expected to play a major role in the distribution and speciation of chromium mass.

The water removed during these relatively short-term field tests will be treated at the surface and disposed of through land application, in compliance with a temporary discharge permit from the NMED Ground Water Quality Bureau. In support of potential longer-term pumping for source removal and as a larger-scale remedy, a study will be conducted to evaluate the feasibility of reinjection of large volumes of treated water, one of several options for large-scale water disposition. The study is described in detail in section 2.2.2.

An additional activity related to source control is concurrently being implemented under a separate work plan to address source control for the chromium project (LANL 2011, 207053). This activity involves constructing a grade-control structure (GCS) in the spring of 2013 in the Sandia Canyon wetland to ensure long-term physical and geochemical stability of contaminated sediments within the wetland. The design of the GCS will enable a substantial reduction in effluent volume necessary to sustain the wetland while also potentially reducing downcanyon flux of effluent through residual chromium inventory in the vadose zone to the regional aquifer.

2.1 Hydraulic and Tracer Tests

A series of field tests will be performed to address the objectives discussed above and will include long-term hydraulic and tracer tests. During the tests, four regional monitoring wells (R-42, R-28, R-43 screen 1, and R-62) and one perched-intermediate monitoring well (SCI-2) will be pumped for extended periods. The field-testing operations and procedures will be similar at each well, the details of which are discussed below. For all tests, before groundwater pumping is initiated, a set of tracers will be introduced into the aquifer to perform dilution and “push-and-pull” tracer tests. The data collected during the hydraulic and tracer tests will be interpreted using different analytical and numerical techniques (integrated open-source computational framework for Model Analysis & Decision Support [MADS], http://mads.lanl.gov; multiwell variable-rate pumping-test analysis tool [WELLS], http://wells.lanl.gov; Istok et al. 2002, 240568; Shook et al. 2004, 240124; Schroth and Istok 2006, 240126; Huang et al. 2010, 240125). The interpretation will provide estimates of spatial variability in the aquifer hydrogeological and geochemical properties. Special attention will be placed on characterizing (1) the spatial distribution, including shape and size, of the high-permeability zone observed at R-28; (2) the spatial distribution of the chromium contaminant plume; and (3) the location and properties of potential contaminant reservoirs (e.g., pore spaces, mineralogical/ geochemical facies) in the aquifer. The analyses of the field tests will evaluate the potential for active removal of chromium contaminant mass from the aquifer via pumping of contaminated groundwater.

Each field test will start with a dilution test in which a dilution tracer is dissolved in groundwater and passively introduced into the aquifer through the well screen. The dilution tracers will be applied to estimate ambient groundwater flow velocities by measuring the decline of tracer concentrations in the well over time, which directly results from ambient flow through the well (Drost et al. 1968, 240121). The dilution tracer will passively migrate from the well for up to 5 d before the push-and-pull tracer test begins.

The push-and-pull tracer tests will follow the dilution tests and include four stages in sequence, with well-specific durations for these stages: (1) introducing two tracers into the aquifer through the well screen; (2) pushing the tracers out of the well with additional groundwater, (3) waiting for a period for migration (advection, dispersion, diffusion) of the tracers into the aquifer materials by ambient groundwater flow and diffusion processes to allow sufficient contact time and still allow reasonable recovery of the tracers, and (4) pumping for a period for "pulling" the tracers back out of the aquifer. The duration and applied groundwater volumes in stages 1 and 2 are contingent upon local hydrogeologic conditions at each well and will be informed by data from the dilution tracer test. Information about the groundwater velocity obtained during the dilution tests may be applied to constrain the duration of the waiting period in stage 3 as well. The duration of the waiting period in stage 3 also depends on well-specific hydrogeological conditions and the pumping rate during the last stage 4. The last "pulling" stage will occur simultaneously with the pumping test phase planned for each well.

During the last stage field analyses will be conducted of water-borne redox-indicating species using field Hach kits. The species analyzed could include nitrate, nitrite, ammonia, total chromium, Cr(VI), total iron, Fe(II), total manganese, and sulfide. Measurement of these species at different times during the pumping period will provide qualitative indications of redox conditions in the aquifer based on the presence or absence of redox-sensitive species. Some of these species are sensitive to changes in oxidation state that may occur during sampling, sample handling, and the time before analysis, so Hach kit analyses will be conducted in the field to minimize these concerns. The presence of redox-sensitive species will provide insights into whether conditions conducive to chromium reduction exist. In general, if no reduced species are detected, it will not be definitively concluded that there is no potential for chromium reduction (because of the potential for oxidation of such species during sampling); however, if reduced species are detected (even in the presence of dissolved oxygen or other oxidized species), it will be taken as an indication that conditions exist in the aquifer conducive to the formation of these reduced species. The potential for chromium reduction can then be evaluated based on known information about the relative ease of reduction of the detected species and Cr(VI). Experience indicates that the kinetics of reduction of the redox-sensitive species are generally slow enough that they can be detected in on-site Hach kit analyses of groundwater samples that also contain significant amounts of oxygen. Field measurements of pH, specific conductance, dissolved oxygen, and oxidation-reduction potential (ORP or Eh) will also be conducted using a multiparameter sonde to complement the measurements of redox-indicating species.

The pumped groundwater will be sampled at varying frequencies throughout the pumping period in each well and analyzed for all injected tracers. Initial sampling frequencies will be approximately hourly and adjusted as necessary based on fast-turnaround analytical results. The normalized tracer concentration (concentration divided by injection mass) versus time transients (breakthrough curves) of the push-and-pull tracers will provide information about groundwater flow and solute transport processes in the aquifer (Reimus et al. 2006, 240120; SNL 2007, 240122). The interpretation of breakthrough curves will help characterize advective groundwater flow and diffusive mass transfer between higher permeability and lower permeability zones in the aquifer, as indicated in Figure 2.0-1. The two push-and-pull tracers (a halide and a fluorinated benzoate) are both monovalent anions, but the halide, a much smaller ion, has a diffusion coefficient about 3 times larger than the fluorinated benzoate (Reimus et al. 2007, 240128). Thus, the halide will diffuse farther out of high-permeability zones into lower permeability zones than the benzoate during the injection and waiting periods of the tests. If mass transfer rates between high- and low-permeability zones are large enough, this difference will result in a somewhat lower and later peak concentration and a longer/higher tail concentration for the halide than the benzoate during the pumping period. These differences in breakthrough curves will allow estimates of diffusive mass transfer rates in the aquifer. If no differences in breakthrough curves are observed, then an upper limit on the mass transfer rate(s) can still be estimated. Using two tracers with different diffusion coefficients also allows more defensible estimates of ambient advective flow velocities to be obtained from the push-pull test (by providing information to allow the effects of diffusion to be “backed out” of the calculations, if necessary, which will complement the flow velocity estimated from the dilution tracer test). A depiction of the diffusion processes affecting tracer transport in the aquifer and the expected normalized tracer breakthrough curves are shown in Figure 2.1-1.

The magnitude of the separation of the tracer breakthrough curves will reflect the magnitude of the diffusive mass transfer rate(s) between the high- and low-permeability zones in the aquifer. If no separation is observed in the tracer breakthrough curves, then it can be concluded that the mass transfer rates were likely slower than the duration between introduction of the tracer and initiation of pumping, and therefore, it will only be possible to place an upper bound on the rate. Diffusive mass transfer between the high- and low-permeability zones represents an important attenuation process for chromium transport in the aquifer, as diffusion out of rapidly-flowing water into more slow-flowing or near-stagnant water will significantly increase chromium travel times. It will also potentially allow chromium to contact adsorbing or reducing surfaces that it would not otherwise contact. Furthermore, separation of tracer breakthrough curves will provide information on the potential importance of chromium mass that may be present in less permeable strata within the regional aquifer. This information can provide significant insights into expected operational performance of pump and treat systems.

The pumping tests at each well will be performed at a constant rate, with the rate and duration optimized for each well. The pumping rate at each well will differ as constrained by the hydrogeological conditions at the well. The pumping test duration will be optimized by two sets of data monitored during the pumping tests: (1) pumping drawdowns observed in the pumping and observation wells and (2) geochemical transients in the pumped groundwater. The constraints for the tests are that (1) drawdowns in the pumping wells do not exceed predefined maximum levels, (2) drawdowns in the nearby monitoring wells are sufficient to characterize aquifer heterogeneity, and (3) transients in key geochemical constituents, such as chromium, nitrate, sulfate, perchlorate, and tritium, are well characterized.

Drawdowns at the pumping well are constrained by the submergence of the pumped screen. The pumping will be performed at constant rates that are expected to cause drawdown, but care will be taken to maintain water levels above the well screen to avoid damage to the wells. The drawdowns at the pumping and monitoring wells will be influenced by various hydrogeologic factors. Some of these factors will slow down the pace of groundwater decline; these factors include “delayed yield” from the vadose zone or from low-permeability zones, lateral-recharge boundaries, high-permeability zones, aquifer “leakage,” vertical flow from hydrostratigraphic units next to the pumped strata, and/or three-dimensional flow effects. In addition, no-flow boundaries or low-permeability zones may increase the rate of groundwater decline. Most of these factors have been observed during past pumping tests conducted in the regional aquifer within the chromium plume area. A conceptual representation of the observed and expected drawdown transients during the pumping test conducted at R-28 in 2012 is shown in Figure 2.1-2. The late-time drawdown transients (past the 10-d duration of the 2012 test [LANL 2012, 228624]) are not known; they will depend on the hydrogeological conditions in the aquifer, and important information about the aquifer properties can be gleaned from understanding these conditions.

The shape and size of the zone of pumping influence (the area around the pumping well within which pumping drawdowns occur) during the pumping tests at each well depend on the local aquifer conditions. The pumping influence zone will be characterized by observing the drawdowns in nearby monitoring wells, including R-1, R-11, R-13, R-15, R-28, R-33, R-34, R-35a, R-35b, R-36, R-42, R-43, R-44, R-45, R-50, R-61, and R-62. It should be noted that some of these will be pumping wells at different stages of the field study. The drawdowns from all the monitoring wells are expected to be relatively small, and their interpretation will require post-processing of the collected data to remove barometric, tidal, and water-supply pumping effects. The goal is to ensure measured drawdown transients caused by pumping at the monitoring wells in the study area are sufficient to characterize the aquifer properties (e.g., heterogeneity, anisotropy, and boundary effects).

During the pumping tests, water samples will be collected regularly for geochemical analyses. Transients in key geochemical constituents such as chromium, nitrate, sulfate, and perchlorate will be characterized and closely monitored. These samples will be collected and submitted for analysis on a weekly basis. Samples will be also collected daily and archived for possible analysis if the results of weekly samples indicate changes that should be explored with more frequent sample analysis. Tritium will be monitored at a biweekly frequency. Selected samples will also be analyzed for chromium isotopes and analyzed on a monthly basis. Transients in chromium isotopes will provide information on aquifer heterogeneity with respect to Cr(VI) reduction potential. Transients in concentrations and other field parameters (e.g., pH and temperature) are expected to provide important information about the hydrogeological and geochemical conditions at the site. Depending on the local aquifer conditions near the pumped wells, different geochemical and hydrological conditions might remain steady, increase, or decrease (more complex transients are plausible as well). Steady conditions will indicate a well-mixed plume within the primary porosity within the capture zone. Increasing or decreasing values of key indicator constituents will suggest that pumping is pulling water from more- or less-contaminated portions (vertically or laterally) of the aquifer, respectively. The shape of the transient curves for the different geochemical indicators will be indicative of the processes that cause the observed fluctuations: linear trends will indicate water mixing and exponential trends may suggest more complicated hydraulic or geochemical processes such as diffusion from tighter pore spaces or adsorption. During the 10-d R-28 pumping test in 2012, the chromium concentrations declined at a steady linear pace without reaching an equilibrium level (LANL 2012, 228624).

The analyses will utilize existing models and computational tools (MADS; WELLS; Istok et al. 2002, 240568; Shook et al. 2004, 240124; Schroth and Istok 2006, 240126; Huang et al. 2010, 240125).

2.1.1 R-42 and R-28 Field Tests

Field tests at regional monitoring wells R-42 and R-28 will be conducted consecutively, starting with R-42. Estimated pumping durations to achieve drawdown sufficient to be detectable in surrounding wells is approximately 100 d at R-42 and 70 d at R-28. Figure 2.1-3 illustrates the zones of influence expected to be observed during the R-42 and R-28 pump tests. If the pumping-test durations needed to observe drawdown at surrounding wells are shorter than expected at the two pumping wells, both wells may be pumped simultaneously for a period allowable under the discharge permit. For each well, the sequence will be to first run the dilution test and then the coupled push-and-pull tracer and pumping tests.

The dilution test in R-42 will use disodium 1,5-naphthalene disulfonate (NDS) with a mass less than 200 g as a tracer. The tracer will be dissolved in approximately one circulation loop volume of aquifer groundwater pumped from R-42 and poured back into the borehole (the water in the injection borehole will be circulated to the surface and returned to the aquifer for some period of time during the dilution test to keep the borehole well mixed, and the volume injected will be the estimated volume of the borehole/screen between the injection point and the pump intake plus the volume of the tubing running to the surface and back). The push-and-pull tracer test in R-42 will use sodium 2,6-difluorobenzoate (DFBA) (less than 5 kg) and sodium iodide (NaI) (less than 5 kg) as tracers. Both tracers will be mixed together in 1500 gal. of aquifer groundwater pumped from R-42. The water will be poured back into the borehole at a rate that does not create a substantial increase in the regional water-levels, and the tracer solution will be “chased” with at least 4000 gal. of groundwater pumped from R-42. It is expected that the tracer introduction will take less than 24 h. After a waiting period of an estimated 20 to 30 d, the pumping test will be started and will provide a pull back of the tracer from the aquifer. It should be noted that the exact chase volume and waiting period will be determined after analyzing the results of the dilution tracer test, which will indicate how rapidly water is flowing through the injection interval. The flow rate through the injection interval will dictate how much chase volume can be injected and how long the tracer solution can be allowed to “drift” with the ambient flow in the aquifer and still recover most of the tracer during pumping. The goal is to maximize the volume and representativeness of the aquifer that is interrogated while ensuring that good recovery of the tracers is obtained. The pumping rate at R-42 is expected to be approximately 8 gallons per minute (gpm) and continue for up to 100 d; the pumping rate and duration may be adjusted during the test to maximize the information content of the collected data.

The R-28 field test will be very similar to the procedure outlined for R-42 above and will use the same dilution and push-and-pull tracers. The only differences will be that (1) the push-and-pull tracers will be chased with up to 10,000 gal. of groundwater pumped from R-28, and (2) the pumping rate will be approximately 28 gpm. The pumping-test duration at R-28 will be up to 70 d.

A schematic representation of capture zone and tracer impact zone during R-28 field test is presented in Figure 2.1-4. The capture and tracer zone estimates assume groundwater flow in uniform and isotropic aquifer. The capture zone presented in the figure assumes a quasi-steady-state flow regime, which is expected to be achieved within about 10 d after the pumping has been commenced. The time-dependent (transient) capture zones representing the volume of water pumped during the R-28 pumping test will define the portion of the aquifer from which the pumped water is extracted. Existing tools and models will be applied for evaluation the transient capture zones and the actual zones of influence for each pumping well during the proposed field tests (Vesselinov et al. 2006, 098324; Vesselinov and Robinson 2006, 240123; LANL 2012, 228624).

2.1.2 R-43, Screen 1, and R-62 Field Tests

Regional monitoring wells R-43 and R-62 are located to the west of (generally upgradient of) R-42 (Figure 1.0-2). The two wells will be subject of field tests similar to the ones proposed for R-42 and R-28 above and the same dilution and push-and-pull tracers will be used. The field tests will be conducted consecutively starting with R-43, screen 1, with pumping durations up to 45 d. The primary goals of the R-43, screen 1, and R-62 field tests are to perform tracer-test analyses and to observe transients in the geochemical constituencies during the pumping. These data will provide important information on groundwater flow and transport properties. A secondary goal of these field tests is to collect pumping drawdown data. Hydraulic responses in all the nearby monitoring wells are not expected within 45 d of pumping of R-62 and R-43. However, hydraulic cross-communication between R-62 and R-43 and some of the very closely placed monitoring wells may be observed.

Wells R-42 and R-28 are located in the central portion of the chromium plume where the highest contaminant concentrations are detected. R-43, screen 1, and R-62 are located at the northwestern and western edges of the plume, respectively. Their testing will be critical to characterize (1) the location and properties of the contaminant source, (2) the spatial extent of the plume, and (3) the impact of mixing contaminated and clean aquifer water. Since the contaminant concentrations in this area are lower than in the R-42/R-28 area, the field tests will provide better information about the potential impact of naturally occurring geochemical processes in the aquifer on chromium contaminant concentrations (e.g., retardation, attenuation, etc.) because these processes may already be depleted in the R-42/R-28 area, but not in the R-43/R-62 area.

For each well, the field test sequence will be to first run the dilution test and then the coupled push-and-pull tracer and pumping tests. The design of the R-43, screen 1, and R-62 field tests will be very similar to the procedures outlined for R-42 above. The only differences will be that (1) the push-and-pull tracers will be chased with up to 3000 gal. of groundwater, (2) the pumping rate will be approximately 5 to 8 gpm, and (3) the pumping-test duration will be up to 30 d.

2.1.3 SCI-2 Field Test

Intermediate monitoring well SCI-2 is screened in a perched-intermediate zone of saturation within the vadose zone beneath Sandia Canyon. The Cr(VI) concentrations in the intermediate groundwater (~500 ppb) are less than the maximum concentrations detected in the regional aquifer (~1000 ppb). Therefore, the contamination in this zone is not the primary source for the contamination in the regional aquifer. However, because of its location, it is expected that the zone is along a contaminant flow path (past or current) through the vadose zone. A field test similar to the one planned for R-43, screen 1, and R-62 will be conducted at SCI-2. The field test sequence will be to first run the dilution test and then the coupled push-and-pull tracer and pumping tests, again using the same dilution and push-and-pull tracers. The only differences will be that (1) the push-and-pull tracers will be chased with up to 1000 gal. of groundwater, (2) the pumping rate will be approximately 2 to 3 gpm, and (3) the pumping-test duration will be up to 30 d. The pumping duration may be constrained by the yield of the perched-intermediate zone. The pumping test and the subsequent recovery will provide important information about the spatial extent, groundwater volume, and recharge capacity of this zone. The chromium concentrations and other geochemical transients in SCI-2 groundwater detected during the pumping and recovery will provide information about the contaminant transport properties of the vadose zone. The tracer tests will provide information about groundwater velocity and advective, dispersive, and diffusive properties of the rocks in this perched-intermediate zone.

2.2 Geochemical Characterization

Geochemical characterization work will be implemented as part of this IMWP under two separate studies.

The first study includes quantifying chemical speciation of chromium and iron on samples collected from within the chromium contamination area and comparing them with samples collected from outside the chromium contamination area (i.e., background samples). These data will indicate whether Cr(VI) reduction within the chromium-contaminated zone has occurred.

The second study will evaluate geochemical interactions that could occur with the injection of treated water. Water removed during the field tests proposed under this IMWP will be treated by ion exchange and disposed of by land application, as governed by the temporary discharge permit for the field tests. However, if large-scale pumping with a pilot well is recommended in the SIMWP, other water disposition methods, including injection, will be considered to dispose of the larger volumes of treated water. Therefore, another activity will be to characterize interactions between reinjected treated water and aquifer materials to determine the viability and operational requirements of injection.

Based on the results of these two studies and the field tests, the SIMWP may propose additional geochemical characterization if necessary. Additional studies may include laboratory batch and column experiments to evaluate chromium attenuation mechanisms in aquifer sediments.

2.2.1 Chemical Speciation of Chromium and Iron

Information on the speciation of contaminant chromium is considered necessary for addressing the long-term fate and transport of chromium in groundwater beneath the Laboratory. Chemical speciation of chromium is a key parameter for understanding the geochemical processes of chromium present in the subsurface and assessing the long-term stability and attenuation potential of vadose-zone and aquifer materials. Cr(III) has extremely low mobility under typical groundwater conditions found beneath the Laboratory. In the 2009 Sandia Canyon investigation report (LANL 2009, 107453), a synchrotron based X-ray absorption near-edge structure (XANES) method was used to evaluate the attenuation capacity of vadose zone and regional aquifer materials for Cr(VI). That study exposed noncontaminated rock samples to Cr(VI)-bearing water in a laboratory setting to determine their attenuation potential. The findings showed that reduction of Cr(VI) to Cr(III) does occur naturally in the environment in the presence of ferrous iron-bearing minerals.

The focus of the proposed activities under this IMWP is to determine chemical speciation of chromium in field samples from within the chromium-contaminated zone to determine the nature of attenuation that has resulted from the presence of contaminant chromium in the regional aquifer and perched-intermediate zones. In addition, the study will incorporate the site conditions (mineralogy, chemistry) to accurately determine speciation and distribution of chromium and other coassociated elements, particularly iron, on rock and grain surfaces that have been exposed to Cr(VI) along the flow path.

The results from the 2009 Sandia Canyon investigation report (LANL 2009, 107453) and other studies suggest that divalent Fe(II) is the prime inorganic constituent to reduce Cr(VI) in a natural system. Thus, a combination of synchrotron-based techniques such as XANES, micro–x-ray fluorescence (µ-XRF) element maps and x-ray absorption fine structure (XAFS) will be used to quantify both Cr(III)/Cr(VI) and Fe(II)/Fe(III) ratios and to identify the correlation between chromium and iron at a given location in the sample. The results of this study will serve to (1) directly observe chromium speciation on materials from the contaminated area and check the correlation with primarily iron-bearing minerals to understand their effect on chromium reduction, and to (2) provide necessary knowledge to guide potential additional geochemical characterization activities to address chromium contamination in groundwater beneath the Laboratory.

Two to four representative archived core/cuttings samples from within the contaminated area (e.g., potentially from R-28, R-42, MCOI-6, and SCI-2) and two to four representative archived core/cuttings samples from noncontaminated areas (e.g., from MCOI-10 and LAOI-7) will be characterized using XRD, XRF, and scanning electron microscopy (SEM). Sample results showing the highest chromium content will be selected for XANES, µ-XRF, and XAFS measurements to ensure that the concentrations of chromium and iron are above the detection limits of these techniques. The results from the noncontaminated samples will be compared with the results those from contaminated samples, particularly for iron.

XANES, µ-XRF, and XAFS measurements will be conducted at the Stanford Synchrotron Radiation Lightsource (SSRL). Two types of measurements will be conducted. One is to determine the oxidation state of chromium and iron of the field samples with an effort to quantify the ratios of Cr(III)/Cr(VI) and Fe(II)/Fe(III). Another will focus on µ-XRF element maps and XAFS analysis to determine chemical coordination and distribution of chromium and other coassociated elements, particularly iron, on rock and particle surfaces from contaminated portions of the subsurface. These data will be used to guide further geochemical characterization, if necessary, planned for the SIMWP, as described in section 2.3.

2.2.2 Geochemical Characterization for Injection of Treated Water into the Aquifer

The purpose of this proposed activity is to evaluate potential interactions between injected treated water and aquifer materials. Water/rock interactions are essential geochemical processes that regulate the groundwater chemistry in aquifer systems. Injection of large amounts of treated water into the regional aquifer could alter groundwater chemistry and cause the formation of precipitates within the screened interval of an injection well or within the surrounding pore space. Injection might also liberate naturally occurring constituents (e.g., arsenic) or otherwise stable contaminants. To understand potential issues that could arise from injection of treated water into the regional aquifer, combined laboratory static bench tests accompanied by geochemical modeling will be conducted.

Batch studies will be performed with representative core and cuttings samples from the predominant lithologic units found below the water table beneath Sandia and Mortandad Canyons (the Puye Formation and Miocene pumiceous unit). Treated groundwater generated during the field tests will be used in the experiments to represent injection water. Solid samples will be brought in contact with the treated groundwater at various conditions to ensure that potential variations in fluid composition, mineral heterogeneity and exposure degree (the ratio between liquid and solid, for example, liquid/solid ratio and time) are considered. Geochemical and transport modeling will be used to simulate physicochemical interactions in the reinjection water/rock system to assess long-term groundwater chemistry in the regional aquifer. Post-characterization (XRD, XRF, SEM) will be performed on representative solid samples to look for precipitates and changes in mineralogy. Fluid composition before and after the batch test will be analyzed using a combination of wet chemical methods (e.g., inductively coupled plasma, high-performance liquid chromatography, titration).

2.3 Supplemental Interim Measures Work Plan

At the completion of the activities discussed in sections 2.1 and 2.2, the SIMWP will be prepared, summarizing the results of the hydraulic and tracer field tests at R-42 and R-28 and the characterization of reinjection water. The SIMWP will also include recommendations regarding the installation of a pilot pumping well to further evaluate the potential for chromium mass removal from the regional aquifer. If a pilot pumping well is recommended, the SIMWP will also recommend the location, design, and operational conditions for the pumping well as an important component of integrated remedial activities for chromium contamination. The SIMWP will include recommendations for the disposition of the considerable quantities of treated water likely to be generated from the additional pumping actions, incorporating the results of the characterization study of reinjection water geochemistry. The SIMWP may also propose additional geochemical characterization, if necessary, depending on the results of the field tests and of the chromium and iron speciation work.

3.0 SCHEDULE

The proposed start date for the hydraulic and tracer tests is June 2013, with the R-42 and R-28 tests conducted during calendar year 2013. The temporary discharge permits that govern disposition of treated water require that land application cease when the ground is too frozen to allow for infiltration of sprayed water. Therefore, it is anticipated that the pumping tests and associated land application of water from R-42 and R-28 will cease sometime in mid- to late November 2013. Geochemical characterization activities will be performed through approximately February 2014. The SIMWP will be submitted to NMED by March 31, 2014, and will include a schedule for any additional work that is proposed. Since analytical results and hydraulic data will be generated at a high frequency during all aspects of this work, it is recommended that frequent discussions are held with NMED to facilitate real-time interpretation of the results.

Pumping and tracer tests at SCI-2, R-43-1, and R-62 will begin in early spring 2014 and are expected to be complete by mid-summer 2014. The Laboratory recommends that the integrated results of this IWMP and the SIWMP be included as content in a corrective measures evaluation (CME) report. The CME report would recommend all aspects of the final remedial approach for the chromium contamination.

4.0 REFERENCES

The following list includes all documents cited in this plan. 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.

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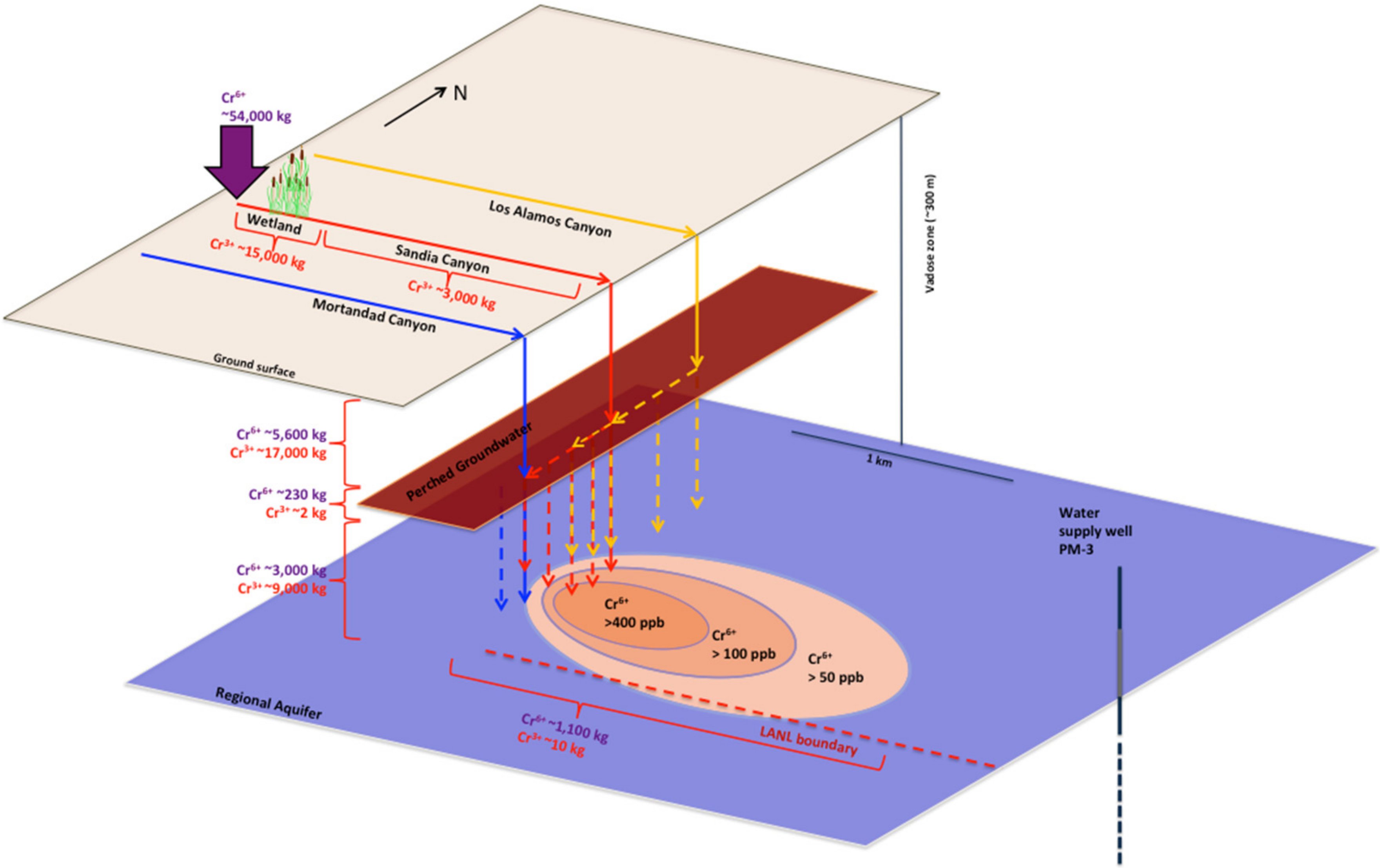


Figure 1.0-1 Conceptual three-dimensional representation of surface-water and groundwater flow paths that influence chromium migration

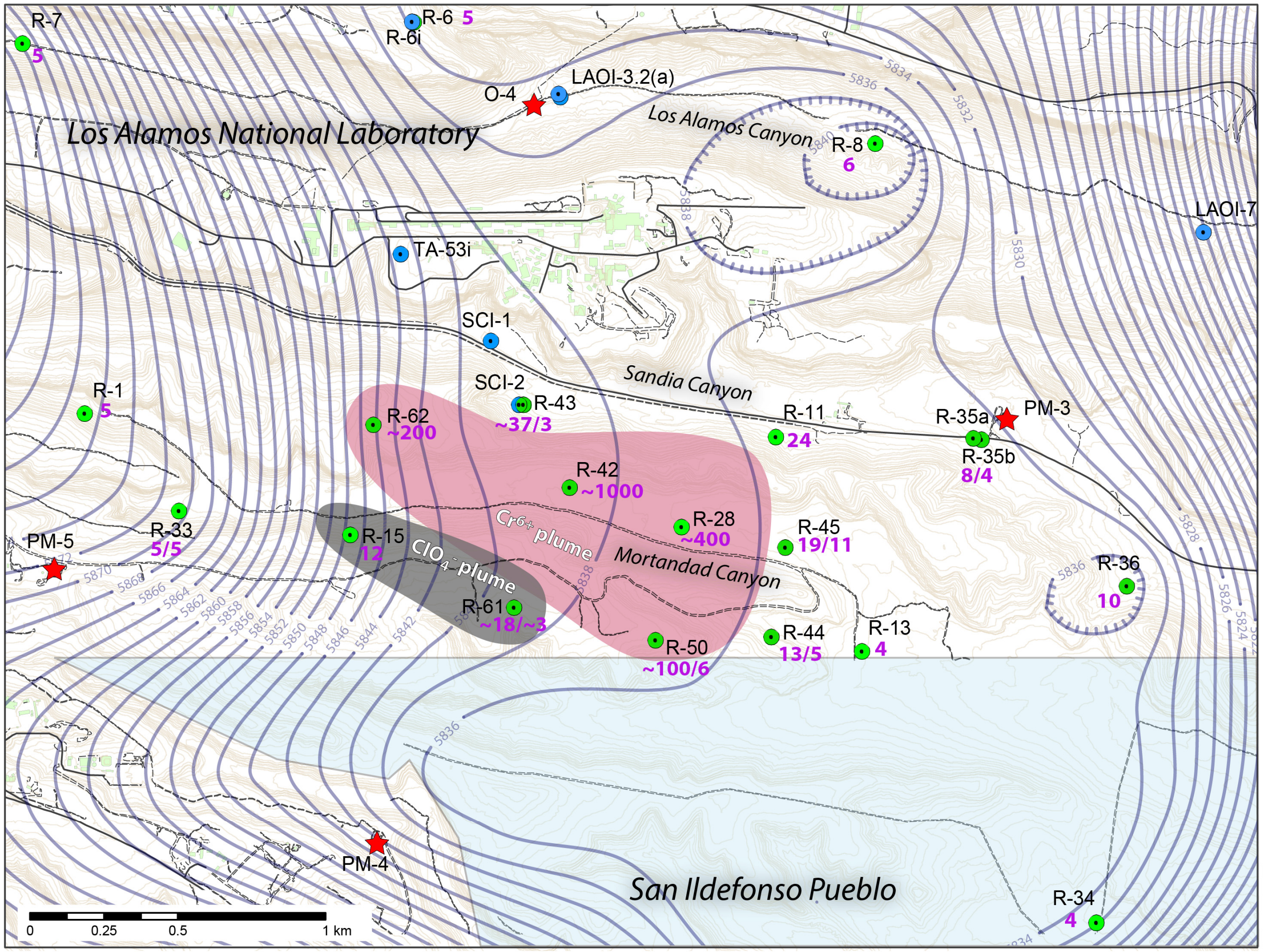
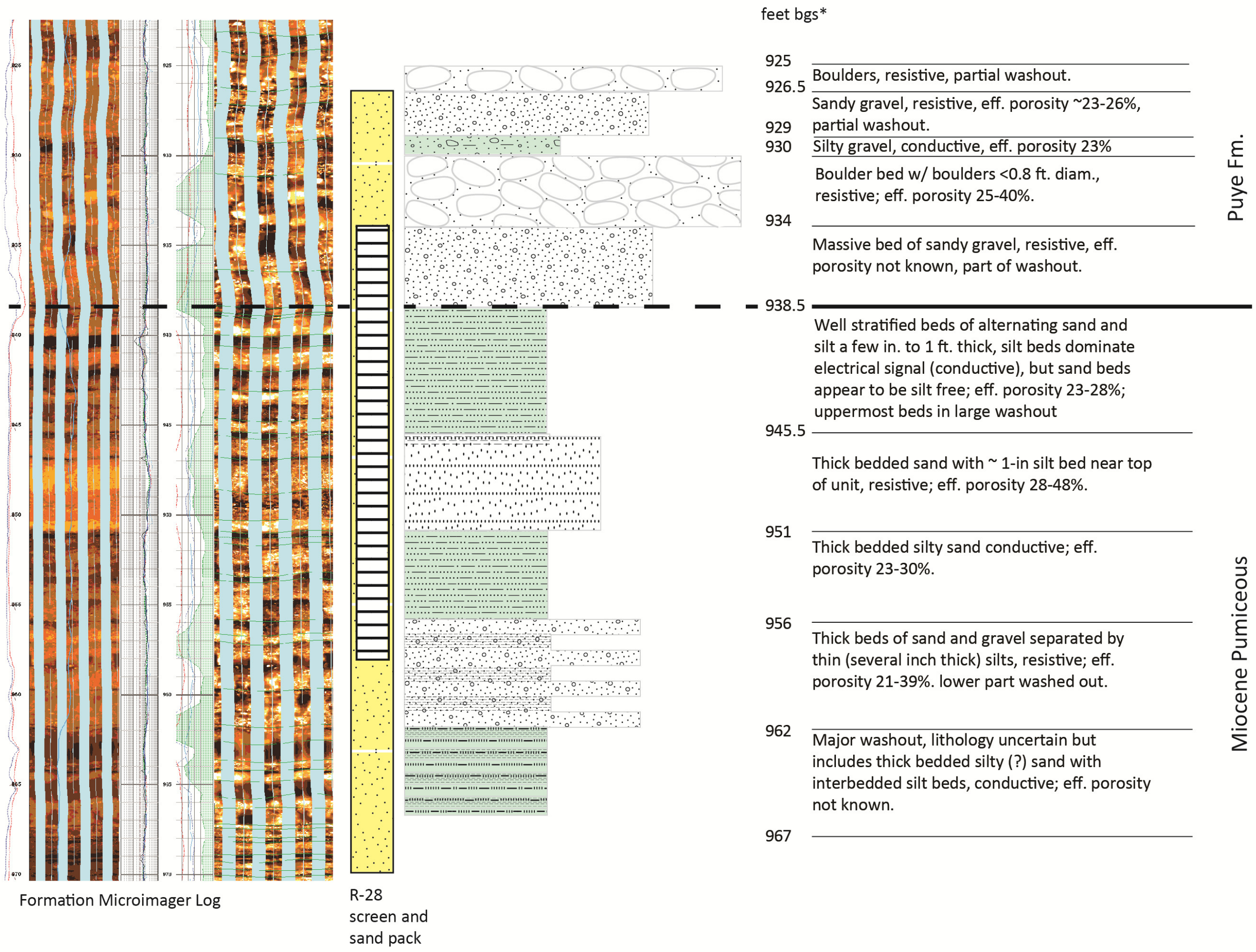


Figure 1.0-2 Plan view of the Cr(VI) plume (>50 ppb contour shown in pink) in the regional aquifer with nearby regional monitoring wells (green circles), perched-intermediate monitoring wells (blue circles), and water-supply wells (red stars). Contour lines (2-ft intervals) represent the regional water table elevations. The approximate area of perchlorate contamination greater than approximately 2 ppb in the regional aquifer is shown in grey. Numbers beneath the well names refer to the approximate chromium concentrations. Two numbers represent concentrations for upper and lower screens.



Sediment facies within the screened interval for R-28. Green shaded units are electrically conductive, non-shaded units are electrically resistive.

*bgs = Below ground surface.

Figure 2.0-1 Detailed stratigraphy within the screened interval in regional well R-28

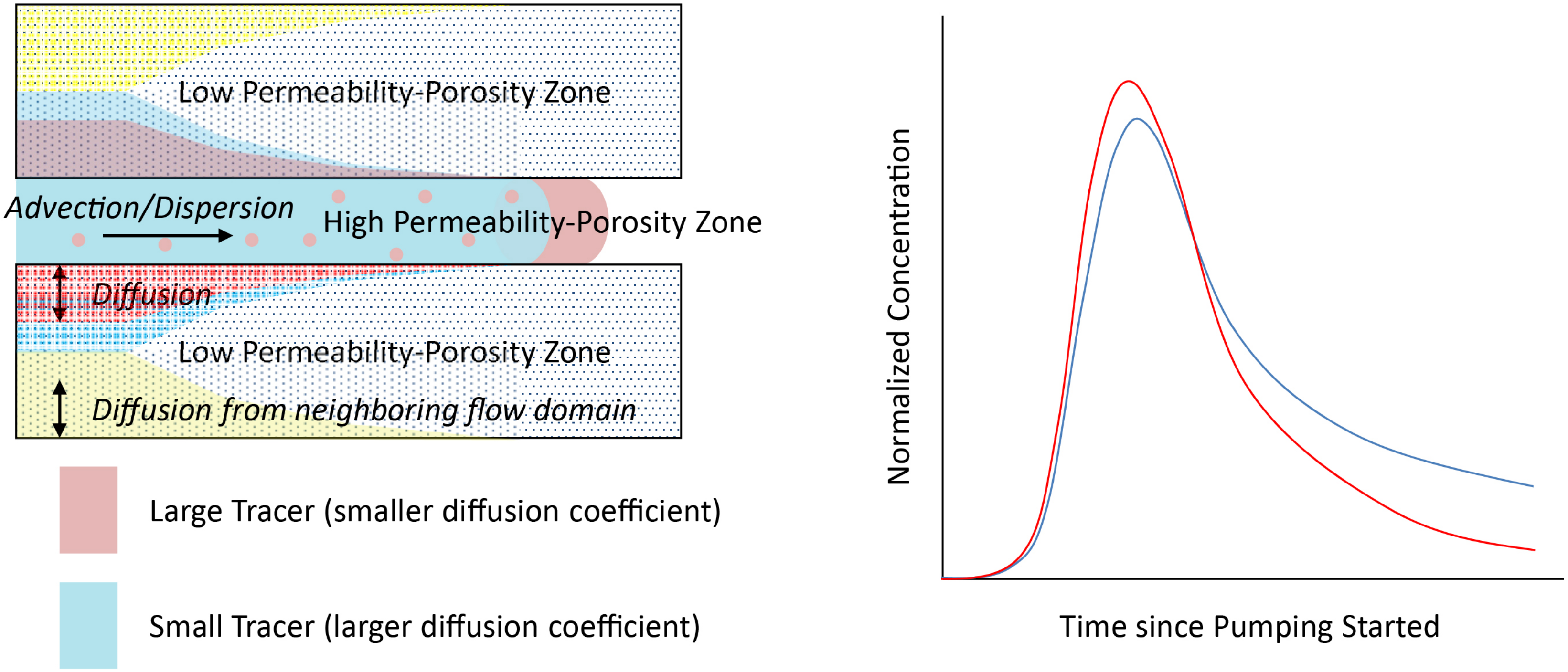


Figure 2.1-1 **Schematic of tracer transport and resulting breakthrough curves for two different size tracer molecules transporting through heterogeneous strata with varying permeability-porosity**

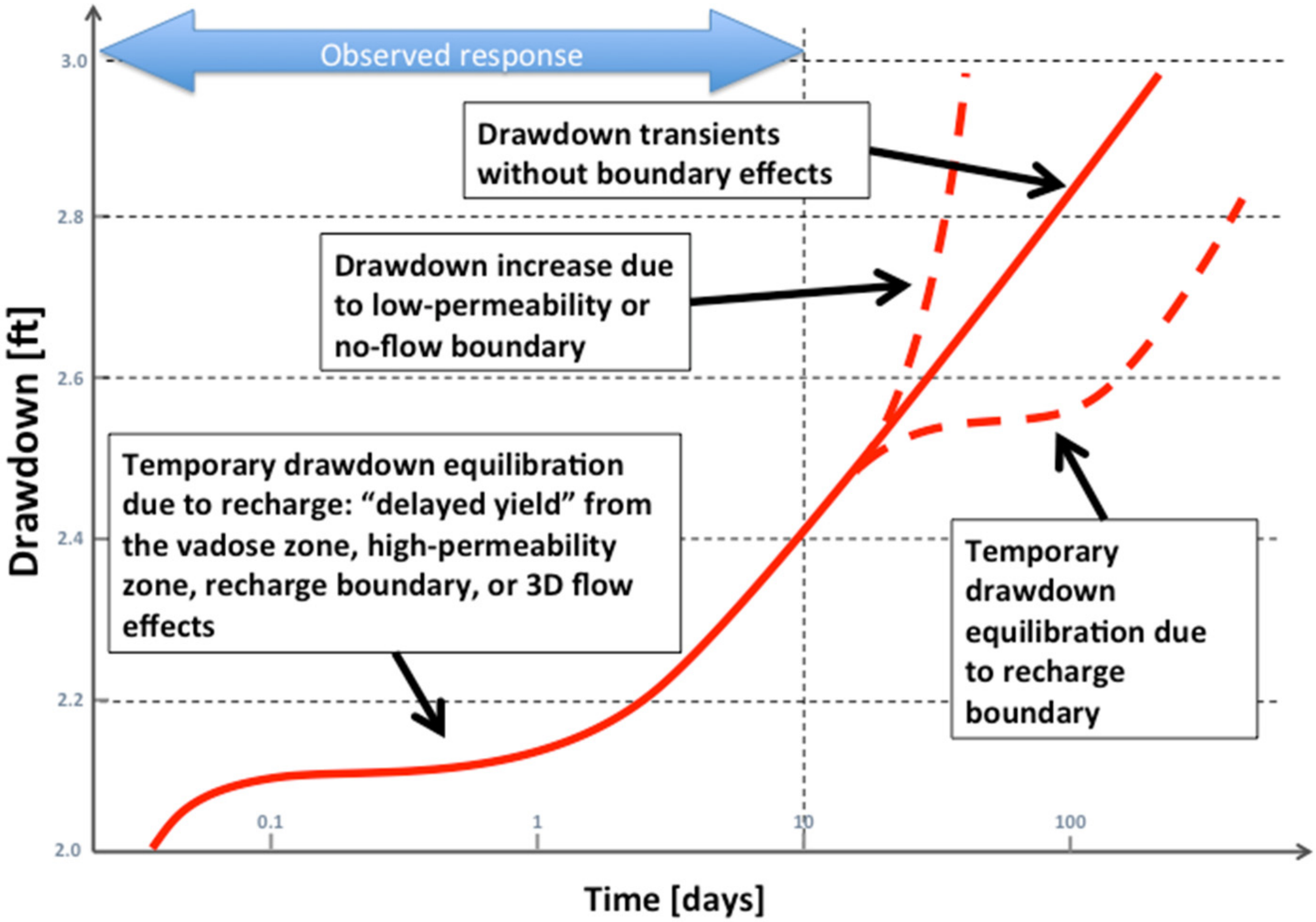


Figure 2.1-2 Observed (first 10 d) and hypothetical (after 10 d of pumping) drawdown versus time curves during pumping at R-28 (similar behavior may be observed at R-42)

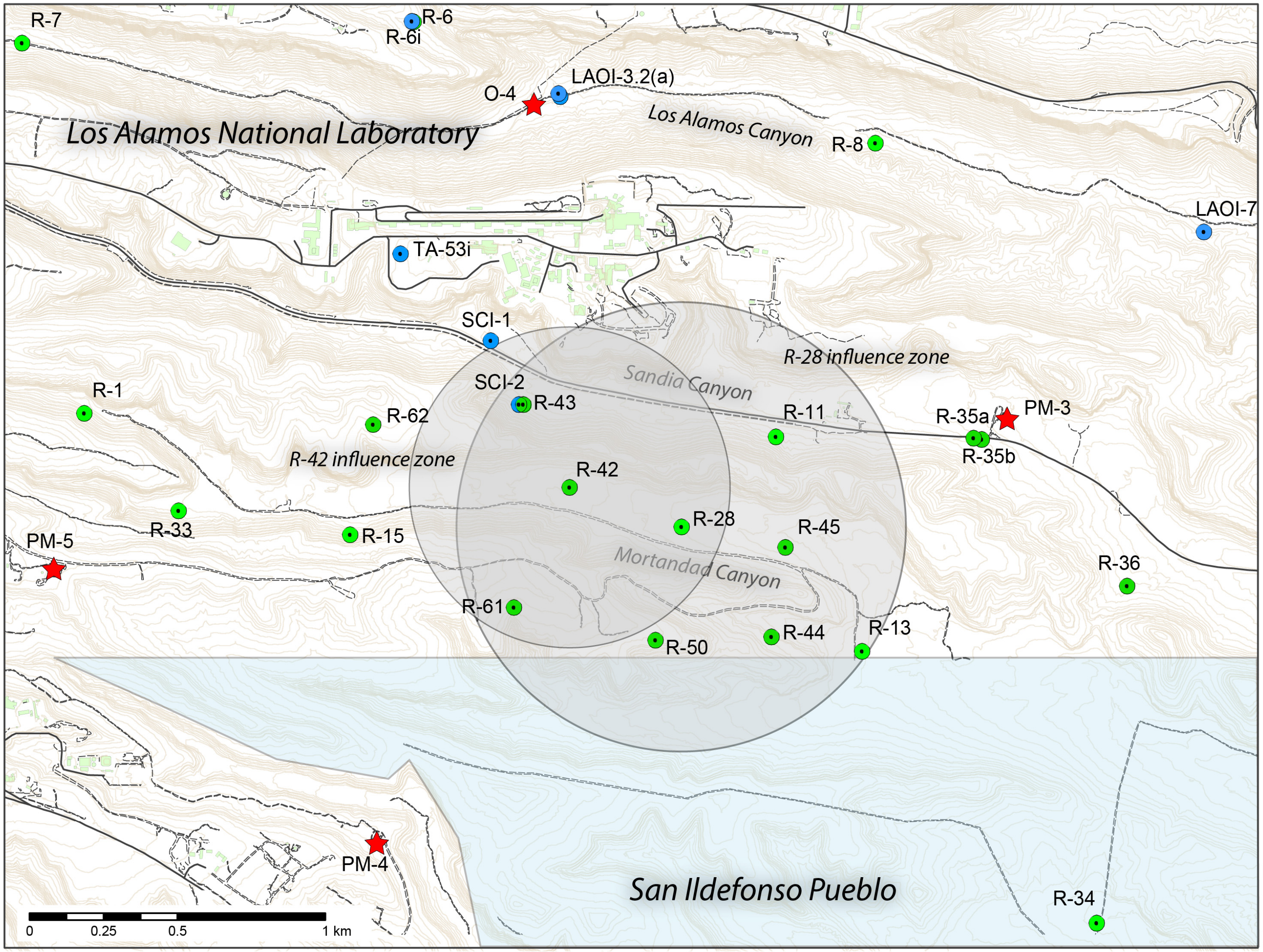


Figure 2.1-3 Expected zones of influence of R-42 and R-28 pumping test

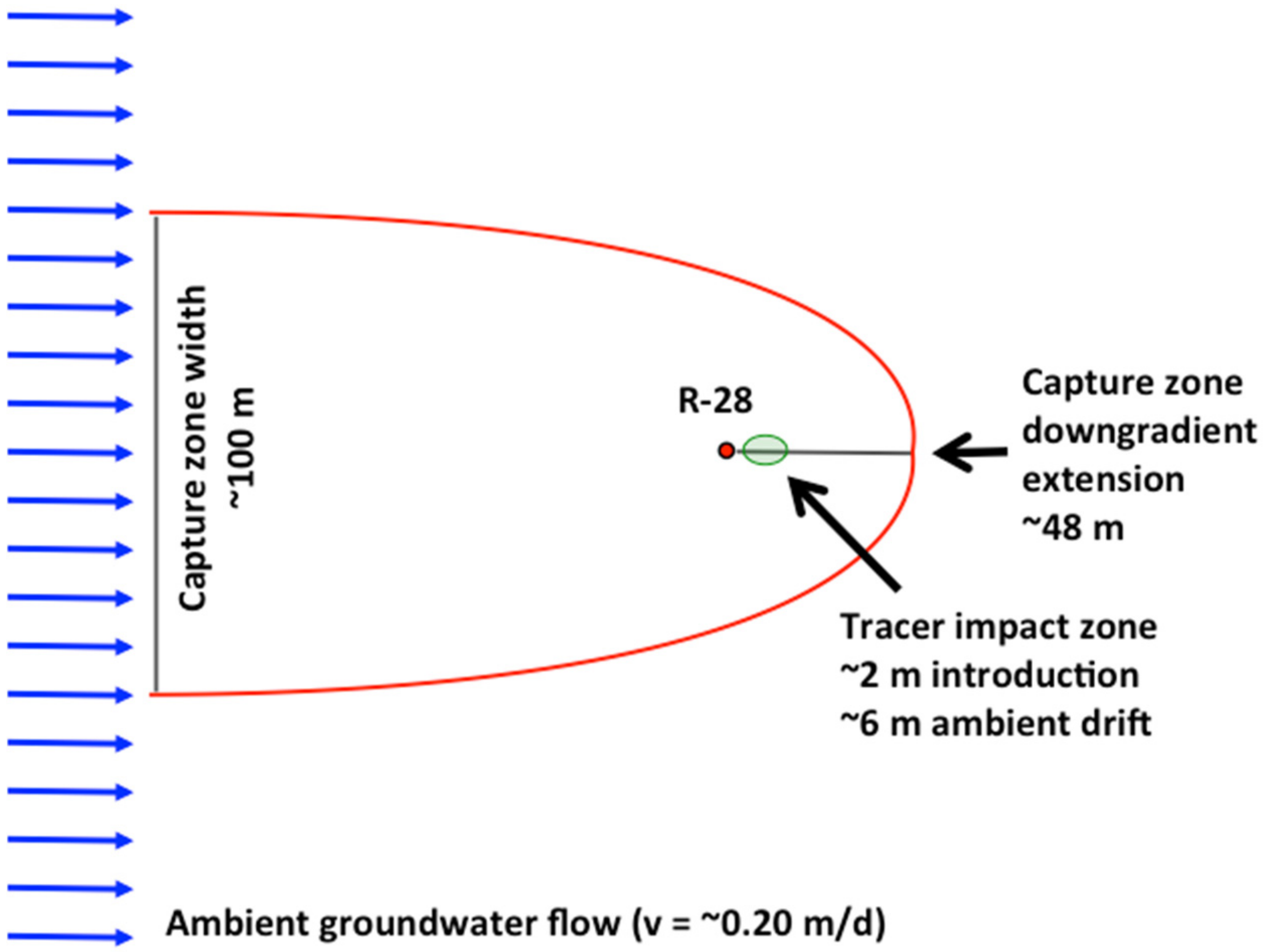


Figure 2.1-4 **Schematic representation of capture zone and tracer-impact zone during R-28 field test. The capture and tracer zone estimates assume steady-state groundwater flow in uniform and isotropic aquifer. The capture zone estimate assumes a quasi-steady-state flow regime, which is expected to be achieved within about 10 d after the pumping has commenced.**

ENCLOSURE 3

Topographical map showing required features and approved land application areas

ENV-DO-15-0245

LA-UR-15-26789

Date: September 3, 2015

ENCLOSURE 3

New Mexico State Plane Coordinate System Central Zone (3002)
North American Datum, 1983 (NAD 83)

US Survey Ft

GIS: Dave Frank, dff@lanl.gov, 665-8182
Date: Wednesday, September 02, 2015
Revision: 0.0
Accessed: Wednesday, September 02, 2015
File: map_15-0059-05

DISCLAIMER: This map was created for work processes associated with ER-ES. All other uses for this map should be confirmed with LANL staff.

ENCLOSURE 4

Table 3.4-1, Interim Monitoring Plan for Chromium Investigation Monitoring Group

ENV-DO-15-0245

LA-UR-15-26789

Date: September 3, 2015

Table 3.4-1
Interim Monitoring Plan for Chromium Investigation Monitoring Group

Location	Watershed	Rationale for Selection of Location	Surface Water Body or Source Aquifer	Metals	VOCs	SVOCs	PCBs	HEXP	Dioxins/Furans	Radionuclides	Tritium	Low-Level Tritium	General Inorganics	Chromium Isotopes	15N/18O Isotopes in Nitrate
MCOI-5	Mortandad	Monitors for potential contaminants from upper Mortandad and Ten Site Canyons or possibly Sandia Canyon.	Intermediate	S	S	S	—	—	—	A	A	—	S	A	—
MCOI-6	Mortandad	Monitors for potential contaminants from upper Mortandad and Ten Site Canyons or possibly Sandia Canyon.	Intermediate	Q	S	S	—	—	—	A	A	—	Q	Q	A
SCI-1	Sandia	Monitors the first perched-intermediate groundwater encountered along the key infiltration pathway in Sandia Canyon.	Intermediate	S	—	—	B (2015)[a]	—	—	A	A	—	S	A	A
SCI-2	Sandia	Monitors key infiltration pathway in Sandia Canyon.	Intermediate	Q	B (2016)[b]	B (2016)	B (2015)	—	—	A	A	—	Q	A	A
R-1	Mortandad	Monitors for potential contaminants from upper Mortandad Canyon or possibly Sandia Canyon. Background location in GBIR R3.	Regional	A	B (2016)	B (2016)	—	—	—	B (2015)	—	A	A	—	—
R-11	Sandia	Monitors for potential contaminants from Sandia Canyon and possibly Los Alamos Canyon.	Regional	Q	—	—	—	—	—	B (2015)	—	A	Q	S	—
R-13	Mortandad	Monitors for nature and extent of contaminants originating in Mortandad and Sandia Canyons. Key lower boundary well. Background location in GBIR R3.	Regional	S	—	—	—	—	—	B (2015)	—	A	S	—	—
R-15	Mortandad	Monitors for potential contaminants from upper Ten Site or Mortandad Canyons.	Regional	S	B (2016)	B (2016)	—	—	—	B (2016)	—	A	S	A	—
R-28	Mortandad	Monitors for potential contaminants from upper Sandia, Mortandad, or Ten Site Canyons or possibly sources in canyons to the north.	Regional	Q	—	—	—	—	—	B (2015)	A	—	Q	A	A
R-35a	Sandia	Sentinel monitoring location for chromium contamination in regional groundwater. Located within the same stratigraphic zone as the upper louvered section of water-supply well PM-3.	Regional	Q	B (2016)	B (2016)	—	—	—	B (2015)	—	A	Q	—	—
R-35b	Sandia	Sentinel monitoring location for chromium contamination in the regional groundwater. Located near the water table above the louvered section of water-supply well PM-3.	Regional	Q	B (2016)	B (2016)	—	—	—	B (2015)	—	A	Q	—	—
R-36	Sandia	Monitors for potential contaminants from the Sandia Canyon source and other potential sources from canyons to the north. Also serves as a sentinel well for water-supply well PM-1.	Regional	S	A	A	—	—	—	B (2015)	—	A	S	—	—
R-42	Mortandad	Key characterization and monitoring point located upgradient of R-28.	Regional	Q	B (2016)	B (2016)	—	—	—	B (2015)	A	—	Q	A	A
R-43 S1	Sandia	Monitors downgradient extent of contamination originating in Sandia Canyon and possibly canyons to the north.	Regional	Q	B (2016)	B (2016)	—	—	—	B (2015)	—	A	Q	Q	A
R-43 S2	Sandia	Monitors downgradient extent of contamination originating in Sandia Canyon and possibly canyons to the north.	Regional	Q	B (2016)	B (2016)	—	—	—	B (2015)	—	A	Q	Q	A
R-44 S1	Mortandad	Monitors near the water table for nature and extent of contaminants from sources in Sandia Canyon and possibly sources in canyons to the north.	Regional	Q	B (2016)	B (2016)	—	—	—	B (2015)	—	A	Q	—	—
R-44 S2	Mortandad	Monitors for nature and extent of contaminants from sources in Sandia Canyon and possibly sources in canyons to the north.	Regional	Q	B (2016)	B (2016)	—	—	—	B (2015)	—	A	Q	—	—
R-45 S1	Mortandad	Monitors near the water table for nature and extent of contaminants from sources in Sandia Canyon and possibly sources in canyons to the north.	Regional	S	B (2016)	B (2016)	—	—	—	B (2015)	—	A	S	Q	A
R-45 S2	Mortandad	Monitors for nature and extent of contaminants from sources in Sandia Canyon and possibly sources in canyons to the north.	Regional	S	B (2016)	B (2016)	—	—	—	B (2015)	—	A	S	Q	A
R-50 S1	Mortandad	Monitoring well located on the mesa south of Mortandad Canyon to define the southern extent of chromium contamination in the regional aquifer.	Regional	Q	B (2016)	B (2016)	—	—	—	B (2015)	—	S	Q	Q	—
R-50 S2	Mortandad	Monitoring well located on the mesa south of Mortandad Canyon to define the southern extent of chromium contamination in the regional aquifer.	Regional	Q	B (2015)	B (2015)	—	—	—	B (2015)	—	S	Q	Q	—
R-61 S1	Mortandad	Located on the mesa south of Mortandad Canyon to define the western extent of the flow path for chromium migration.	Regional	Q (filtered and non-filtered)	S	S	A	A	A	S	—	S	Q	Q	A
R-62	Mortandad	Located on a ridge between Sandia and Mortandad Canyon at the east end of Sigma Mesa.	Regional	S	S	S	A	A	A	S	—	S	S	S	S

Notes: Sampling suites and frequencies: C = continuous; Q = quarterly (4 times/yr); S = semiannual (2 times/yr); A = annual (1 time/yr); B = biennial (1 time/2 yr); T = triennial (1 time/3 yr); V = quinquennial (1 time/5 yr); X = sampled once in MY2016.

[a] 2015 = Samples scheduled to be collected during implementation of MY2015 Interim Plan.

[b] 2016 = Samples scheduled to be collected during implementation of MY2016 Interim Plan.

ENCLOSURE 5

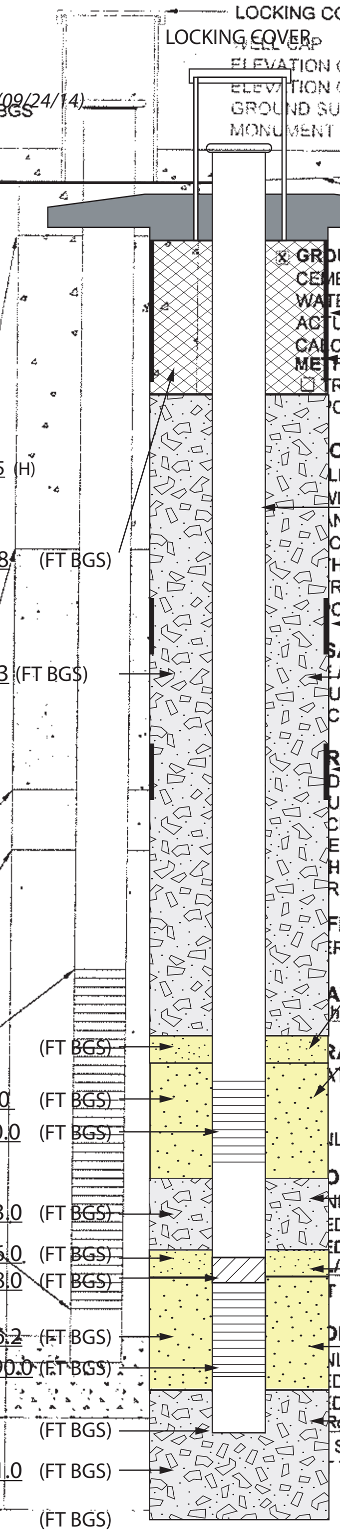
Well and Piezometer Fact Sheets

CrEX-1
CrPZ-1
CrPZ-2a
CrPZ-2b
CrPZ-3
CrPZ-4
CrPZ-5
R-28
R-42
R-43
R-50
R-62
R-67
SCI-2
MCA-9
MCO-9
MCO-12

ENV-DO-15-0245

LA-UR-15-26789

Date: September 3, 2015



TOTAL LENGTH OF CASING AND SCREEN (FT) 1115.6

DEPTH TO WATER FOLLOWING INSTALLATION (FT BGS) 997.2 (09/24/14)

DIAMETER OF BOREHOLE
24.00 (IN) FROM 0 TO 55 (FT BGS)
19.00 (IN) FROM 55 TO 475 (FT BGS)
17.00 (IN) FROM 475 TO 816 (FT BGS)
14.75 (IN) FROM 816 TO 1211 (FT BGS)

SURFACE COMPLETION *(proposed)*
PROTECTIVE CASING
TYPE STEEL SIZE (IN) 16
PROTECTIVE POSTS INSTALLED YES
SURFACE SEAL AND PAD
CHECK FOR SETTLEMENT YES
PAD MATERIAL CONCRETE
REINFORCED WIRE MESH
PAD DIMENSIONS (FT) 10 (L) 10 (W) 0.5 (H)

SURFACE SEAL	4.0	TO	59.8	(FT BGS)
BENTONITE SEAL	59.8	TO	979.3	(FT BGS)
FINE SAND COLLAR	979.3	TO	985.3	(FT BGS)
FILTER PACK	985.3	TO	1048.0	(FT BGS)
SCREENED INTERVAL	990.0	TO	1040.0	(FT BGS)
BENTONITE SEAL	1048.0	TO	1063.0	(FT BGS)
FINE SAND COLLAR	1063.0	TO	1066.0	(FT BGS)
TAM PACKER	1062.0	TO	1068.0	(FT BGS)
FILTER PACK	1066.0	TO	1096.2	(FT BGS)
SCREENED INTERVAL	1070.0	TO	1090.0	(FT BGS)
BOTTOM OF CASING			1112.6	(FT BGS)
BACKFILL	1096.2	TO	1211.0	(FT BGS)
BOTTOM OF BORING			1211.0	(FT BGS)

LOCKING COVER

ELEVATION (AMSL)
WELL CASING TBD
PROTECTIVE CASING TBD
GROUND SURFACE TBD
BRASS CAP (MARKER) TBD

SLOPED CONCRETE PAD / SURFACE SEAL

SURFACE SEAL

20-IN CSG 0 TO 55 (FT BGS)

SURFACE SEAL
MIX (WT%) PORTLAND CEMENT 92 BENTONITE 8
QUANTITY USED 90.0 FT³ CALC 90.0 FT³

TYPE OF CASING
MATERIAL PASSIVATED A304 STAINLESS STEEL
ID (IN) 8.00 OD (IN) 8.625 (8⅝)
JOINT TYPE WELDED

18-IN CSG/SHOE 470.0 TO 475.0 (FT BGS)

HYDRATED BENTONITE SEAL
FORM ⅜-IN BENTONITE CHIP
QUANTITY USED 1253.2 FT³ CALC 1100.7 FT³

16-IN CSG/SHOE 811.0 TO 816.0 (FT BGS)

FINE SAND COLLAR
SIZE/TYPE 20/40 SILICA
QUANTITY USED 14.0 FT³ CALC 4.7 FT³

FILTER PACK SAND
SIZE/TYPE 10/20 SILICA
QUANTITY USED 46.5 FT³ CALC 49.4 FT³

TYPE OF SCREEN(S)
MATERIAL A304 STAINLESS STEEL
ID (IN) 8.00 OD (IN) 5.88 (5⅞)
SLOT SIZE (IN) 0.040
JOINT TYPE WELDED

HYDRATED BENTONITE SEAL
FORM ⅜-IN BENTONITE CHIP
QUANTITY USED 8.8 FT³ CALC 11.7 FT³

FINE SAND COLLAR
SIZE/TYPE 20/40 SILICA
QUANTITY USED 4.5 FT³ CALC 2.3 FT³

FILTER PACK SAND
SIZE/TYPE 10/20 SILICA
QUANTITY USED 23.0 FT³ CALC 23.6 FT³

HYDRATED BENTONITE BACKFILL
MATERIAL ⅜-IN BENTONITE CHIP
QUANTITY USED 83.0 FT³ CALC 129.5 FT³

STAINLESS-STEEL CENTRALIZERS
USED YES, BETWEEN LOWER AND UPPER SCREENS AND EVERY 40 FT FROM 10 FT ABOVE UPPER SCREEN TO 197 FT BGS

WELL COMPLETION BEGAN
DATE 08/12/14 TIME 1235h

WELL COMPLETION FINISHED
DATE 08/17/14 TIME 1100h

Well CrEX-1 As-Built Well Construction Diagram

Technical Area 05 (TA-05)
Los Alamos National Laboratory
Los Alamos, New Mexico

Fact Sheet

Los Alamos NATIONAL LABORATORY EST. 1943

Drafted By: PTM
Date: November 3, 2014
File Name: CrEX-1_AsBuiltDiagram_FactSheet

TOTAL LENGTH OF CASING AND SCREEN 870.2 FT

DEPTH TO WATER FOLLOWING INSTALLATION (TOC) 715.71 FT BGS (9/13/05)

DIAMETER OF BOREHOLE
21.6" FROM 0 FT TO 40 FT BGS
15.0" FROM 40 FT TO 645 FT BGS
10.625" FROM 645 FT TO 881 FT BGS

SURFACE COMPLETION INFORMATION
TYPE OF PROTECTIVE CASING
STEEL SIZE
PROTECTIVE POSTS INSTALLED
SURFACE SEAL/PAD COMPLETION
CHECKED FOR SETTLEMENT
MATERIAL USED:
REINFORCED
YES:
NO
PAD DIMENSIONS
FT (L) x FT (W) x FT (H)

3 DEPTH TO TOP OF SURFACE SEAL (FT BGS)

79 DEPTH TO TOP OF BENTONITE SEAL (FT BGS)

811 DEPTH TO TOP OF FINE SAND COLLAR (FT BGS)

813 DEPTH TO TOP OF FILTER PACK (FT BGS)

DEPTH TO TOP OF SCREEN (FT BGS)

DEPTH TO BOTTOM OF SCREEN (FT BGS)

854 DEPTH TO TOP OF BACKFILL MATERIAL (FT BGS)

861.54 DEPTH TO BOTTOM OF CASING (FT BGS)

872 DEPTH TO TOP OF FORMATION COLLAPSE (FT BGS)

881 DEPTH TO BOTTOM OF BORING (FT BGS)

LOCKING COVER
WELL CAP
ELEVATION OF PROTECTIVE CASING
ELEVATION OF TOP WELL CASING (FT AMSL)
GROUND SURFACE ELEVATION
MONUMENT MARKER ELEV.

SLOPED CONCRETE PAD/SURFACE SEAL

☒ GROUT FORMULA (PROPORTION OF EACH)
CEMENT 10% BENTONITE not added to grout mix
WATER 9% OTHER Aggregate 78%
ACTUAL VOLUME 135 ft³
CALCULATED VOLUME 82.9 ft³
METHOD INSTALLED
☐ TREMIE ☒ Pumper truck with hose at 5 ft bgs
☐ POURED ☐ NOT USED

BENTONITE SEAL
PELLETS ☐ SLURRY
POWDER/GRANULAR ☐
QUANTITY USED 1452.5
CALCULATED VOLUME 798.5 ft³
METHOD INSTALLED
TREMIE ☐
POURED ☐ NOT USED

SAND COLLAR (OPTIONAL)
SIZE / TYPE 20/40
ACTUAL VOLUME 3.5 ft³
CALCULATED VOLUME 0.96 ft³

FILTER PACK
SAND SIZE 10/20
ACTUAL VOLUME 30.0 ft³
CALCULATED VOLUME 19.7 ft³
MATERIAL
METHOD INSTALLED
TREMIE

BACKFILL MATERIAL
MATERIAL: Bentonite/20/40 sand

FORMATION COLLAPSE

CENTRALIZERS USED
AT: 723.30 FT
823.30 FT
849.29 FT
STAINLESS STEEL

TYPE OF CASING
STAINLESS STEEL
SCHEDULE 40 PVC
SCHEDULE 80 PVC
CASING DIAMETER
INSIDE 4.5 in.
OUTSIDE 5.0 in.
JOINT TYPE (threaded collars)

TYPE OF SCREEN
STAINLESS STEEL
SCHEDULE 40 PVC
SCHEDULE 80 PVC
SCREEN DIAMETER
INSIDE 4.5 in.
OUTSIDE 5.2 in.
Rod Base
SLOT SIZE 0.020 in.
JOINT TYPE (threaded collars)

WELL COMPLETION BEGAN
DATE 8/29/05 TIME 15:00

WELL COMPLETION FINISHED
DATE 9/12/05 TIME 18:30

WELL DEVELOPMENT INFORMATION
DEVELOPMENT METHOD
SWABBING BAILING
PUMPING
TOTAL PURGE VOLUME GALLONS

FINAL PARAMETER MEASUREMENTS
pH
TEMPERATURE C
SPECIFIC CONDUCTANCE uS
TURBIDITY NTU

PENDING

KLEINFELDER

Drawn By: C. Bhongir	Date: September 2005
Project No.: 49436	Filename: 49436_02_0.dwg
Scale: not-to-scale	Revision: –

AS-BUILT WELL SCHEMATIC
Characterization Well R-24
TA 74 / Bayo Canyon
Los Alamos, New Mexico

FIGURE 2
NOT TO SCALE

TOTAL LENGTH
OF CASING AND SCREEN (FT) 1141.6

DEPTH TO WATER
FOLLOWING INSTALLATION (FT BGS) 1118.0 *(11/8/14)*

DIAMETER OF BOREHOLE
20.00 (IN) FROM 0.0 TO 60.0 (FT BGS)
12.00 (IN) FROM 60.0 TO 585.0 (FT BGS)
10.00 (IN) FROM 585.0 TO 905.0 (FT BGS)
6.00 (IN) FROM 905.5 TO 1158.0 (FT BGS)

SURFACE COMPLETION *(proposed)*
PROTECTIVE CASING
TYPE STEEL SIZE (IN) 16
PROTECTIVE POSTS INSTALLED YES
SURFACE SEAL AND PAD
CHECK FOR SETTLEMENT YES
PAD MATERIAL CONCRETE
REINFORCED WIRE MESH
PAD DIMENSIONS (FT) 10 (L) 10 (W) 0.5 (H)

SURFACE SEAL 4.0 TO 61.0 (FT BGS)

BENTONITE SEAL 61.0 TO 1115.5 (FT BGS)

FINE SAND COLLAR 1115.5 TO 1117.5 (FT BGS)

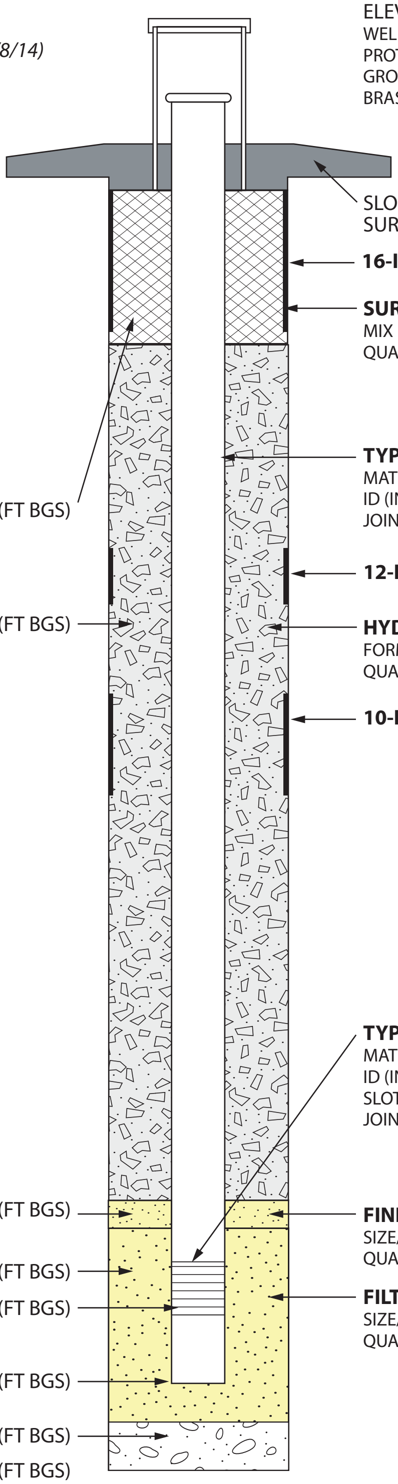
FILTER PACK 1117.5 TO 1145.0 (FT BGS)

SCREENED INTERVAL 1122.9 TO 1132.9 (FT BGS)

BOTTOM OF CASING 1138.0 (FT BGS)

SLOUGH 1145.0 TO 1158.0 (FT BGS)

BOTTOM OF BORING 1158.0 (FT BGS)



ELEVATIONS (FT AMSL)
WELL CASING TBD
PROTECTIVE CASING TBD
GROUND SURFACE TBD
BRASS CAP (MARKER) TBD

16-IN CSG 0 TO 60 (FT BGS)

SURFACE SEAL
MIX (WT%) PORTLAND CEMENT 92 BENTONITE 8
QUANTITY USED 79.0 FT^3 CALC 77.8 FT^3

TYPE OF CASING
MATERIAL PASSIVATED A304 STAINLESS STEEL
ID (IN) 2.00
JOINT TYPE THREADED

12-IN CSG/SHOE 580.0 TO 585.0 (FT BGS)

HYDRATED BENTONITE SEAL
FORM ⅜-IN BENTONITE CHIP
QUANTITY USED 743.4 FT^3 CALC 596.9 FT^3

10-IN CSG/SHOE 866.0 TO 886.0 (FT BGS)

TYPE OF SCREEN(S)
MATERIAL A304 STAINLESS STEEL
ID (IN) 2.00
SLOT SIZE (IN) 0.040
JOINT TYPE THREADED

FINE SAND COLLAR
SIZE/TYPE 20/40 SILICA
QUANTITY USED 1.3 FT^3 CALC 0.3 FT^3

FILTER PACK SAND
SIZE/TYPE 10/20 SILICA
QUANTITY USED 10.0 FT^3 CALC 4.8 FT^3

STAINLESS-STEEL CENTRALIZERS
USED YES
ABOVE AND BELOW SCREEN AND
EVERY 40 FT FROM SCREEN TO 102 FT BGS

WELL COMPLETION BEGAN
DATE 10/25/14 TIME 1515h
WELL COMPLETION FINISHED
DATE 11/08/14 TIME 1900h

Los Alamos
NATIONAL LABORATORY
EST. 1943

Drafted By: PTM
Date: December 2, 2014
File Name: CrCH-1_AsBuiltDiagram_FactSheet

Well CrCH-1 As-Built Well Construction Diagram
Technical Area 05 (TA-05)
Los Alamos National Laboratory
Los Alamos, New Mexico

Fact Sheet
NOT TO SCALE

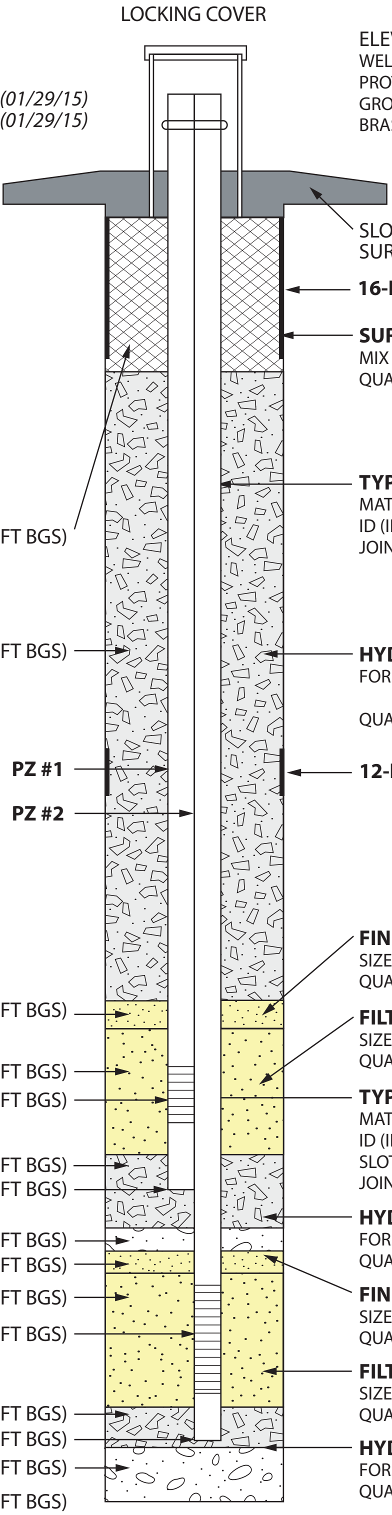
TOTAL LENGTH
OF PZ #1 CASING AND SCREEN (FT) 932.5
OF PZ #2 CASING AND SCREEN (FT) 976.7

DEPTH TO WATER
PZ #1 FOLLOWING INSTALLATION (FT BGS) 901.6 *(01/29/15)*
PZ #2 FOLLOWING INSTALLATION (FT BGS) 904.1 *(01/29/15)*

DIAMETER OF BOREHOLE
24.00 (IN) FROM 0.0 TO 57.0 (FT BGS)
12.00 (IN) FROM 57.0 TO 580.0 (FT BGS)
8.00 (IN) FROM 580.0 TO 987.2 (FT BGS)

SURFACE COMPLETION *(proposed)*
PROTECTIVE CASING
TYPE STEEL SIZE (IN) TBD
PROTECTIVE POSTS INSTALLED YES
SURFACE SEAL AND PAD
CHECK FOR SETTLEMENT YES
PAD MATERIAL CONCRETE
REINFORCED WIRE MESH
PAD DIMENSIONS (FT) 10 (L) 10 (W) 0.5 (H)

ELEVATIONS (FT AMSL)
WELL CASING TBD
PROTECTIVE CASING TBD
GROUND SURFACE TBD
BRASS CAP (MARKER) TBD



SLOPED CONCRETE PAD/ SURFACE SEAL

16-IN CSG 0 TO 57 (FT BGS)

SURFACE SEAL
MIX (WT%) PORTLAND CEMENT 100
QUANTITY USED 67.2 FT³ CALC 53.4 FT³

TYPE OF CASING
MATERIAL PASSIVATED A304 STAINLESS STEEL
ID (IN) 2.00 OD (IN) 2.375
JOINT TYPE THREADED

HYDRATED BENTONITE SEAL
FORM ⅜-IN BENTONITE CHIP (90%) PLUS 10/20 SAND (10%)
QUANTITY USED 721.2 FT³ CALC 927.6 FT³

12-IN CSG/SHOE 575.0 TO 580.0 (FT BGS)

FINE SAND COLLAR
SIZE/TYPE 20/40 SILICA
QUANTITY USED 0.50 FT³ CALC 0.57 FT³

FILTER PACK SAND
SIZE/TYPE 10/20 SILICA
QUANTITY USED 8.5 FT³ CALC 6.1 FT³

TYPE OF SCREEN(S)
MATERIAL A304 STAINLESS STEEL
ID (IN) 2.00 OD (IN) 2.375
SLOT SIZE (IN) 0.040
JOINT TYPE THREADED

HYDRATED BENTONITE SEAL
FORM ⅜-IN BENTONITE CHIP
QUANTITY USED 2.8 FT³ CALC 3.0 FT³

FINE SAND COLLAR
SIZE/TYPE 20/40 SILICA
QUANTITY USED 0.50 FT³ CALC 0.64 FT³

FILTER PACK SAND
SIZE/TYPE 10/20 SILICA
QUANTITY USED 12.5 FT³ CALC 9.0 FT³

HYDRATED BENTONITE SEAL
FORM ⅜-IN BENTONITE CHIP
QUANTITY USED 1.4 FT³ CALC 2.3 FT³

SURFACE SEAL	2.0	TO	60.0	(FT BGS)
BENTONITE SEAL	60.0	TO	902.0	(FT BGS)
FINE SAND COLLAR	902.0	TO	904.0	(FT BGS)
FILTER PACK	904.0	TO	925.3	(FT BGS)
SCREENED INTERVAL	909.8	TO	919.8	(FT BGS)
BENTONITE SEAL	925.3	TO	935.3	(FT BGS)
PZ #1 BOTTOM OF CASING			930.0	(FT BGS)
SLOUGH	935.3	TO	938.0	(FT BGS)
FINE SAND COLLAR	938.0	TO	940.0	(FT BGS)
FILTER PACK	940.0	TO	968.3	(FT BGS)
SCREENED INTERVAL	944.0	TO	964.0	(FT BGS)
BENTONITE SEAL	968.3	TO	975.3	(FT BGS)
PZ #2 BOTTOM OF CASING			974.2	(FT BGS)
SLOUGH	975.3	TO	987.0	(FT BGS)
BOTTOM OF BORING			987.0	(FT BGS)

STAINLESS-STEEL CENTRALIZERS
USED YES
ABOVE AND BELOW SCREEN

WELL COMPLETION BEGAN
DATE 1/11/15 TIME 1015h
WELL COMPLETION FINISHED
DATE 1/19/15 TIME 1000h

Los Alamos NATIONAL LABORATORY EST. 1943

Drafted By: PTM
Date: February 4, 2015
File Name: CrCH-2_AsBuiltDiagram_FactSheet

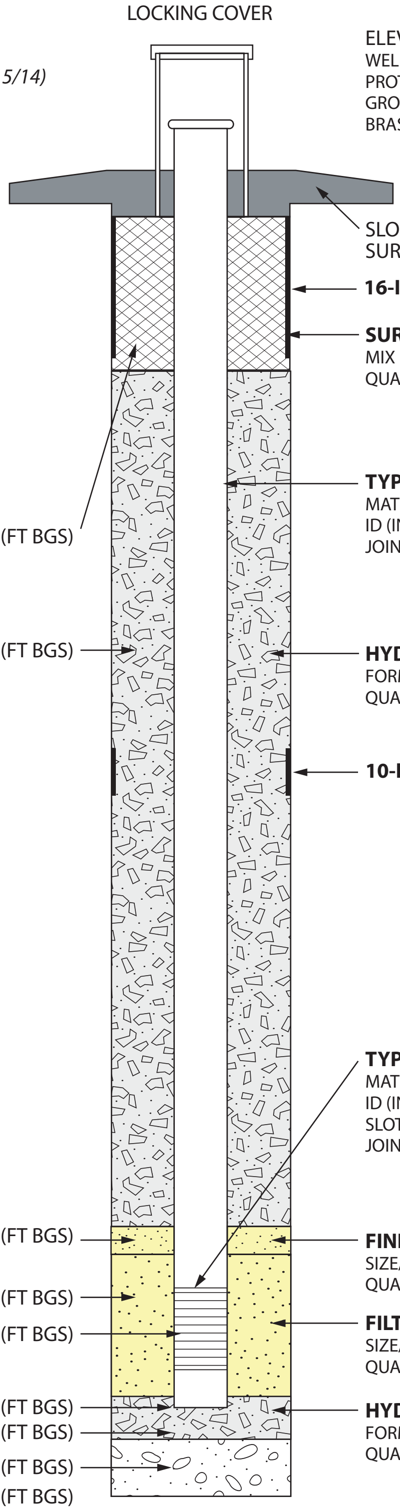
Well CrCH-2 As-Built Well Construction Diagram
Technical Area 05 (TA-05)
Los Alamos National Laboratory
Los Alamos, New Mexico

Fact Sheet
NOT TO SCALE

TOTAL LENGTH
OF CASING AND SCREEN (FT) 970.13

DEPTH TO WATER
FOLLOWING INSTALLATION (FT BGS) 932.7 *(12/15/14)*

DIAMETER OF BOREHOLE
20.00 (IN) FROM 0.0 TO 61.0 (FT BGS)
11.00 (IN) FROM 61.0 TO 680.0 (FT BGS)
6.00 (IN) FROM 680.0 TO 990.0 (FT BGS)



ELEVATIONS (FT AMSL)
WELL CASING TBD
PROTECTIVE CASING TBD
GROUND SURFACE TBD
BRASS CAP (MARKER) TBD

SLOPED CONCRETE PAD/
SURFACE SEAL

SURFACE COMPLETION *(proposed)*
PROTECTIVE CASING
TYPE STEEL SIZE (IN) 16
PROTECTIVE POSTS INSTALLED YES
SURFACE SEAL AND PAD
CHECK FOR SETTLEMENT YES
PAD MATERIAL CONCRETE
REINFORCED WIRE MESH
PAD DIMENSIONS (FT) 10 (L) 10 (W) 0.5 (H)

16-IN CSG 0 TO 60 (FT BGS)

SURFACE SEAL
MIX (WT%) PORTLAND CEMENT 92 BENTONITE 8
QUANTITY USED 80.0 FT^3 CALC 81.2 FT^3

TYPE OF CASING
MATERIAL PASSIVATED A304 STAINLESS STEEL
ID (IN) 2.00 OD (IN) 2.375
JOINT TYPE THREADED

SURFACE SEAL 1.0 TO 61.0 (FT BGS)

BENTONITE SEAL 61.0 TO 932.0 (FT BGS)

HYDRATED BENTONITE SEAL
FORM ⅜-IN BENTONITE CHIP
QUANTITY USED 428.5 FT^3 CALC 423.0 FT^3

10-IN CSG/SHOE 685.0 TO 690.0 (FT BGS)

TYPE OF SCREEN(S)
MATERIAL A304 STAINLESS STEEL
ID (IN) 2.00 OD (IN) 2.375
SLOT SIZE (IN) 0.040
JOINT TYPE THREADED

FINE SAND COLLAR 932.0 TO 934.0 (FT BGS)

FILTER PACK 934.0 TO 966.0 (FT BGS)

SCREENED INTERVAL 939.4 TO 959.4 (FT BGS)

BOTTOM OF CASING 969.63 (FT BGS)

BENTONITE SEAL 966.0 TO 990.0 (FT BGS)

SLOUGH AND SAND 990.0 TO 1023.0 (FT BGS)

BOTTOM OF BORING 1023.0 (FT BGS)

FINE SAND COLLAR
SIZE/TYPE 20/40 SILICA
QUANTITY USED 0.25 FT^3 CALC 0.33 FT^3

FILTER PACK SAND
SIZE/TYPE 10/20 SILICA
QUANTITY USED 5.25 FT^3 CALC 5.30 FT^3

HYDRATED BENTONITE SEAL
FORM ⅜-IN BENTONITE CHIP
QUANTITY USED 4.90 FT^3 CALC 4.62 FT^3

STAINLESS-STEEL CENTRALIZERS
USED YES
ABOVE AND BELOW SCREEN

WELL COMPLETION BEGAN
DATE 12/5/14 TIME 1302h
WELL COMPLETION FINISHED
DATE 12/9/14 TIME 1800h

Los Alamos NATIONAL LABORATORY EST. 1943

Drafted By: PTM
Date: December 18, 2014
File Name: CrCH-3_AsBuiltDiagram_FactSheet

Well CrCH-3 As-Built Well Construction Diagram
Technical Area 05 (TA-05)
Los Alamos National Laboratory
Los Alamos, New Mexico

Fact Sheet
NOT TO SCALE

TOTAL LENGTH
OF CASING AND SCREEN (FT) 1000.07

DEPTH TO WATER
FOLLOWING INSTALLATION (FT BGS) 950.3 *(3/4/15)*

DIAMETER OF BOREHOLE
24.00 (IN) FROM 0.0 TO 56.0 (FT BGS)
11.42 (IN) FROM 56.0 TO 754.8 (FT BGS)
6.00 (IN) FROM 754.8 TO 1047.0 (FT BGS)

ELEVATIONS (FT AMSL)
WELL CASING 6805.45
PROTECTIVE CASING 6806.02
GROUND SURFACE 6802.61
BRASS CAP (MARKER) 6802.61

SURFACE COMPLETION *(proposed)*
PROTECTIVE CASING
TYPE STEEL SIZE (IN) 16
PROTECTIVE POSTS INSTALLED YES
SURFACE SEAL AND PAD
CHECK FOR SETTLEMENT YES
PAD MATERIAL CONCRETE
REINFORCED WIRE MESH
PAD DIMENSIONS (FT) 10 (L) 10 (W) 0.75 (H)

SURFACE SEAL 3.0 TO 66.0 (FT BGS)

BENTONITE SEAL 66.0 TO 948.2 (FT BGS)

FINE SAND COLLAR 948.2 TO 951.8 (FT BGS)

FILTER PACK 951.8 TO 983.7 (FT BGS)

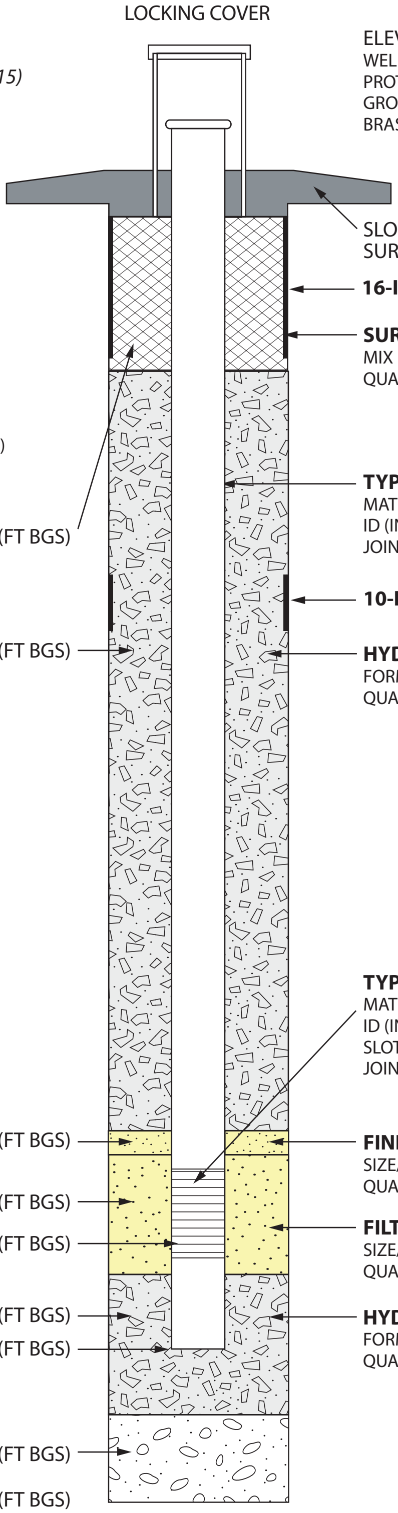
SCREENED INTERVAL 957.0 TO 977.0 (FT BGS)

BENTONITE SEAL 983.7 TO 1023.0 (FT BGS)

BOTTOM OF CASING 997.23 (FT BGS)

SLOUGH 1023.0 TO 1047.0 (FT BGS)

BOTTOM OF BORING 1047.0 (FT BGS)



16-IN CSG 0 TO 56 (FT BGS)

SURFACE SEAL
MIX (WT%) PORTLAND CEMENT 92 BENTONITE 8
QUANTITY USED 80.9 FT^3 CALC 85.9 FT^3

TYPE OF CASING
MATERIAL PASSIVATED A304 STAINLESS STEEL
ID (IN) 2.00
JOINT TYPE THREADED

10-IN CSG/SHOE 725.0 TO 730.0 (FT BGS)

HYDRATED BENTONITE SEAL
FORM ⅜-IN BENTONITE CHIP
QUANTITY USED 459.8 FT^3 CALC 500.1 FT^3

TYPE OF SCREEN(S)
MATERIAL A304 STAINLESS STEEL
ID (IN) 2.00
SLOT SIZE (IN) 0.040
JOINT TYPE THREADED

FINE SAND COLLAR
SIZE/TYPE 20/40 SILICA
QUANTITY USED 0.5 FT^3 CALC 0.6 FT^3

FILTER PACK SAND
SIZE/TYPE 10/20 SILICA
QUANTITY USED 7.0 FT^3 CALC 5.3 FT^3

HYDRATED BENTONITE SEAL
FORM ⅜-IN BENTONITE CHIP
QUANTITY USED 7.55 FT^3 CALC 7.18 FT^3

STAINLESS-STEEL CENTRALIZERS
USED YES
ABOVE AND BELOW SCREEN

WELL COMPLETION BEGAN
DATE 1/24/15 TIME 0815h
WELL COMPLETION FINISHED
DATE 3/13/15 TIME 0930h

Los Alamos
NATIONAL LABORATORY
EST. 1943

Drafted By: PTM
Date: April 16, 2015

Well CrCH-4 As-Built Well Construction Diagram
Technical Area 05 (TA-05)
Los Alamos National Laboratory
Los Alamos, New Mexico

Fact Sheet
NOT TO SCALE

TOTAL LENGTH
OF CASING AND SCREEN (FT) 1009.07

DEPTH TO WATER
FOLLOWING INSTALLATION (FT BGS) 967.9 *(3/24/15)*

DIAMETER OF BOREHOLE
24.00 (IN) FROM 0.0 TO 55.0 (FT BGS)
11.42 (IN) FROM 55.0 TO 750.0 (FT BGS)
6.00 (IN) FROM 750.0 TO 1016.0 (FT BGS)

SURFACE COMPLETION *(proposed)*
PROTECTIVE CASING
  TYPE STEEL SIZE (IN) 16
  PROTECTIVE POSTS INSTALLED YES
SURFACE SEAL AND PAD
  CHECK FOR SETTLEMENT YES
  PAD MATERIAL CONCRETE
  REINFORCED WIRE MESH
  PAD DIMENSIONS (FT) 10 (L) 10 (W) 0.75 (H)

SURFACE SEAL 3.0 TO 64.0 (FT BGS)

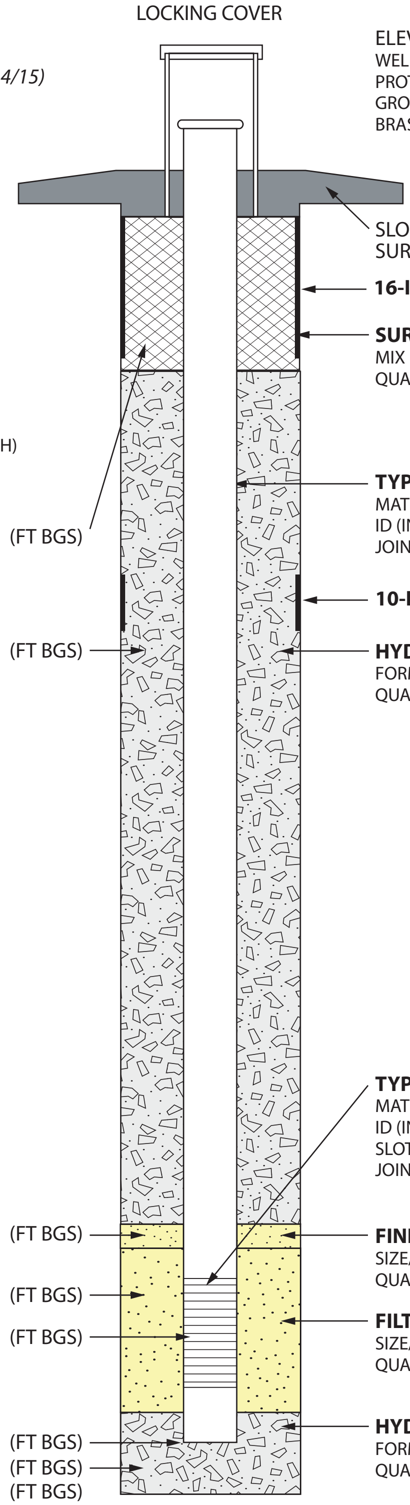
BENTONITE SEAL 64.0 TO 968.5 (FT BGS)

FINE SAND COLLAR 968.5 TO 970.5 (FT BGS)

FILTER PACK 970.5 TO 1001.0 (FT BGS)

SCREENED INTERVAL 976.0 TO 996.0 (FT BGS)

BOTTOM OF CASING 1006.2 (FT BGS)
BENTONITE 1001.0 TO 1016.0 (FT BGS)
BOTTOM OF BORING 1016.0 (FT BGS)



ELEVATIONS (FT AMSL)
WELL CASING 6805.45
PROTECTIVE CASING 6806.02
GROUND SURFACE 6802.58
BRASS CAP (MARKER) 6802.58

SLOPED CONCRETE PAD/
SURFACE SEAL

16-IN CSG 0 TO 55 (FT BGS)

SURFACE SEAL
MIX (WT%) PORTLAND CEMENT 92 BENTONITE 8
QUANTITY USED 82.0 FT^3 CALC 77.1 FT^3

TYPE OF CASING
MATERIAL PASSIVATED A304 STAINLESS STEEL
ID (IN) 2.00
JOINT TYPE THREADED

10-IN CSG/SHOE 526.0 TO 531.0 (FT BGS)

HYDRATED BENTONITE SEAL
FORM ⅜-IN BENTONITE CHIP
QUANTITY USED 448.7 FT^3 CALC 502.1 FT^3

TYPE OF SCREEN(S)
MATERIAL A304 STAINLESS STEEL
ID (IN) 2.00
SLOT SIZE (IN) 0.040
JOINT TYPE THREADED

FINE SAND COLLAR
SIZE/TYPE 20/40 SILICA
QUANTITY USED 1.0 FT^3 CALC 0.33 FT^3

FILTER PACK SAND
SIZE/TYPE 10/20 SILICA
QUANTITY USED 2.0 FT^3 CALC 5.0 FT^3

HYDRATED BENTONITE SEAL
FORM ⅜-IN BENTONITE CHIP
QUANTITY USED 1.4 FT^3 CALC 2.9 FT^3

STAINLESS-STEEL CENTRALIZERS
USED YES
ABOVE AND BELOW SCREEN

WELL COMPLETION BEGAN
DATE 2/11/15 TIME 0920h
WELL COMPLETION FINISHED
DATE 3/16/15 TIME 1300h

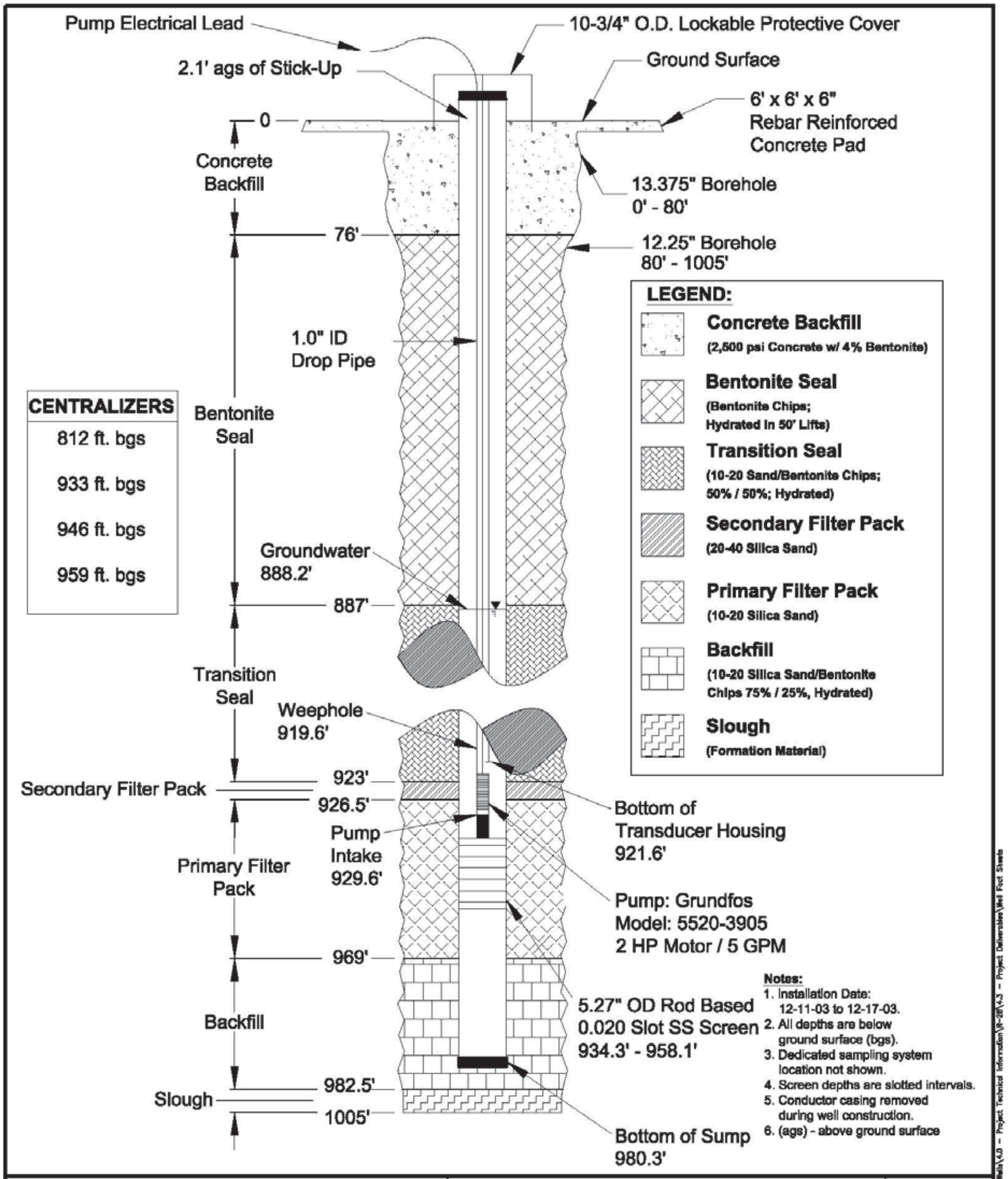
Los Alamos
NATIONAL LABORATORY
EST. 1943

Drafted By: PTM
Date: April 16, 2015

Well CrCH-5 As-Built Well Construction Diagram

Technical Area 05 (TA-05)
Los Alamos National Laboratory
Los Alamos, New Mexico

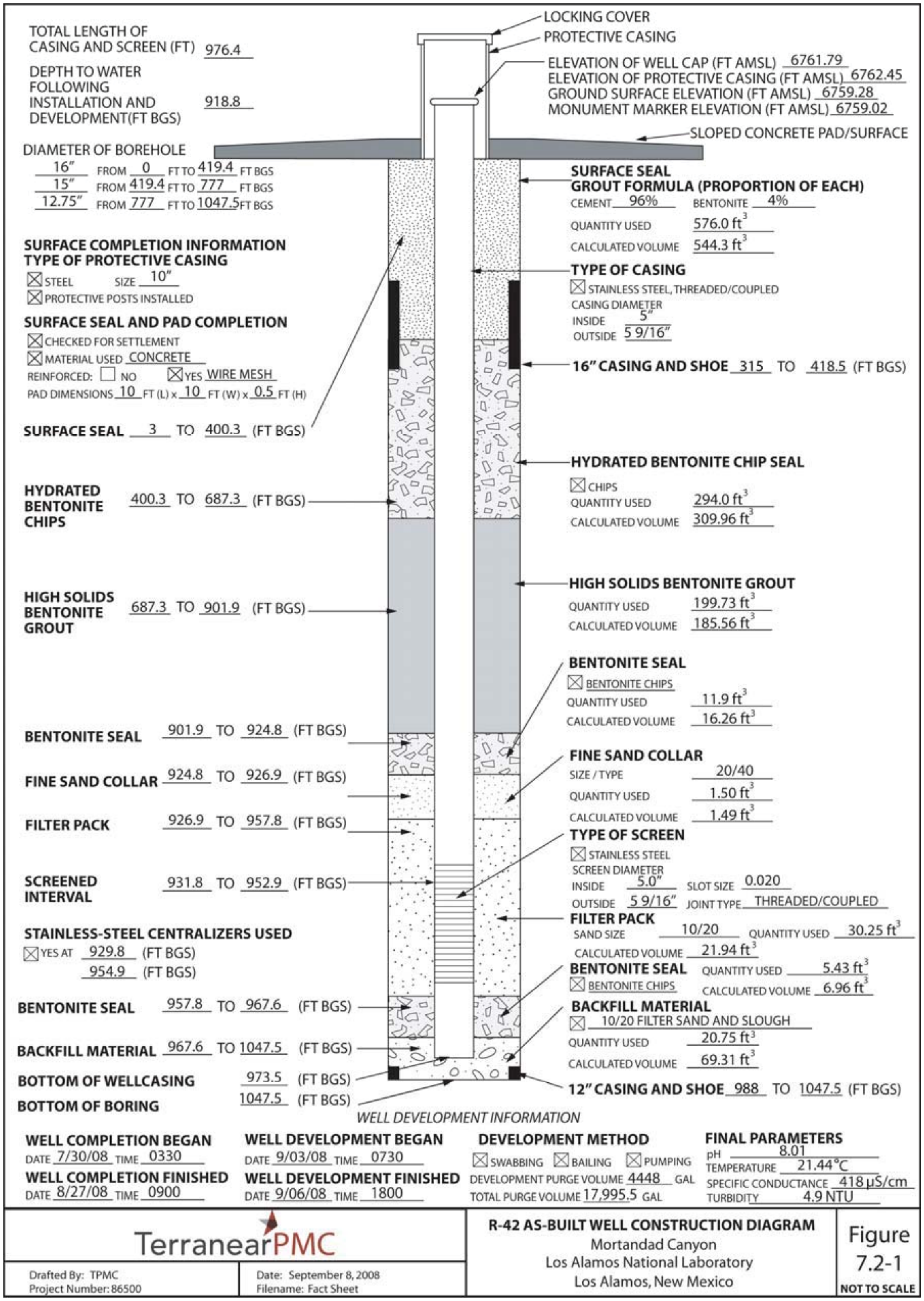
Fact Sheet
NOT TO SCALE



Notes:
1. Installation Date:
   12-11-03 to 12-17-03.
2. All depths are below
   ground surface (bgs).
3. Dedicated sampling system
   location not shown.
4. Screen depths are slotted intervals.
5. Conductor casing removed
   during well construction.
6. (ags) - above ground surface

L:\2003\Projects\37151 DOE Deep Wells\4.0 – Project Technical Information\R-28\4.3 – Project Deliverables\Well Fact Sheets

KLEINFELDER		Schematic Diagram of Well R-28 Los Alamos National Laboratory Los Alamos, New Mexico	FIGURE 7.2-1
Drawn By: C. Landon	Date: August 2004		
Project No.: 37151	Filename: Figure 7.2–1 Rev1		
Scale: Not–To–Scale	Revision: 1		
Reviewed By: B. Bockisch	Approved By: M. Everett		



TOTAL LENGTH OF CASING AND SCREEN (FT) 976.4

DEPTH TO WATER FOLLOWING INSTALLATION AND DEVELOPMENT(FT BGS) 918.8

ELEVATION OF WELL CAP (FT AMSL) 6761.79
ELEVATION OF PROTECTIVE CASING (FT AMSL) 6762.45
GROUND SURFACE ELEVATION (FT AMSL) 6759.28
MONUMENT MARKER ELEVATION (FT AMSL) 6759.02

DIAMETER OF BOREHOLE
16" FROM 0 FT TO 419.4 FT BGS
15" FROM 419.4 FT TO 777 FT BGS
12.75" FROM 777 FT TO 1047.5 FT BGS

SURFACE SEAL
GROUT FORMULA (PROPORTION OF EACH)
CEMENT 96% BENTONITE 4%
QUANTITY USED 576.0 ft^3
CALCULATED VOLUME 544.3 ft^3

SURFACE COMPLETION INFORMATION
TYPE OF PROTECTIVE CASING
☒ STEEL SIZE 10"
☒ PROTECTIVE POSTS INSTALLED

SURFACE SEAL AND PAD COMPLETION
☒ CHECKED FOR SETTLEMENT
☒ MATERIAL USED CONCRETE
REINFORCED: ☐ NO ☒ YES WIRE MESH
PAD DIMENSIONS 10 FT (L) x 10 FT (W) x 0.5 FT (H)

TYPE OF CASING
☒ STAINLESS STEEL, THREADED/COUPLED
CASING DIAMETER
INSIDE 5"
OUTSIDE 5 9/16"

16" CASING AND SHOE 315 TO 418.5 (FT BGS)

SURFACE SEAL 3 TO 400.3 (FT BGS)

HYDRATED BENTONITE CHIP SEAL
☒ CHIPS
QUANTITY USED 294.0 ft^3
CALCULATED VOLUME 309.96 ft^3

HYDRATED BENTONITE CHIPS 400.3 TO 687.3 (FT BGS)

HIGH SOLIDS BENTONITE GROUT
QUANTITY USED 199.73 ft^3
CALCULATED VOLUME 185.56 ft^3

HIGH SOLIDS BENTONITE GROUT 687.3 TO 901.9 (FT BGS)

BENTONITE SEAL
☒ BENTONITE CHIPS
QUANTITY USED 11.9 ft^3
CALCULATED VOLUME 16.26 ft^3

BENTONITE SEAL 901.9 TO 924.8 (FT BGS)

FINE SAND COLLAR
SIZE / TYPE 20/40
QUANTITY USED 1.50 ft^3
CALCULATED VOLUME 1.49 ft^3

FINE SAND COLLAR 924.8 TO 926.9 (FT BGS)

FILTER PACK 926.9 TO 957.8 (FT BGS)

TYPE OF SCREEN
☒ STAINLESS STEEL
SCREEN DIAMETER
INSIDE 5.0" SLOT SIZE 0.020
OUTSIDE 5 9/16" JOINT TYPE THREADED/COUPLED

SCREENED INTERVAL 931.8 TO 952.9 (FT BGS)

FILTER PACK
SAND SIZE 10/20 QUANTITY USED 30.25 ft^3
CALCULATED VOLUME 21.94 ft^3

STAINLESS-STEEL CENTRALIZERS USED
☒ YES AT 929.8 (FT BGS)
954.9 (FT BGS)

BENTONITE SEAL QUANTITY USED 5.43 ft^3
☒ BENTONITE CHIPS CALCULATED VOLUME 6.96 ft^3

BENTONITE SEAL 957.8 TO 967.6 (FT BGS)

BACKFILL MATERIAL
☒ 10/20 FILTER SAND AND SLOUGH
QUANTITY USED 20.75 ft^3
CALCULATED VOLUME 69.31 ft^3

BACKFILL MATERIAL 967.6 TO 1047.5 (FT BGS)

BOTTOM OF WELLCASING 973.5 (FT BGS)

BOTTOM OF BORING 1047.5 (FT BGS)

12" CASING AND SHOE 988 TO 1047.5 (FT BGS)

WELL COMPLETION BEGAN
DATE 7/30/08 TIME 0330
WELL COMPLETION FINISHED
DATE 8/27/08 TIME 0900

WELL DEVELOPMENT BEGAN
DATE 9/03/08 TIME 0730
WELL DEVELOPMENT FINISHED
DATE 9/06/08 TIME 1800

DEVELOPMENT METHOD
☒ SWABBING ☒ BAILING ☒ PUMPING
DEVELOPMENT PURGE VOLUME 4448 GAL
TOTAL PURGE VOLUME 17,995.5 GAL

FINAL PARAMETERS
pH 8.01
TEMPERATURE 21.44°C
SPECIFIC CONDUCTANCE 418 µS/cm
TURBIDITY 4.9 NTU

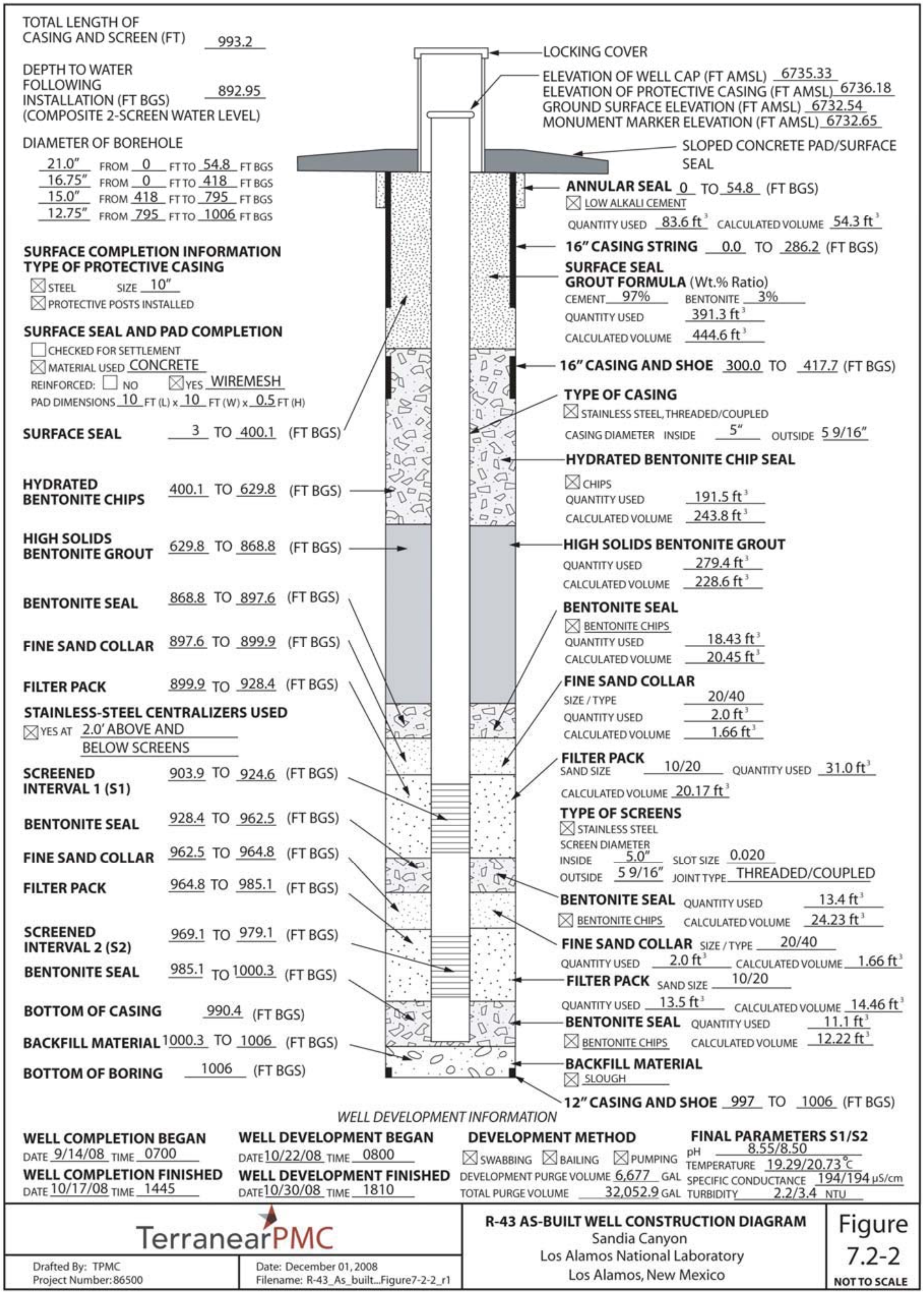
Drafted By: TPMC
Project Number: 86500

Date: September 8, 2008
Filename: Fact Sheet

R-42 AS-BUILT WELL CONSTRUCTION DIAGRAM
Mortandad Canyon
Los Alamos National Laboratory
Los Alamos, New Mexico

Figure
7.2-1
NOT TO SCALE

Figure 7.2-1 R-42 as-built well construction diagram



TOTAL LENGTH OF CASING AND SCREEN (FT) 993.2

DEPTH TO WATER FOLLOWING INSTALLATION (FT BGS) 892.95
(COMPOSITE 2-SCREEN WATER LEVEL)

DIAMETER OF BOREHOLE
21.0" FROM 0 FT TO 54.8 FT BGS
16.75" FROM 0 FT TO 418 FT BGS
15.0" FROM 418 FT TO 795 FT BGS
12.75" FROM 795 FT TO 1006 FT BGS

SURFACE COMPLETION INFORMATION
TYPE OF PROTECTIVE CASING
☒ STEEL SIZE 10"
☒ PROTECTIVE POSTS INSTALLED

SURFACE SEAL AND PAD COMPLETION
☐ CHECKED FOR SETTLEMENT
☒ MATERIAL USED CONCRETE
REINFORCED: ☐ NO ☒ YES WIREMESH
PAD DIMENSIONS 10 FT (L) x 10 FT (W) x 0.5 FT (H)

SURFACE SEAL 3 TO 400.1 (FT BGS)
HYDRATED BENTONITE CHIPS 400.1 TO 629.8 (FT BGS)
HIGH SOLIDS BENTONITE GROUT 629.8 TO 868.8 (FT BGS)
BENTONITE SEAL 868.8 TO 897.6 (FT BGS)
FINE SAND COLLAR 897.6 TO 899.9 (FT BGS)
FILTER PACK 899.9 TO 928.4 (FT BGS)

STAINLESS-STEEL CENTRALIZERS USED
☒ YES AT 2.0' ABOVE AND BELOW SCREENS

SCREENED INTERVAL 1 (S1) 903.9 TO 924.6 (FT BGS)
BENTONITE SEAL 928.4 TO 962.5 (FT BGS)
FINE SAND COLLAR 962.5 TO 964.8 (FT BGS)
FILTER PACK 964.8 TO 985.1 (FT BGS)
SCREENED INTERVAL 2 (S2) 969.1 TO 979.1 (FT BGS)
BENTONITE SEAL 985.1 TO 1000.3 (FT BGS)
BOTTOM OF CASING 990.4 (FT BGS)
BACKFILL MATERIAL 1000.3 TO 1006 (FT BGS)
BOTTOM OF BORING 1006 (FT BGS)

LOCKING COVER
ELEVATION OF WELL CAP (FT AMSL) 6735.33
ELEVATION OF PROTECTIVE CASING (FT AMSL) 6736.18
GROUND SURFACE ELEVATION (FT AMSL) 6732.54
MONUMENT MARKER ELEVATION (FT AMSL) 6732.65

SLOPED CONCRETE PAD/SURFACE SEAL

ANNULAR SEAL 0 TO 54.8 (FT BGS)
☒ LOW ALKALI CEMENT
QUANTITY USED 83.6 ft³ CALCULATED VOLUME 54.3 ft³

16" CASING STRING 0.0 TO 286.2 (FT BGS)

SURFACE SEAL
GROUT FORMULA (Wt.% Ratio)
CEMENT 97% BENTONITE 3%
QUANTITY USED 391.3 ft³
CALCULATED VOLUME 444.6 ft³

16" CASING AND SHOE 300.0 TO 417.7 (FT BGS)

TYPE OF CASING
☒ STAINLESS STEEL, THREADED/COUPLED
CASING DIAMETER INSIDE 5" OUTSIDE 5 9/16"

HYDRATED BENTONITE CHIP SEAL
☒ CHIPS
QUANTITY USED 191.5 ft³
CALCULATED VOLUME 243.8 ft³

HIGH SOLIDS BENTONITE GROUT
QUANTITY USED 279.4 ft³
CALCULATED VOLUME 228.6 ft³

BENTONITE SEAL
☒ BENTONITE CHIPS
QUANTITY USED 18.43 ft³
CALCULATED VOLUME 20.45 ft³

FINE SAND COLLAR
SIZE / TYPE 20/40
QUANTITY USED 2.0 ft³
CALCULATED VOLUME 1.66 ft³

FILTER PACK
SAND SIZE 10/20 QUANTITY USED 31.0 ft³
CALCULATED VOLUME 20.17 ft³

TYPE OF SCREENS
☒ STAINLESS STEEL
SCREEN DIAMETER
INSIDE 5.0" SLOT SIZE 0.020
OUTSIDE 5 9/16" JOINT TYPE THREADED/COUPLED

BENTONITE SEAL QUANTITY USED 13.4 ft³
☒ BENTONITE CHIPS CALCULATED VOLUME 24.23 ft³

FINE SAND COLLAR SIZE / TYPE 20/40
QUANTITY USED 2.0 ft³ CALCULATED VOLUME 1.66 ft³

FILTER PACK SAND SIZE 10/20
QUANTITY USED 13.5 ft³ CALCULATED VOLUME 14.46 ft³

BENTONITE SEAL QUANTITY USED 11.1 ft³
☒ BENTONITE CHIPS CALCULATED VOLUME 12.22 ft³

BACKFILL MATERIAL
☒ SLOUGH

12" CASING AND SHOE 997 TO 1006 (FT BGS)

WELL DEVELOPMENT INFORMATION

WELL COMPLETION BEGAN
DATE 9/14/08 TIME 0700
WELL COMPLETION FINISHED
DATE 10/17/08 TIME 1445

WELL DEVELOPMENT BEGAN
DATE 10/22/08 TIME 0800
WELL DEVELOPMENT FINISHED
DATE 10/30/08 TIME 1810

DEVELOPMENT METHOD
☒ SWABBING ☒ BAILING ☒ PUMPING
DEVELOPMENT PURGE VOLUME 6,677 GAL
TOTAL PURGE VOLUME 32,052.9 GAL

FINAL PARAMETERS S1/S2
pH 8.55/8.50
TEMPERATURE 19.29/20.73 °C
SPECIFIC CONDUCTANCE 194/194 µS/cm
TURBIDITY 2.2/3.4 NTU

TerranearPMC

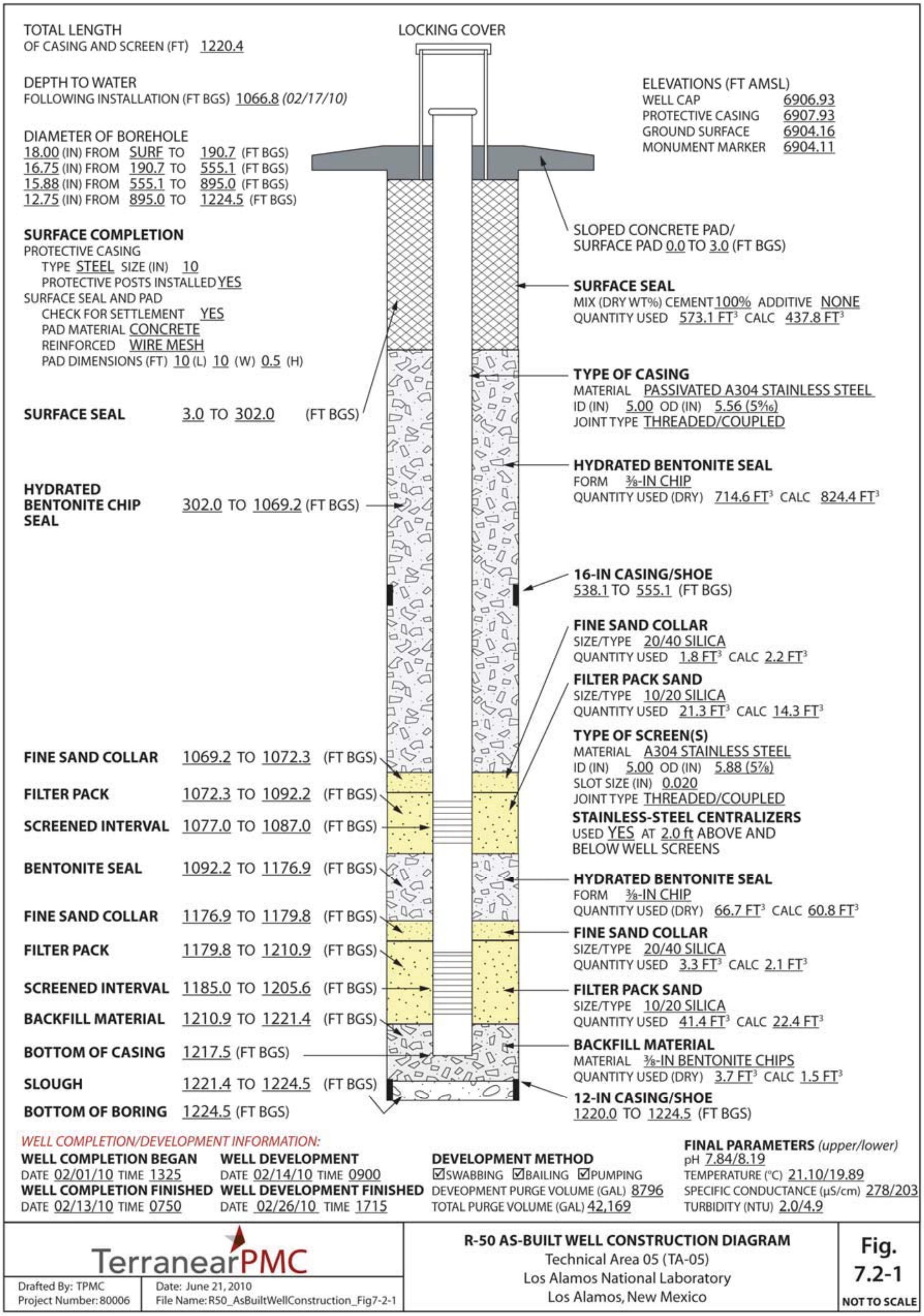
Drafted By: TPMC
Project Number: 86500

Date: December 01, 2008
Filename: R-43_As_built...Figure7-2-2_r1

R-43 AS-BUILT WELL CONSTRUCTION DIAGRAM
Sandia Canyon
Los Alamos National Laboratory
Los Alamos, New Mexico

Figure 7.2-2
NOT TO SCALE

Figure 7.2-2 R-43 As-built construction diagram



TOTAL LENGTH
OF CASING AND SCREEN (FT) 1220.4

DEPTH TO WATER
FOLLOWING INSTALLATION (FT BGS) 1066.8 *(02/17/10)*

DIAMETER OF BOREHOLE
18.00 (IN) FROM SURF TO 190.7 (FT BGS)
16.75 (IN) FROM 190.7 TO 555.1 (FT BGS)
15.88 (IN) FROM 555.1 TO 895.0 (FT BGS)
12.75 (IN) FROM 895.0 TO 1224.5 (FT BGS)

SURFACE COMPLETION
PROTECTIVE CASING
TYPE STEEL SIZE (IN) 10
PROTECTIVE POSTS INSTALLED YES
SURFACE SEAL AND PAD
CHECK FOR SETTLEMENT YES
PAD MATERIAL CONCRETE
REINFORCED WIRE MESH
PAD DIMENSIONS (FT) 10 (L) 10 (W) 0.5 (H)

SURFACE SEAL 3.0 TO 302.0 (FT BGS)

HYDRATED BENTONITE CHIP SEAL 302.0 TO 1069.2 (FT BGS)

FINE SAND COLLAR 1069.2 TO 1072.3 (FT BGS)
FILTER PACK 1072.3 TO 1092.2 (FT BGS)
SCREENED INTERVAL 1077.0 TO 1087.0 (FT BGS)
BENTONITE SEAL 1092.2 TO 1176.9 (FT BGS)
FINE SAND COLLAR 1176.9 TO 1179.8 (FT BGS)
FILTER PACK 1179.8 TO 1210.9 (FT BGS)
SCREENED INTERVAL 1185.0 TO 1205.6 (FT BGS)
BACKFILL MATERIAL 1210.9 TO 1221.4 (FT BGS)
BOTTOM OF CASING 1217.5 (FT BGS)
SLOUGH 1221.4 TO 1224.5 (FT BGS)
BOTTOM OF BORING 1224.5 (FT BGS)

ELEVATIONS (FT AMSL)
WELL CAP 6906.93
PROTECTIVE CASING 6907.93
GROUND SURFACE 6904.16
MONUMENT MARKER 6904.11

SURFACE SEAL
MIX (DRY WT%) CEMENT 100% ADDITIVE NONE
QUANTITY USED 573.1 FT^3 CALC 437.8 FT^3

TYPE OF CASING
MATERIAL PASSIVATED A304 STAINLESS STEEL
ID (IN) 5.00 OD (IN) 5.56 ($5\frac{9}{16}$)
JOINT TYPE THREADED/COUPLED

HYDRATED BENTONITE SEAL
FORM ⅜-IN CHIP
QUANTITY USED (DRY) 714.6 FT^3 CALC 824.4 FT^3

16-IN CASING/SHOE
538.1 TO 555.1 (FT BGS)

FINE SAND COLLAR
SIZE/TYPE 20/40 SILICA
QUANTITY USED 1.8 FT^3 CALC 2.2 FT^3

FILTER PACK SAND
SIZE/TYPE 10/20 SILICA
QUANTITY USED 21.3 FT^3 CALC 14.3 FT^3

TYPE OF SCREEN(S)
MATERIAL A304 STAINLESS STEEL
ID (IN) 5.00 OD (IN) 5.88 (5⅞)
SLOT SIZE (IN) 0.020
JOINT TYPE THREADED/COUPLED

STAINLESS-STEEL CENTRALIZERS
USED YES AT 2.0 ft ABOVE AND
BELOW WELL SCREENS

HYDRATED BENTONITE SEAL
FORM ⅜-IN CHIP
QUANTITY USED (DRY) 66.7 FT^3 CALC 60.8 FT^3

FINE SAND COLLAR
SIZE/TYPE 20/40 SILICA
QUANTITY USED 3.3 FT^3 CALC 2.1 FT^3

FILTER PACK SAND
SIZE/TYPE 10/20 SILICA
QUANTITY USED 41.4 FT^3 CALC 22.4 FT^3

BACKFILL MATERIAL
MATERIAL ⅜-IN BENTONITE CHIPS
QUANTITY USED (DRY) 3.7 FT^3 CALC 1.5 FT^3

12-IN CASING/SHOE
1220.0 TO 1224.5 (FT BGS)

WELL COMPLETION/DEVELOPMENT INFORMATION:

WELL COMPLETION BEGAN
DATE 02/01/10 TIME 1325
WELL COMPLETION FINISHED
DATE 02/13/10 TIME 0750

WELL DEVELOPMENT
DATE 02/14/10 TIME 0900
WELL DEVELOPMENT FINISHED
DATE 02/26/10 TIME 1715

DEVELOPMENT METHOD
☑SWABBING ☑BAILING ☑PUMPING
DEVEOPMENT PURGE VOLUME (GAL) 8796
TOTAL PURGE VOLUME (GAL) 42,169

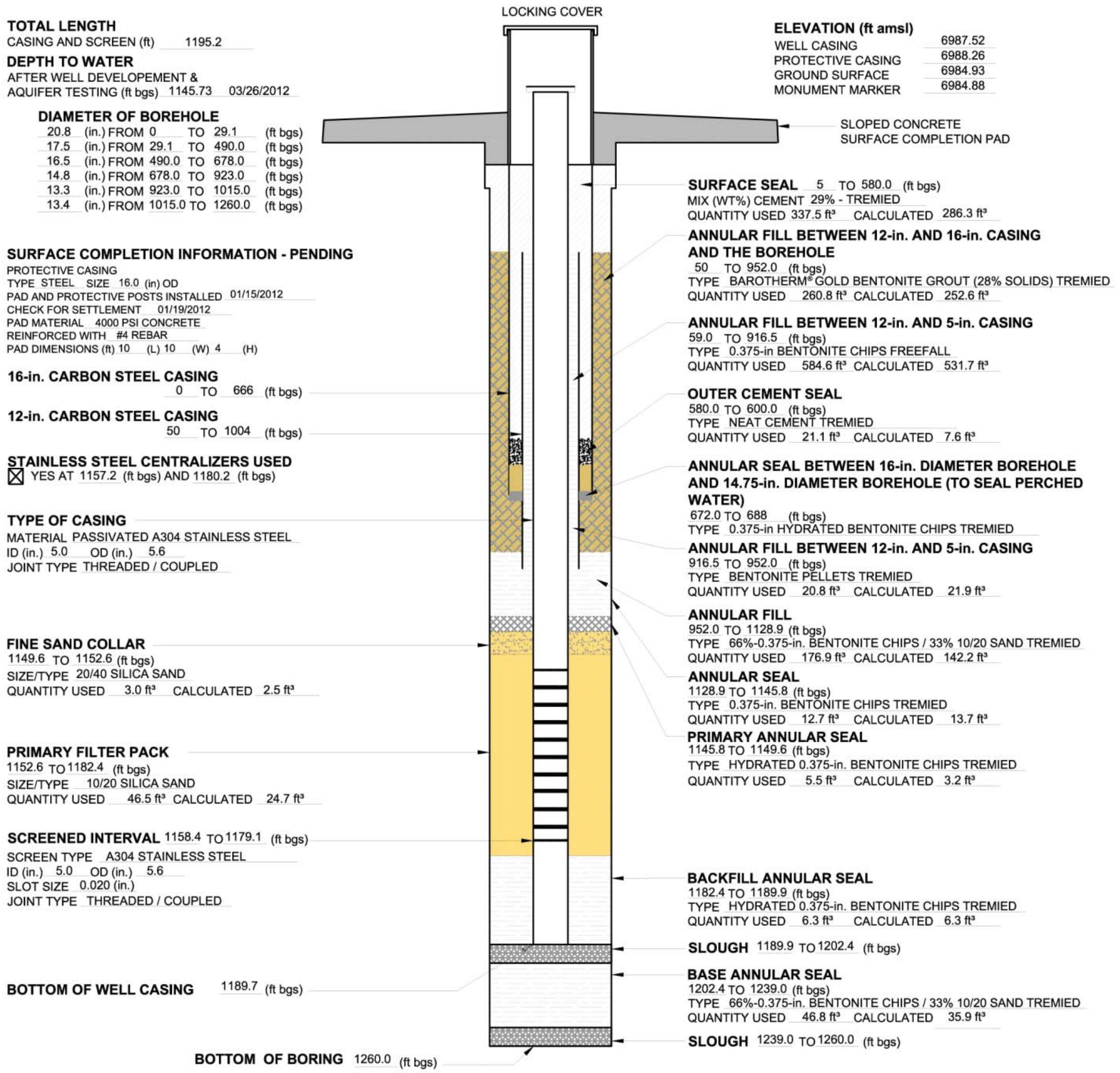
FINAL PARAMETERS *(upper/lower)*
pH 7.84/8.19
TEMPERATURE (°C) 21.10/19.89
SPECIFIC CONDUCTANCE (µS/cm) 278/203
TURBIDITY (NTU) 2.0/4.9

TerranearPMC
Drafted By: TPMC
Project Number: 80006
Date: June 21, 2010
File Name: R50_AsBuiltWellConstruction_Fig7-2-1

R-50 AS-BUILT WELL CONSTRUCTION DIAGRAM
Technical Area 05 (TA-05)
Los Alamos National Laboratory
Los Alamos, New Mexico

Fig. 7.2-1
NOT TO SCALE

Figure 7.2-1 Regional monitoring well R-50 as-built well construction diagram



TOTAL LENGTH
CASING AND SCREEN (ft) 1195.2

DEPTH TO WATER
AFTER WELL DEVELOPEMENT &
AQUIFER TESTING (ft bgs) 1145.73 03/26/2012

DIAMETER OF BOREHOLE
20.8 (in.) FROM 0 TO 29.1 (ft bgs)
17.5 (in.) FROM 29.1 TO 490.0 (ft bgs)
16.5 (in.) FROM 490.0 TO 678.0 (ft bgs)
14.8 (in.) FROM 678.0 TO 923.0 (ft bgs)
13.3 (in.) FROM 923.0 TO 1015.0 (ft bgs)
13.4 (in.) FROM 1015.0 TO 1260.0 (ft bgs)

SURFACE COMPLETION INFORMATION - PENDING
PROTECTIVE CASING
TYPE STEEL SIZE 16.0 (in) OD
PAD AND PROTECTIVE POSTS INSTALLED 01/15/2012
CHECK FOR SETTLEMENT 01/19/2012
PAD MATERIAL 4000 PSI CONCRETE
REINFORCED WITH #4 REBAR
PAD DIMENSIONS (ft) 10 (L) 10 (W) 4 (H)

16-in. CARBON STEEL CASING
0 TO 666 (ft bgs)

12-in. CARBON STEEL CASING
50 TO 1004 (ft bgs)

STAINLESS STEEL CENTRALIZERS USED
☒ YES AT 1157.2 (ft bgs) AND 1180.2 (ft bgs)

TYPE OF CASING
MATERIAL PASSIVATED A304 STAINLESS STEEL
ID (in.) 5.0 OD (in.) 5.6
JOINT TYPE THREADED / COUPLED

FINE SAND COLLAR
1149.6 TO 1152.6 (ft bgs)
SIZE/TYPE 20/40 SILICA SAND
QUANTITY USED 3.0 ft³ CALCULATED 2.5 ft³

PRIMARY FILTER PACK
1152.6 TO 1182.4 (ft bgs)
SIZE/TYPE 10/20 SILICA SAND
QUANTITY USED 46.5 ft³ CALCULATED 24.7 ft³

SCREENED INTERVAL 1158.4 TO 1179.1 (ft bgs)
SCREEN TYPE A304 STAINLESS STEEL
ID (in.) 5.0 OD (in.) 5.6
SLOT SIZE 0.020 (in.)
JOINT TYPE THREADED / COUPLED

BOTTOM OF WELL CASING 1189.7 (ft bgs)

BOTTOM OF BORING 1260.0 (ft bgs)

ELEVATION (ft amsl)
WELL CASING 6987.52
PROTECTIVE CASING 6988.26
GROUND SURFACE 6984.93
MONUMENT MARKER 6984.88

SURFACE SEAL 5 TO 580.0 (ft bgs)
MIX (WT%) CEMENT 29% - TREMIED
QUANTITY USED 337.5 ft³ CALCULATED 286.3 ft³

ANNULAR FILL BETWEEN 12-in. AND 16-in. CASING AND THE BOREHOLE
50 TO 952.0 (ft bgs)
TYPE BAROTHERM® GOLD BENTONITE GROUT (28% SOLIDS) TREMIED
QUANTITY USED 260.8 ft³ CALCULATED 252.6 ft³

ANNULAR FILL BETWEEN 12-in. AND 5-in. CASING
59.0 TO 916.5 (ft bgs)
TYPE 0.375-in BENTONITE CHIPS FREEFALL
QUANTITY USED 584.6 ft³ CALCULATED 531.7 ft³

OUTER CEMENT SEAL
580.0 TO 600.0 (ft bgs)
TYPE NEAT CEMENT TREMIED
QUANTITY USED 21.1 ft³ CALCULATED 7.6 ft³

ANNULAR SEAL BETWEEN 16-in. DIAMETER BOREHOLE AND 14.75-in. DIAMETER BOREHOLE (TO SEAL PERCHED WATER)
672.0 TO 688 (ft bgs)
TYPE 0.375-in HYDRATED BENTONITE CHIPS TREMIED

ANNULAR FILL BETWEEN 12-in. AND 5-in. CASING
916.5 TO 952.0 (ft bgs)
TYPE BENTONITE PELLETS TREMIED
QUANTITY USED 20.8 ft³ CALCULATED 21.9 ft³

ANNULAR FILL
952.0 TO 1128.9 (ft bgs)
TYPE 66%-0.375-in. BENTONITE CHIPS / 33% 10/20 SAND TREMIED
QUANTITY USED 176.9 ft³ CALCULATED 142.2 ft³

ANNULAR SEAL
1128.9 TO 1145.8 (ft bgs)
TYPE 0.375-in. BENTONITE CHIPS TREMIED
QUANTITY USED 12.7 ft³ CALCULATED 13.7 ft³

PRIMARY ANNULAR SEAL
1145.8 TO 1149.6 (ft bgs)
TYPE HYDRATED 0.375-in. BENTONITE CHIPS TREMIED
QUANTITY USED 5.5 ft³ CALCULATED 3.2 ft³

BACKFILL ANNULAR SEAL
1182.4 TO 1189.9 (ft bgs)
TYPE HYDRATED 0.375-in. BENTONITE CHIPS TREMIED
QUANTITY USED 6.3 ft³ CALCULATED 6.3 ft³

SLOUGH 1189.9 TO 1202.4 (ft bgs)

BASE ANNULAR SEAL
1202.4 TO 1239.0 (ft bgs)
TYPE 66%-0.375-in. BENTONITE CHIPS / 33% 10/20 SAND TREMIED
QUANTITY USED 46.8 ft³ CALCULATED 35.9 ft³

SLOUGH 1239.0 TO 1260.0 (ft bgs)

WELL DEVELOPMENT BEGAN
DATE 10/4/2011
TIME 13:40

WELL DEVELOPMENT FINISHED
DATE 03/14/2012
TIME 17:50

DEVELOPMENT METHOD
☒ SWABBING ☒ BAILING
☒ PUMPING
TOTAL PURGE VOLUME
40,501 gal.

FINAL PARAMETERS
pH 7.98
TEMPERATURE (°C) 19.86
SPECIFIC CONDUCTANCE (µS/cm) NR
TURBIDITY (NTU) 27.6

WELL COMPLETION BEGAN
DATE 9/1/2011 TIME 21:15

WELL COMPLETION FINISHED
DATE 10/3/2011 TIME 14:20

Figure 7.2-1 As-built construction diagram for well R-62

TOTAL LENGTH
OF CASING AND SCREEN (FT) __

DEPTH TO WATER
FOLLOWING INSTALLATION (FT BGS) 1225.4 (8/29/15)

DIAMETER OF BOREHOLE
16.00 (IN) FROM 0 TO 415 (FT BGS)
15.00 (IN) FROM 415 TO 555 (FT BGS)
12.75 (IN) FROM 555 TO 999 (FT BGS)
10.75 (IN) FROM 999 TO 1324.6 (FT BGS)

SURFACE COMPLETION
PROTECTIVE CASING
TYPE STEEL SIZE (IN) 16
PROTECTIVE POSTS INSTALLED __
SURFACE SEAL AND PAD
CHECK FOR SETTLEMENT __
PAD MATERIAL __
REINFORCED __
PAD DIMENSIONS (FT) 10 (L) 10 (W) 0.8 (H)

SURFACE SEAL 3.0 TO 60 (FT BGS)
SURFACE SEAL ____ TO ____ (FT BGS)

HYDRATED BENTONITE CHIP SEAL 60 TO 1236 (FT BGS)
HYDRATED BENTONITE CHIP SEAL ____ TO ____ (FT BGS)

FINE SAND COLLAR 1236 TO 1238 (FT BGS)
FINE SAND COLLAR ____ TO ____ (FT BGS)

FILTER PACK 1238 TO 1268.4 (FT BGS)
FILTER PACK ____ TO ____ (FT BGS)

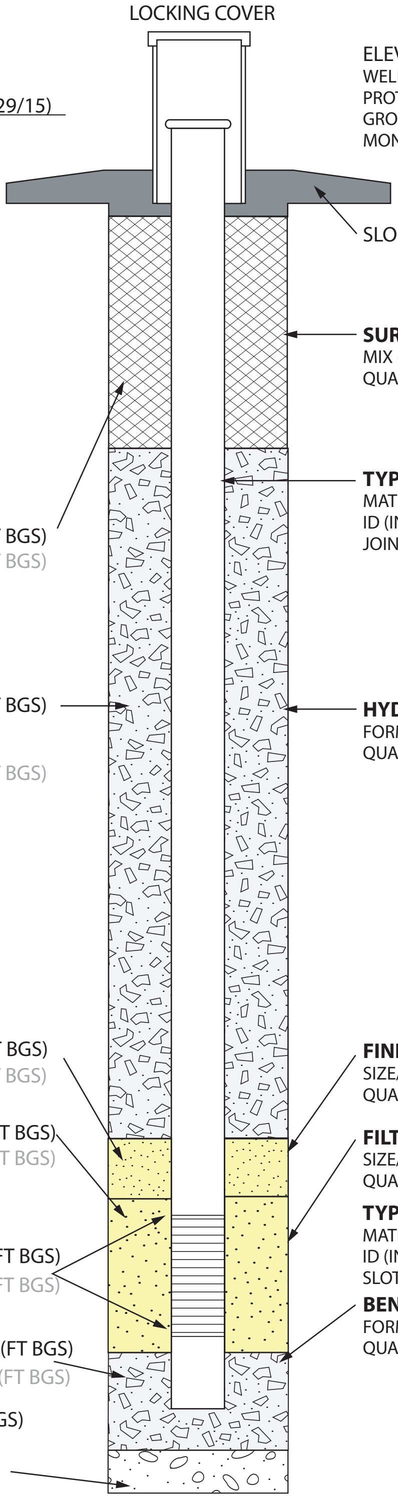
SCREENED INTERVAL 1243 TO 1263.4 (FT BGS)
SCREENED INTERVAL ____ TO ____ (FT BGS)

BENTONITE SEAL 1268.4 TO 1324.6 (FT BGS)
BENTONITE SEAL ____ TO ____ (FT BGS)

BOTTOM OF CASING 1273.7 (FT BGS)

SLOUGH __ TO __ (FT BGS)

BOTTOM OF BORING 1324.6



ELEVATIONS (FT AMSL)
WELL CAP TBD
PROTECTIVE CASING TBD
GROUND SURFACE TBD
MONUMENT MARKER TBD

SLOPED CONCRETE PAD/SURFACE

SURFACE SEAL
MIX (WT%) CEMENT ____ BENTONITE ____
QUANTITY USED ____ CALCULATED ____

TYPE OF CASING
MATERIAL STAINLESS-STEEL
ID (IN) 5.00 OD (IN) 5.56 (5 9⁄16)
JOINT TYPE ________

HYDRATED BENTONITE SEAL
FORM CHIP
QUANTITY USED _____ CALCULATED _____

FINE SAND COLLAR
SIZE/TYPE 20/40 SILICA
QUANTITY USED _____ CALCULATED _____

FILTER PACK SAND
SIZE/TYPE 10/20 SILICA
QUANTITY USED _____ CALCULATED _____

TYPE OF SCREEN
MATERIAL STAINLESS-STEEL
ID (IN) 5.00 OD (IN) 5.88 (5⅞)
SLOT SIZE (IN) 0.040 JOINT TYPE Beveled

BENTONITE SEAL
FORM CHIP
QUANTITY USED _____ CALCULATED _____

STAINLESS-STEEL CENTRALIZERS
USED 4 AT 2.0 ft ABOVE AND
BELOW WELL SCREENS

WELL COMPLETION BEGAN
DATE 8/27/15 TIME 0850
WELL COMPLETION FINISHED
DATE ________ TIME _____

PROPOSED WELL COMPLETION DEPTHS IN BLACK, ACTUAL DEPTHS IN GRAY

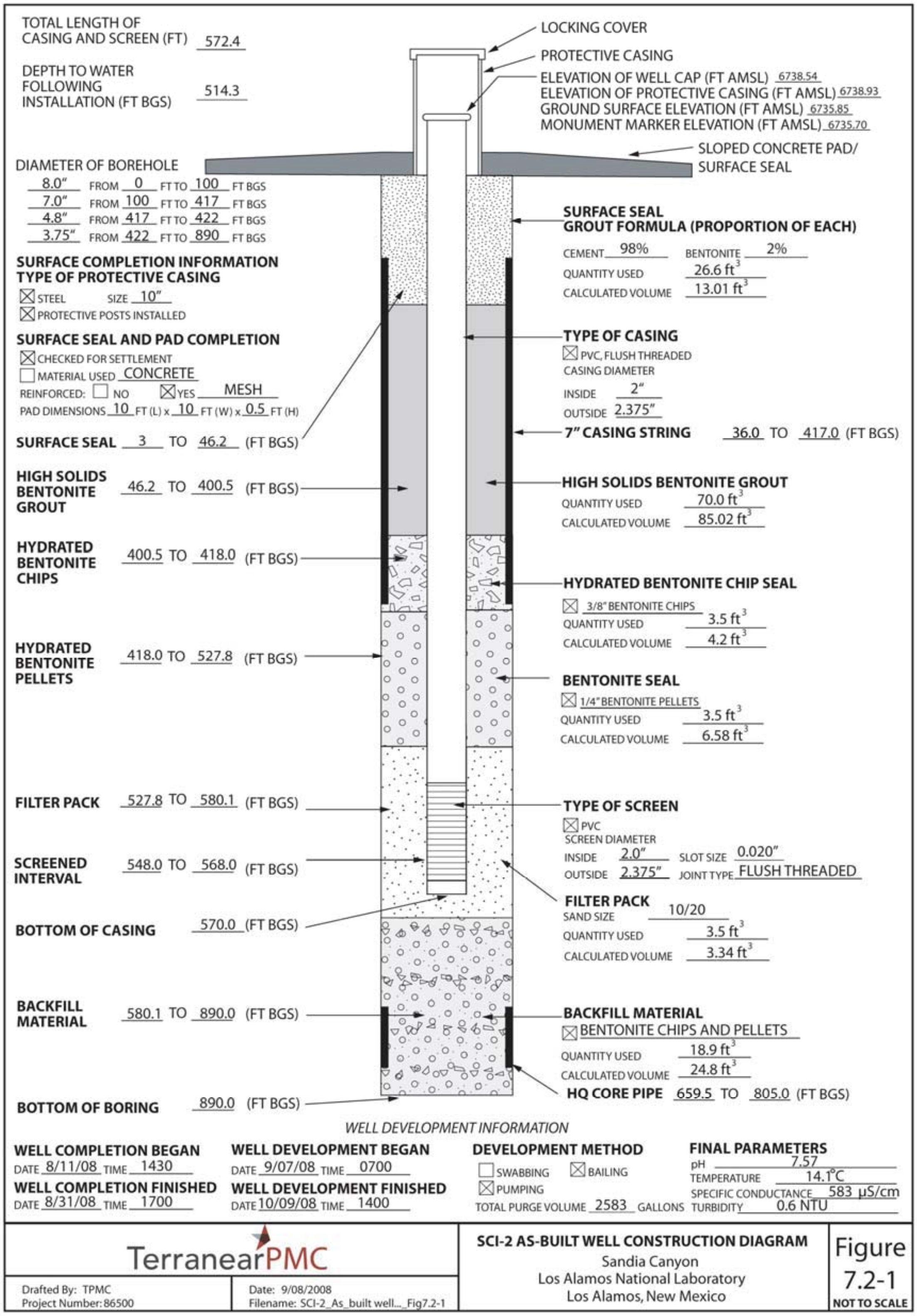
TerranearPMC

Drafted By: TPMC
Project Number: 86318
Date: August 30, 2015
File Name: R-67_ProposedWellDesign_Rev1

Proposed Well Design Characterization Well R-67
Technical Area 61 (TA-61)
Los Alamos National Laboratory
Los Alamos, New Mexico

Figure
R-67
Proposed
NOT TO SCALE

John Branch STR ADEP-CAP
Printed Name Signature Title Organization Date



TOTAL LENGTH OF CASING AND SCREEN (FT) 572.4

DEPTH TO WATER FOLLOWING INSTALLATION (FT BGS) 514.3

DIAMETER OF BOREHOLE
8.0" FROM 0 FT TO 100 FT BGS
7.0" FROM 100 FT TO 417 FT BGS
4.8" FROM 417 FT TO 422 FT BGS
3.75" FROM 422 FT TO 890 FT BGS

SURFACE COMPLETION INFORMATION
TYPE OF PROTECTIVE CASING
☒ STEEL SIZE 10"
☒ PROTECTIVE POSTS INSTALLED

SURFACE SEAL AND PAD COMPLETION
☒ CHECKED FOR SETTLEMENT
☐ MATERIAL USED CONCRETE
REINFORCED: ☐ NO ☒ YES MESH
PAD DIMENSIONS 10 FT (L) x 10 FT (W) x 0.5 FT (H)

SURFACE SEAL 3 TO 46.2 (FT BGS)

HIGH SOLIDS BENTONITE GROUT 46.2 TO 400.5 (FT BGS)

HYDRATED BENTONITE CHIPS 400.5 TO 418.0 (FT BGS)

HYDRATED BENTONITE PELLETS 418.0 TO 527.8 (FT BGS)

FILTER PACK 527.8 TO 580.1 (FT BGS)

SCREENED INTERVAL 548.0 TO 568.0 (FT BGS)

BOTTOM OF CASING 570.0 (FT BGS)

BACKFILL MATERIAL 580.1 TO 890.0 (FT BGS)

BOTTOM OF BORING 890.0 (FT BGS)

ELEVATION OF WELL CAP (FT AMSL) 6738.54
ELEVATION OF PROTECTIVE CASING (FT AMSL) 6738.93
GROUND SURFACE ELEVATION (FT AMSL) 6735.85
MONUMENT MARKER ELEVATION (FT AMSL) 6735.70

SURFACE SEAL
GROUT FORMULA (PROPORTION OF EACH)
CEMENT 98% BENTONITE 2%
QUANTITY USED 26.6 ft^3
CALCULATED VOLUME 13.01 ft^3

TYPE OF CASING
☒ PVC, FLUSH THREADED
CASING DIAMETER
INSIDE 2"
OUTSIDE 2.375"

7" CASING STRING 36.0 TO 417.0 (FT BGS)

HIGH SOLIDS BENTONITE GROUT
QUANTITY USED 70.0 ft^3
CALCULATED VOLUME 85.02 ft^3

HYDRATED BENTONITE CHIP SEAL
☒ 3/8" BENTONITE CHIPS
QUANTITY USED 3.5 ft^3
CALCULATED VOLUME 4.2 ft^3

BENTONITE SEAL
☒ 1/4" BENTONITE PELLETS
QUANTITY USED 3.5 ft^3
CALCULATED VOLUME 6.58 ft^3

TYPE OF SCREEN
☒ PVC
SCREEN DIAMETER
INSIDE 2.0" SLOT SIZE 0.020"
OUTSIDE 2.375" JOINT TYPE FLUSH THREADED

FILTER PACK
SAND SIZE 10/20
QUANTITY USED 3.5 ft^3
CALCULATED VOLUME 3.34 ft^3

BACKFILL MATERIAL
☒ BENTONITE CHIPS AND PELLETS
QUANTITY USED 18.9 ft^3
CALCULATED VOLUME 24.8 ft^3

HQ CORE PIPE 659.5 TO 805.0 (FT BGS)

WELL DEVELOPMENT INFORMATION

WELL COMPLETION BEGAN
DATE 8/11/08 TIME 1430
WELL COMPLETION FINISHED
DATE 8/31/08 TIME 1700

WELL DEVELOPMENT BEGAN
DATE 9/07/08 TIME 0700
WELL DEVELOPMENT FINISHED
DATE 10/09/08 TIME 1400

DEVELOPMENT METHOD
☐ SWABBING ☒ BAILING
☒ PUMPING
TOTAL PURGE VOLUME 2583 GALLONS

FINAL PARAMETERS
pH 7.57
TEMPERATURE 14.1°C
SPECIFIC CONDUCTANCE 583 µS/cm
TURBIDITY 0.6 NTU

TerranearPMC

Drafted By: TPMC
Project Number: 86500

Date: 9/08/2008
Filename: SCI-2_As_built well..._Fig7.2-1

SCI-2 AS-BUILT WELL CONSTRUCTION DIAGRAM
Sandia Canyon
Los Alamos National Laboratory
Los Alamos, New Mexico

Figure 7.2-1
NOT TO SCALE

Figure 7.2-1 SCI-2 As-built construction diagram

KLEINFELDER

Lithologic Log

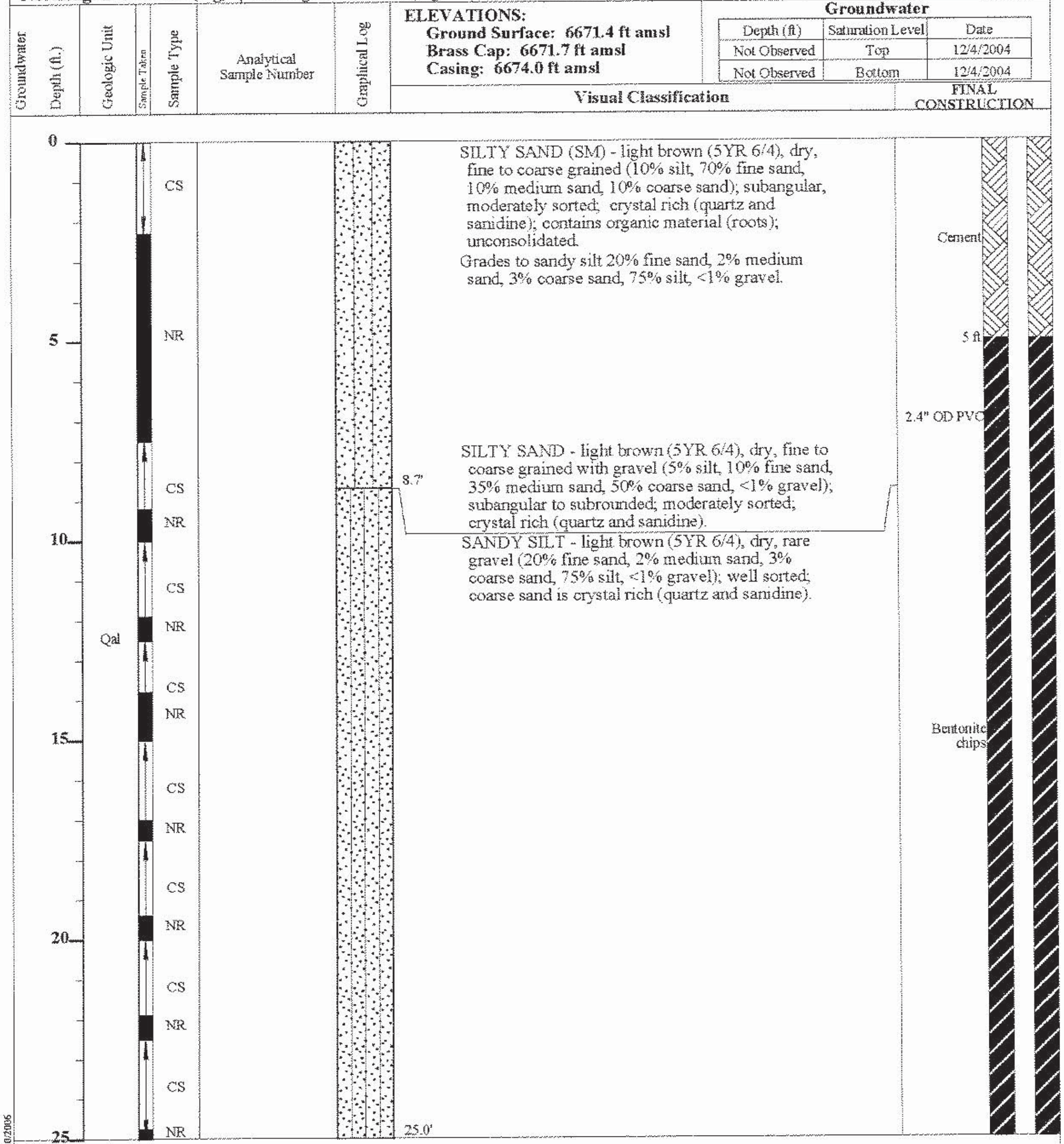
Sheet 1 of 5

Date Started: 12/3/2004
Date Completed: 12/4/2004
Project Number 49436
Project DOE - Mortandad Canyon Wells Program
Well No. MCA-9
Rig Type: CME 550
Logged By: J. Vaughn
TD Borehole: 115 ft
Northing: 1767392.67 (csg)
Easting: 1641471.83 (csg)
Location ID: None
TD Casing: 113 ft

ELEVATIONS:
Ground Surface: 6671.4 ft amsl
Brass Cap: 6671.7 ft amsl
Casing: 6674.0 ft amsl

Groundwater

Depth (ft)	Saturation Level	Date
Not Observed	Top	12/4/2004
Not Observed	Bottom	12/4/2004



SILTY SAND (SM) - light brown (5YR 6/4), dry, fine to coarse grained (10% silt, 70% fine sand, 10% medium sand, 10% coarse sand); subangular, moderately sorted; crystal rich (quartz and sanidine); contains organic material (roots); unconsolidated.

Grades to sandy silt 20% fine sand, 2% medium sand, 3% coarse sand, 75% silt, <1% gravel.

SILTY SAND - light brown (5YR 6/4), dry, fine to coarse grained with gravel (5% silt, 10% fine sand, 35% medium sand, 50% coarse sand, <1% gravel); subangular to subrounded; moderately sorted; crystal rich (quartz and sanidine).

SANDY SILT - light brown (5YR 6/4), dry, rare gravel (20% fine sand, 2% medium sand, 3% coarse sand, 75% silt, <1% gravel); well sorted; coarse sand is crystal rich (quartz and sanidine).

Notes:
All depths are in feet below ground surface.
All geologic contacts are preliminary and subject to change.
▼ - Top of saturation; ▽ - Bottom of saturation.
CS - Continuous Sampler; NR - No Recovery; OD - Outer Diameter; P & A - Plugged and Abandoned; TD - Total Depth
amsl - above mean sea level

Figure 2.10-1. Lithologic Log and Completion Information for MCA-9 (page 1 of 5)

KLEINFELDER

Lithologic Log

Sheet 2 of 5

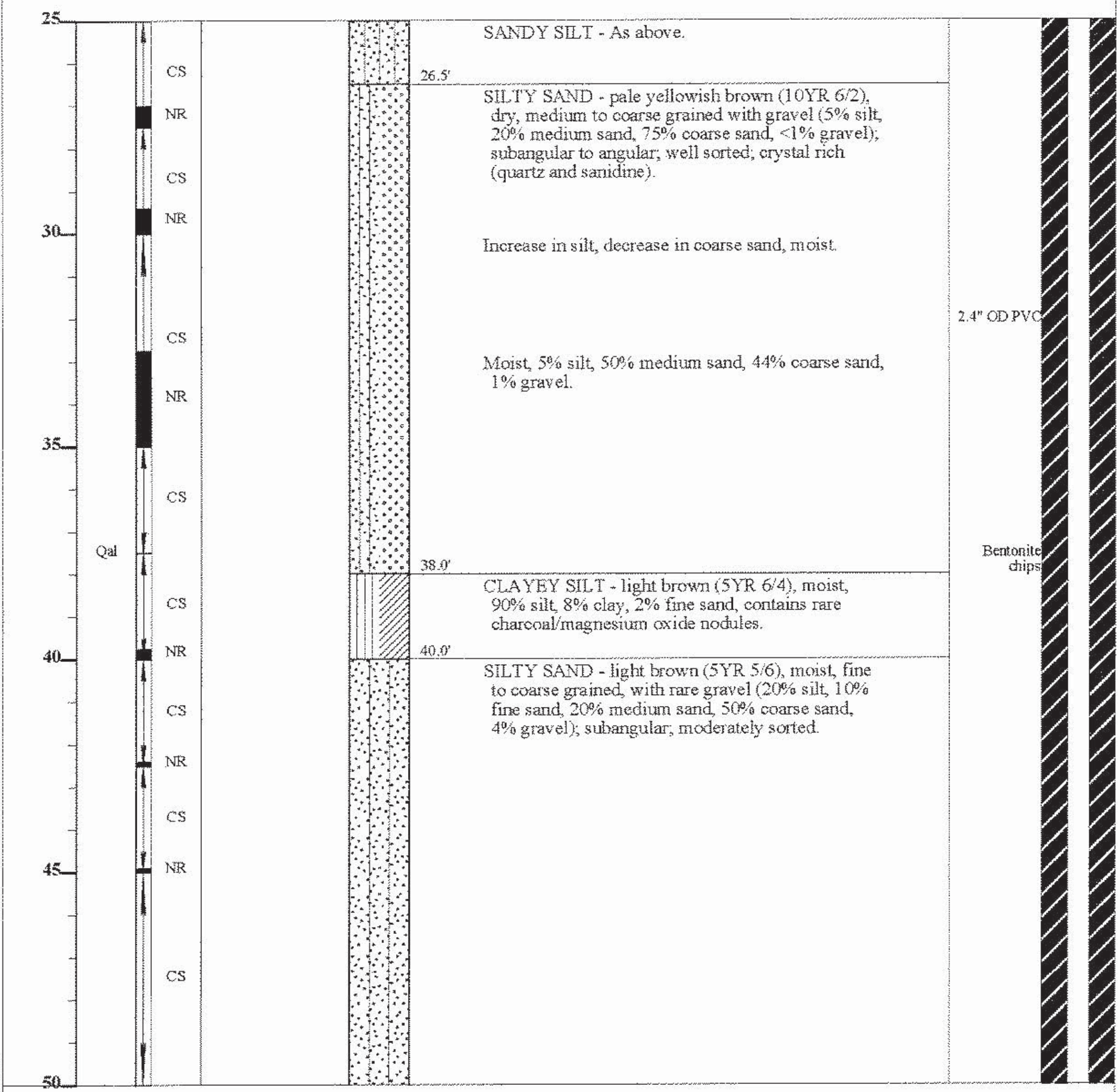
Date Started: 12/3/2004
Completed: 12/4/2004
Project Number 49436
Project DOE - Mortandad Canyon Wells Program
Well No. MCA-9
Rig Type: CME 550
Logged By: J. Vaughn
TD Borehole: 115 ft
Northing: 1767392.67 (csg)
Easting: 1641471.83 (csg)
Location ID: None
TD Casing: 113 ft

ELEVATIONS:
Ground Surface: 6671.4 ft amsl
Brass Cap: 6671.7 ft amsl
Casing: 6674.0 ft amsl

Groundwater

Depth (ft)	Saturation Level	Date
Not Observed	Top	12/4/2004
Not Observed	Bottom	12/4/2004

Groundwater | Depth (ft.) | Geologic Unit | Sample Taken | Sample Type | Analytical Sample Number | Graphical Log | **Visual Classification** | **FINAL CONSTRUCTION**



SANDY SILT - As above.

SILTY SAND - pale yellowish brown (10YR 6/2), dry, medium to coarse grained with gravel (5% silt, 20% medium sand, 75% coarse sand, <1% gravel); subangular to angular; well sorted; crystal rich (quartz and sanidine).

Increase in silt, decrease in coarse sand, moist.

Moist, 5% silt, 50% medium sand, 44% coarse sand, 1% gravel.

CLAYEY SILT - light brown (5YR 6/4), moist, 90% silt, 8% clay, 2% fine sand, contains rare charcoal/magnesium oxide nodules.

SILTY SAND - light brown (5YR 5/6), moist, fine to coarse grained, with rare gravel (20% silt, 10% fine sand, 20% medium sand, 50% coarse sand, 4% gravel); subangular; moderately sorted.

Notes:
All depths are in feet below ground surface.
All geologic contacts are preliminary and subject to change.
▼ - Top of saturation; ▽ - Bottom of saturation.
CS - Continuous Sampler; NR - No Recovery; OD - Outer Diameter; P & A - Plugged and Abandoned; TD - Total Depth
amsl - above mean sea level

Figure 2.10-1. Lithologic Log and Completion Information for MCA-9 (page 2 of 5)

KLEINFELDER

Lithologic Log

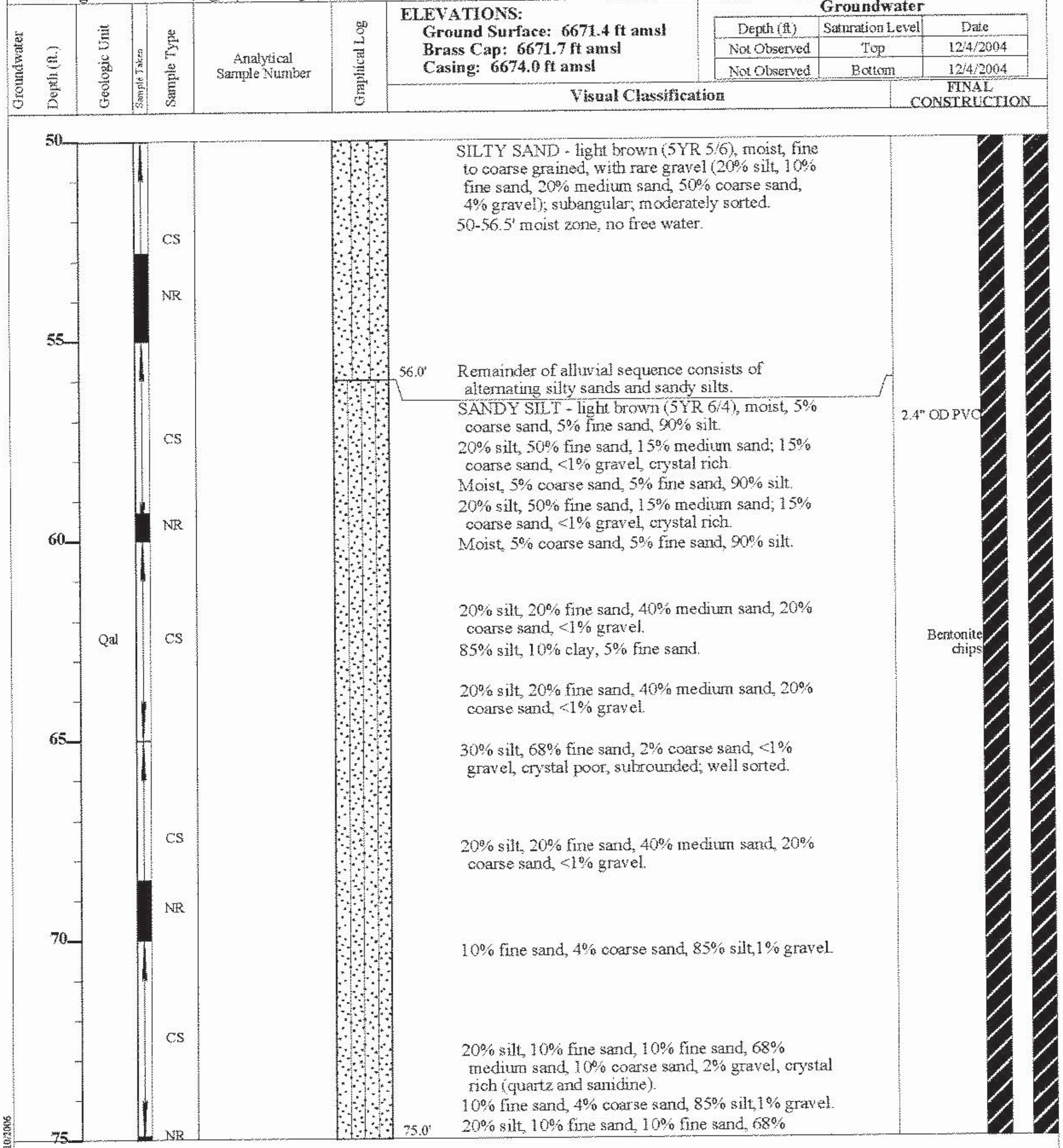
Sheet 3 of 5

Date Started: 12/3/2004 Completed: 12/4/2004	**Project Number** 49436	**Project** DOE - Mortandad Canyon Wells Program	**Well No.** MCA-9
	Rig Type: CME 550	**Logged By: J. Vaughn**	**TD Borehole: 115 ft**
Northing: 1767392.67 (csg)	**Easting: 1641471.83 (csg)**	**Location ID: None**	**TD Casing: 113 ft**

ELEVATIONS:
Ground Surface: 6671.4 ft amsl
Brass Cap: 6671.7 ft amsl
Casing: 6674.0 ft amsl

Groundwater

Depth (ft)	Saturation Level	Date
Not Observed	Top	12/4/2004
Not Observed	Bottom	12/4/2004



SILTY SAND - light brown (5YR 5/6), moist, fine to coarse grained, with rare gravel (20% silt, 10% fine sand, 20% medium sand, 50% coarse sand, 4% gravel); subangular; moderately sorted.

50-56.5' moist zone, no free water.

Remainder of alluvial sequence consists of alternating silty sands and sandy silts.

SANDY SILT - light brown (5YR 6/4), moist, 5% coarse sand, 5% fine sand, 90% silt.

20% silt, 50% fine sand, 15% medium sand; 15% coarse sand, <1% gravel, crystal rich.

Moist, 5% coarse sand, 5% fine sand, 90% silt.

20% silt, 50% fine sand, 15% medium sand; 15% coarse sand, <1% gravel, crystal rich.

Moist, 5% coarse sand, 5% fine sand, 90% silt.

20% silt, 20% fine sand, 40% medium sand, 20% coarse sand, <1% gravel.

85% silt, 10% clay, 5% fine sand.

20% silt, 20% fine sand, 40% medium sand, 20% coarse sand, <1% gravel.

30% silt, 68% fine sand, 2% coarse sand, <1% gravel, crystal poor, subrounded; well sorted.

20% silt, 20% fine sand, 40% medium sand, 20% coarse sand, <1% gravel.

10% fine sand, 4% coarse sand, 85% silt,1% gravel.

20% silt, 10% fine sand, 10% fine sand, 68% medium sand, 10% coarse sand, 2% gravel, crystal rich (quartz and sanidine).

10% fine sand, 4% coarse sand, 85% silt,1% gravel.

20% silt, 10% fine sand, 10% fine sand, 68%

Notes:
All depths are in feet below ground surface.
All geologic contacts are preliminary and subject to change.
▼ - Top of saturation; ▽ - Bottom of saturation.
CS - Continuous Sampler; NR - No Recovery; OD - Outer Diameter; P & A - Plugged and Abandoned; TD - Total Depth
amsl - above mean sea level

Figure 2.10-1. Lithologic Log and Completion Information for MCA-9 (page 3 of 5)

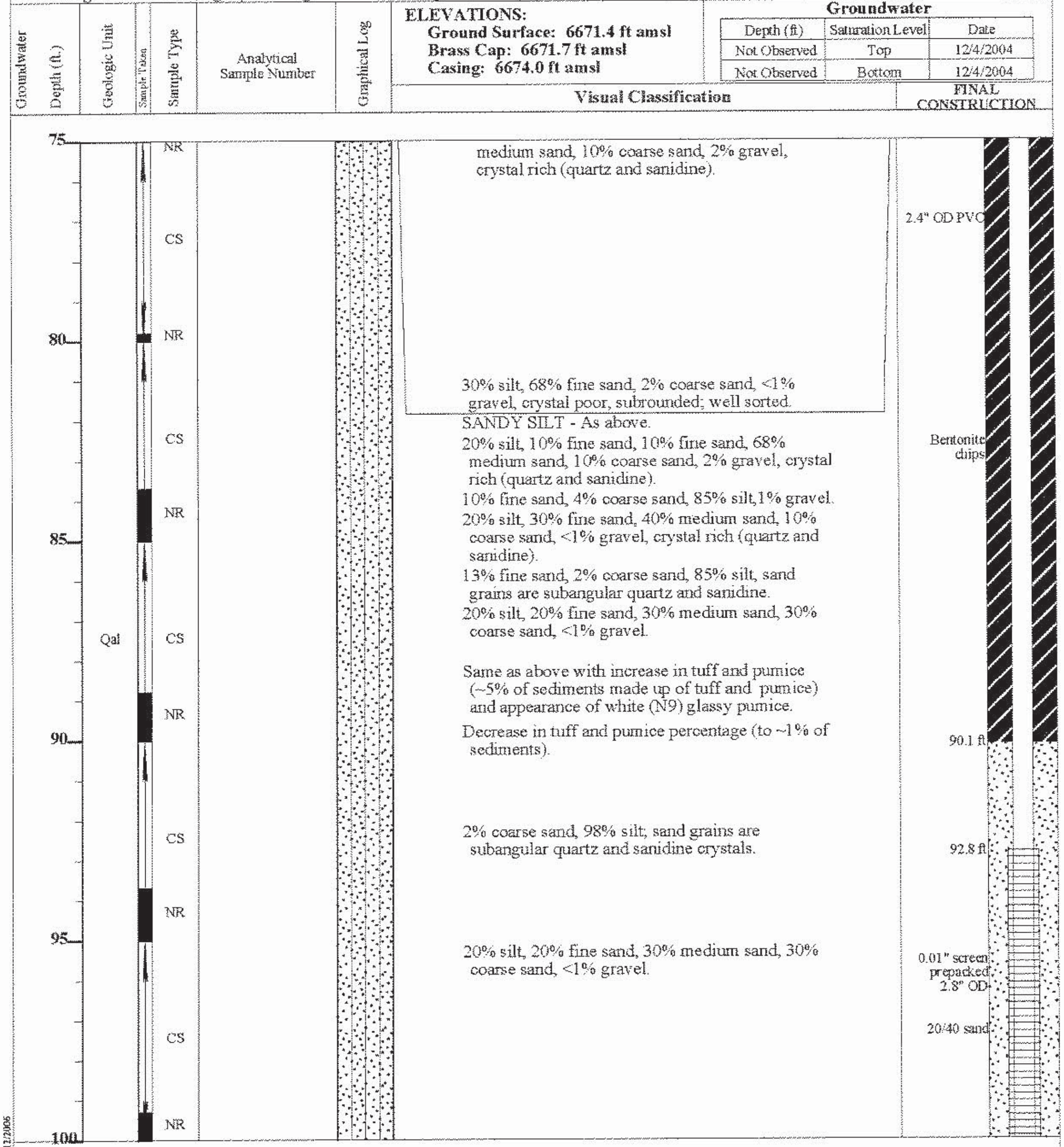
KLEINFELDER **Lithologic Log** **Sheet 4 of 5**

Date **Started: 12/3/2004**
Completed: 12/4/2004
Project Number 49436
Project DOE - Mortandad Canyon Wells Program
Well No. MCA-9
Rig Type: CME 550
Logged By: J. Vaughn
TD Borehole: 115 ft
Northing: 1767392.67 (csg)
Easting: 1641471.83 (csg)
Location ID: None
TD Casing: 113 ft

ELEVATIONS:
Ground Surface: 6671.4 ft amsl
Brass Cap: 6671.7 ft amsl
Casing: 6674.0 ft amsl

Groundwater

Depth (ft)	Saturation Level	Date
Not Observed	Top	12/4/2004
Not Observed	Bottom	12/4/2004



medium sand, 10% coarse sand, 2% gravel, crystal rich (quartz and sanidine).

30% silt, 68% fine sand, 2% coarse sand, <1% gravel, crystal poor, subrounded; well sorted.

SANDY SILT - As above.

20% silt, 10% fine sand, 10% fine sand, 68% medium sand, 10% coarse sand, 2% gravel, crystal rich (quartz and sanidine).

10% fine sand, 4% coarse sand, 85% silt,1% gravel.

20% silt, 30% fine sand, 40% medium sand, 10% coarse sand, <1% gravel, crystal rich (quartz and sanidine).

13% fine sand, 2% coarse sand, 85% silt, sand grains are subangular quartz and sanidine.

20% silt, 20% fine sand, 30% medium sand, 30% coarse sand, <1% gravel.

Same as above with increase in tuff and pumice (~5% of sediments made up of tuff and pumice) and appearance of white (N9) glassy pumice.

Decrease in tuff and pumice percentage (to ~1% of sediments).

2% coarse sand, 98% silt; sand grains are subangular quartz and sanidine crystals.

20% silt, 20% fine sand, 30% medium sand, 30% coarse sand, <1% gravel.

Notes:
All depths are in feet below ground surface.
All geologic contacts are preliminary and subject to change.
▼ - Top of saturation; ▽ - Bottom of saturation.
CS - Continuous Sampler; NR - No Recovery; OD - Outer Diameter; P & A - Plugged and Abandoned; TD - Total Depth
amsl - above mean sea level

Figure 2.10-1. Lithologic Log and Completion Information for MCA-9 (page 4 of 5)

KLEINFELDER **Lithologic Log** **Sheet 5 of 5**

Date
Started: 12/3/2004
Completed: 12/4/2004

Project Number
49436

Project
DOE - Mortandad Canyon Wells Program

Well No.
MCA-9

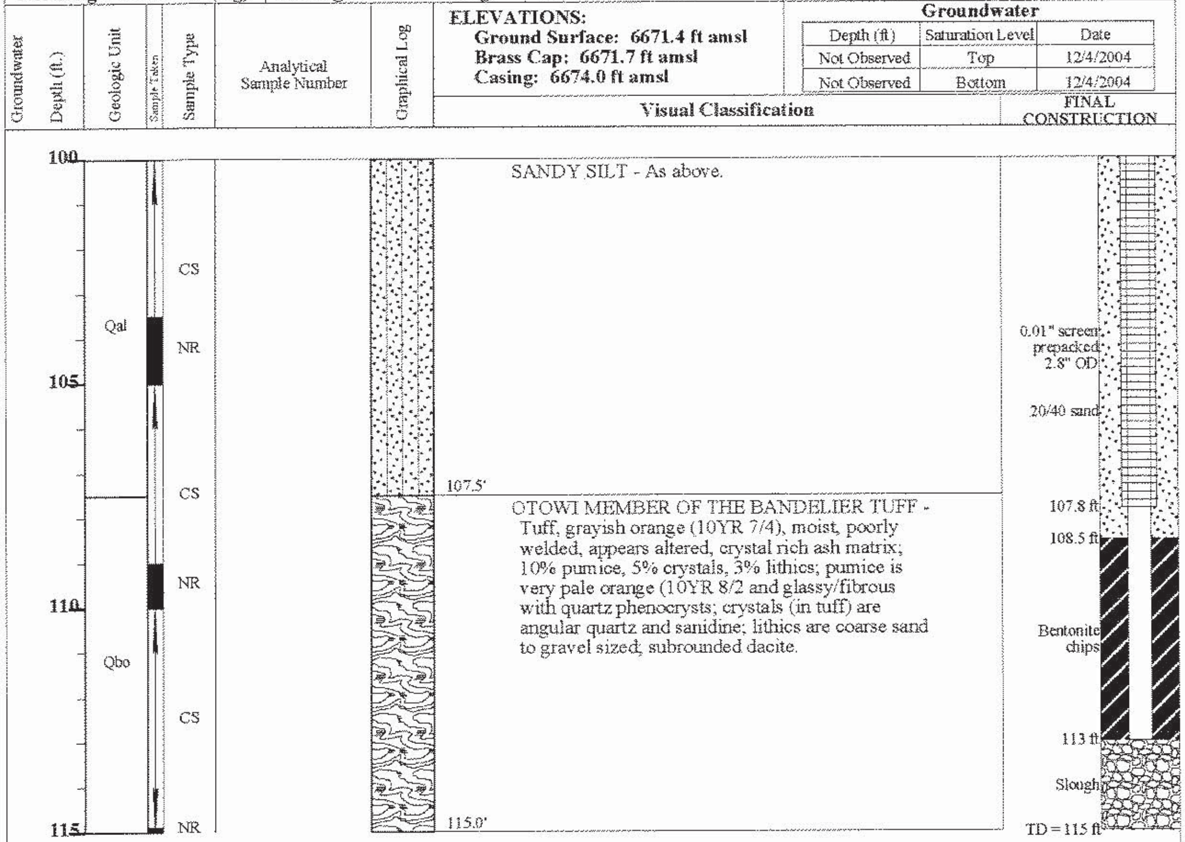
Rig Type: CME 550
Logged By: J. Vaughn
TD Borehole: 115 ft

Northing: 1767392.67 (csg)
Easting: 1641471.83 (csg)
Location ID: None
TD Casing: 113 ft

ELEVATIONS:
Ground Surface: 6671.4 ft amsl
Brass Cap: 6671.7 ft amsl
Casing: 6674.0 ft amsl

Groundwater

Depth (ft)	Saturation Level	Date
Not Observed	Top	12/4/2004
Not Observed	Bottom	12/4/2004



SANDY SILT - As above.

OTOWI MEMBER OF THE BANDELIER TUFF - Tuff, grayish orange (10YR 7/4), moist, poorly welded, appears altered, crystal rich ash matrix; 10% pumice, 5% crystals, 3% lithics; pumice is very pale orange (10YR 8/2 and glassy/fibrous with quartz phenocrysts; crystals (in tuff) are angular quartz and sanidine; lithics are coarse sand to gravel sized; subrounded dacite.

Notes:
All depths are in feet below ground surface.
All geologic contacts are preliminary and subject to change.
▼ - Top of saturation; ▽ - Bottom of saturation.
CS - Continuous Sampler; NR - No Recovery; OD - Outer Diameter; P & A - Plugged and Abandoned; TD - Total Depth
amsl - above mean sea level

Figure 2.10-1. Lithologic Log and Completion Information for MCA-9 (page 5 of 5)

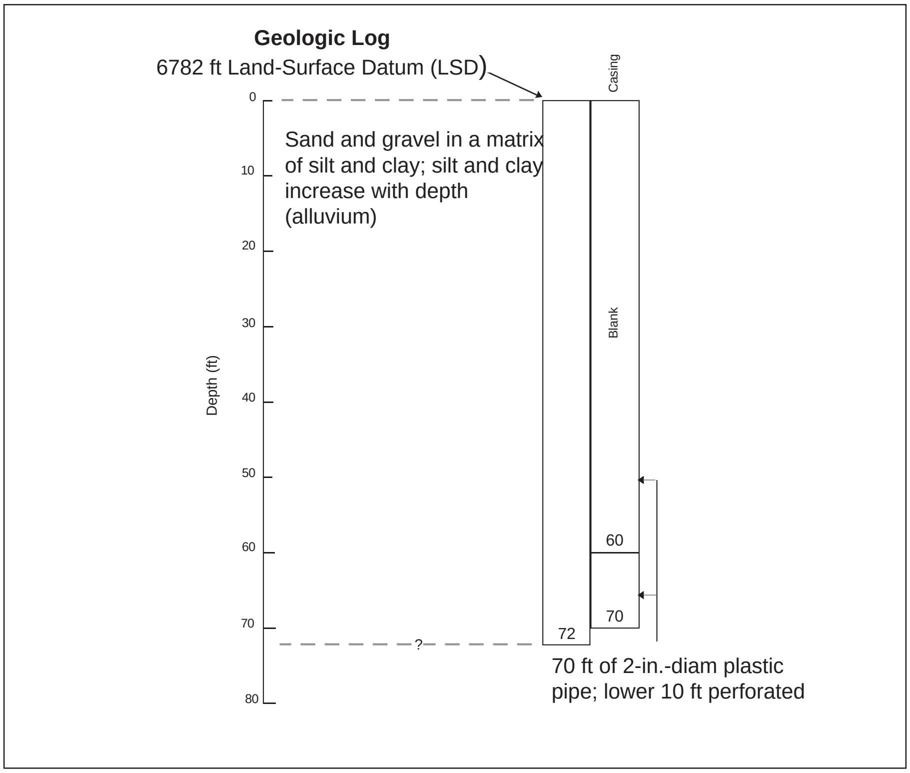


Fig. VI-O. Mortandad Canyon observation well MCO-8.2, completed November 1961, water level 59.2 ft (Purtymun 1964).

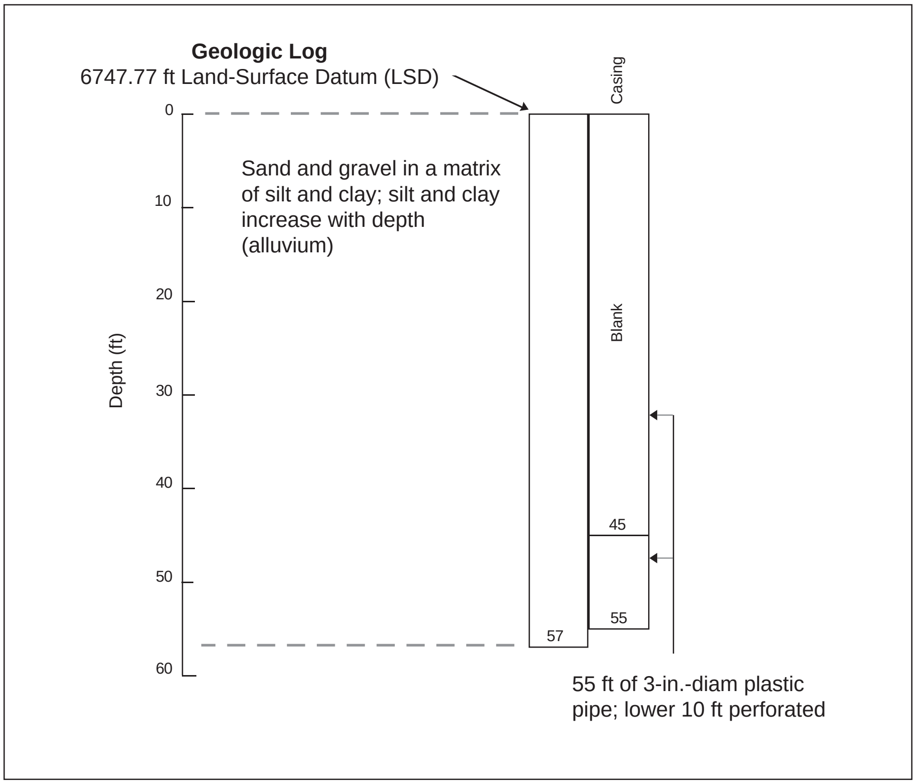


Fig. VI-P. Mortandad Canyon observation well MCO-9, completed November 1961, dry (Purtymun 1964).

TABLE VI-A. Hydrologic Data for Observation Wells in Mortandad Canyon

					Water Levels					
Observation Wells	Date Completed	Depth Drilled (ft)	Depth Completed (ft)	Depth 1991	At Completion (ft)	At Present Date	(ft)	Elevation Land-Surface Datum (LSD) (ft)	Top of Casing (Measuring Point) to Land Surface Datum	Remarks
MCO-1	11/60	8	8	—	2.8	—	—	7153	—	Unable to locate in 1991
MCO-2	11/60	10	9	7.5	0.3	4/91	5.06	7133	2.00	
MCO-3	3/67	18	12	10.1	4.4	4/91	3.36	7052.72	1.54	Originally drilled 11/60; redrilled and cased 3/67
MCO-4	10/63	24	19	16.3	3.3	4/91	7.19	6900.36	1.02	
MCO-4.9	7/73	42	30	23.4	—	4/91	22.10	6879.31	1.25	
MCO-5	10/60	47	46	44.9	24.6	2/91	20.75	6875.80	1.95	
MCO-6	10/60	82	71	—	38.1	—	—	6849	—	Plugged and abandoned (relocated)
MCO-6	3/74	47	47	41.5	28.9	2/91	33.75	6848.96	2.34	
MCO-6.5A	11/61	47	45	33.3	41.0	2/91	Dry	6840	2.15	
MCO-6.5B	11/61	42	42	36.0	36.3	2/91	Dry	6839	0.70	
MCO-7	10/60	77	69	54.7	39.7	2/91	37.47	6827.40	1.24	
MCO-7.5A	11/61	63	60	—	41.2	—	—	6809	—	Well damaged (relocated)
MCO-7.5B	4/74	62	60	56.0	42.1	2/91	43.71	6808.80	1.28	
MCO-8	10/60	92	84	22.7	61.6		—	6796.70	0.25	Obstruction in well
MCO-8A	11/61	52	50	48.5	Dry	2/91	Dry	6800	0.61	
MCO-8.2	11/61	72	70	60.3	59.2	2/91	Dry	6782	2.00	
MCO-9	11/60	57	55	54.6	Dry	2/91	Dry	6747.77	1.44	
MCO-9.5	11/61	57	46	40.3	Dry	2/91	Dry	6740	2.00	
MCO-11	11/61	23	20	—	Dry	—	—	6720	—	Unable to locate in 1991
MCO-12	11/61	64	60	—	Dry	—	—	6700	—	Casing pulled; hole plugged (relocated)
MCO-12	6/71	112	108	96.2	Dry	2/91	Dry	6702	0.62	
MCO-13	7/70	112	107	106.2	Dry	2/91	Dry	6674	0.67	
TSCO-1	11/61	37	35	23.1	Dry	2/91	8.93	6857	0.97	

Sources: Baltz et al. 1963; Purtymun 1964, 1971, and 1974.

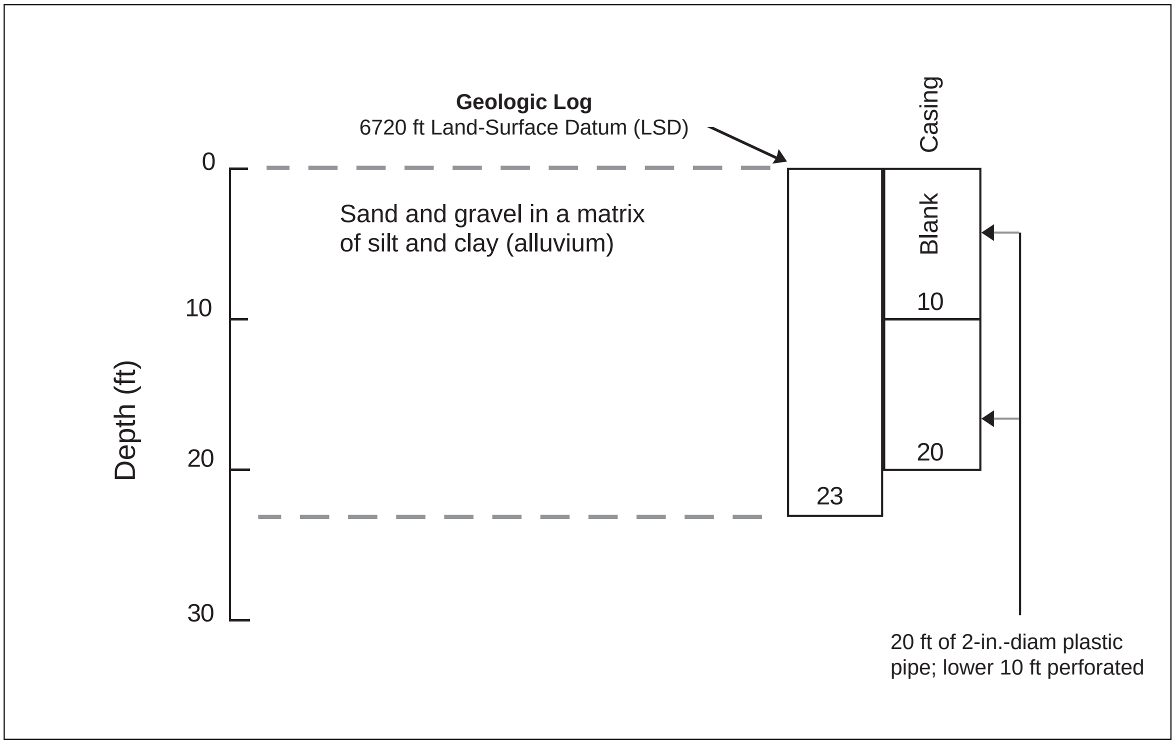


Fig. VI-R. Mortandad Canyon observation well MCO-11, completed November 1961, dry; unable to locate, February 1991 (Purtymun 1964).

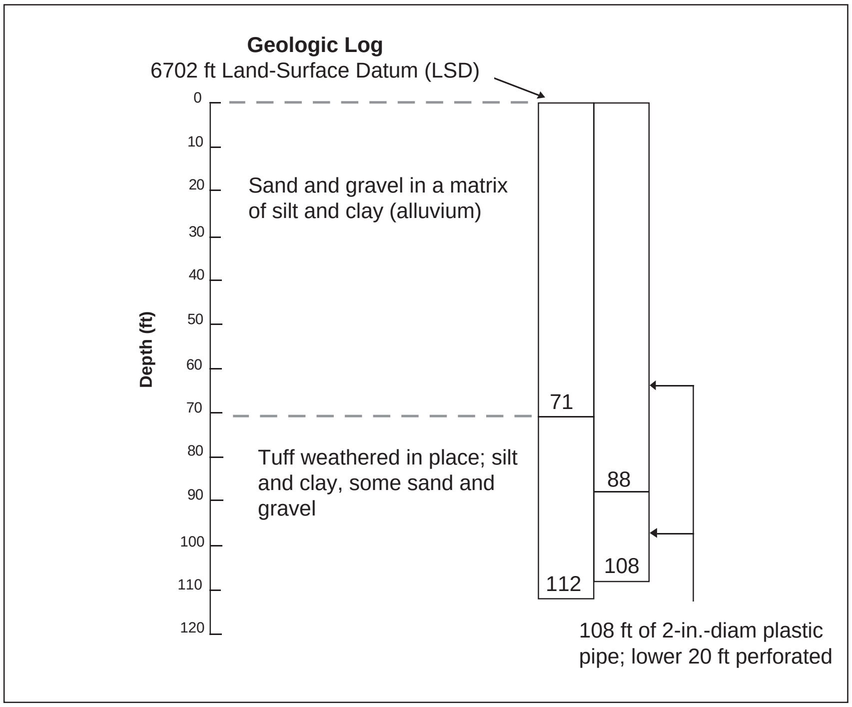


Fig. VI-S. Mortandad Canyon observation well MCO-12, completed June 1971, dry; replaced previous well MCO-12 (see Fig. VI-T.), which was plugged and abandoned about 12 ft to the south (Purtymun 1971b).

ENCLOSURE 6

Water quality data from CrEX-1

ENV-DO-15-0245

LA-UR-15-26789

Date: September 3, 2015

Table 1. CrEX-1 water qualtiy data from 2014. NMWQCC 20.6.2.3103 metals. Source: IntellusNM

Location	Sample ID	Date	Analytical Method	Parameter	Result	Units	Lab Qualifier	Detected	Filtered
CrEX-1	Cr-Ex-15-91501	12/20/2014	EPA:200.7	Aluminum	4.9	ug/L		Y	Y
CrEX-1	CR-EX-15-90411	11/14/2014	EPA:200.7	Aluminum	5.4	ug/L		Y	Y
CrEX-1	CR-EX-15-90405	11/7/2014	EPA:200.7	Aluminum	6.0	ug/L		Y	Y
CrEX-1	Cr-Ex-15-91509	12/16/2014	EPA:200.7	Aluminum	6.8	ug/L		Y	Y
CrEX-1	Cr-Ex-15-91503	12/18/2014	EPA:200.7	Aluminum	9.2	ug/L		Y	Y
CrEX-1	CR-EX-15-90956	12/10/2014	EPA:200.7	Aluminum	10	ug/L		Y	Y
CrEX-1	Cr-Ex-15-91506	12/21/2014	EPA:200.7	Barium	38	ug/L		Y	Y
CrEX-1	Cr-Ex-15-91502	12/12/2014	EPA:200.7	Barium	38	ug/L		Y	Y
CrEX-1	Cr-Ex-15-91488	12/22/2014	EPA:200.7	Barium	40	ug/L		Y	Y
CrEX-1	Cr-Ex-15-91501	12/20/2014	EPA:200.7	Barium	40	ug/L		Y	Y
CrEX-1	Cr-Ex-15-91507	12/19/2014	EPA:200.7	Barium	40	ug/L		Y	Y
CrEX-1	Cr-Ex-15-91509	12/16/2014	EPA:200.7	Barium	40	ug/L		Y	Y
CrEX-1	Cr-Ex-15-91487	12/16/2014	EPA:200.7	Boron	3.8	ug/L		Y	Y
CrEX-1	Cr-Ex-15-91506	12/21/2014	EPA:200.7	Boron	4.4	ug/L		Y	Y
CrEX-1	Cr-Ex-15-91502	12/12/2014	EPA:200.7	Boron	4.6	ug/L		Y	Y
CrEX-1	Cr-Ex-15-90954	11/19/2014	EPA:200.7	Boron	6.3	ug/L		Y	Y
CrEX-1	CR-EX-15-90956	12/10/2014	EPA:200.7	Boron	6.6	ug/L		Y	Y
CrEX-1	Cr-Ex-15-90404	11/3/2014	EPA:200.7	Boron	9.0	ug/L		Y	Y
CrEX-1	Cr-Ex-15-91488	12/22/2014	EPA:200.7	Iron	14	ug/L		Y	Y
CrEX-1	Cr-Ex-15-91501	12/20/2014	EPA:200.7	Iron	19	ug/L		Y	Y
CrEX-1	Cr-Ex-15-91510	12/23/2014	EPA:200.7	Iron	24	ug/L		Y	Y
CrEX-1	Cr-Ex-15-91509	12/16/2014	EPA:200.7	Iron	30	ug/L		Y	Y
CrEX-1	Cr-Ex-15-91506	12/21/2014	EPA:200.7	Iron	39	ug/L		Y	Y
CrEX-1	CR-EX-15-90411	11/14/2014	EPA:200.7	Iron	66	ug/L		Y	Y
CrEX-1	Cr-Ex-15-91502	12/12/2014	EPA:200.7	Manganese	1.9	ug/L		Y	Y
CrEX-1	Cr-Ex-15-91503	12/18/2014	EPA:200.7	Manganese	2.1	ug/L		Y	Y
CrEX-1	Cr-Ex-15-91509	12/16/2014	EPA:200.7	Manganese	2.2	ug/L		Y	Y
CrEX-1	Cr-Ex-15-91506	12/21/2014	EPA:200.7	Manganese	2.4	ug/L		Y	Y
CrEX-1	Cr-Ex-15-90406	10/27/2014	EPA:200.7	Manganese	2.8	ug/L		Y	Y
CrEX-1	CR-EX-15-91505	12/11/2014	EPA:200.7	Manganese	2.9	ug/L		Y	Y
CrEX-1	Cr-Ex-15-91503	12/18/2014	EPA:200.7	Zinc	955	ug/L		Y	Y
CrEX-1	Cr-Ex-15-91501	12/20/2014	EPA:200.7	Zinc	1329	ug/L		Y	Y
CrEX-1	Cr-Ex-15-91509	12/16/2014	EPA:200.7	Zinc	1529	ug/L		Y	Y
CrEX-1	Cr-Ex-15-91488	12/22/2014	EPA:200.7	Zinc	1596	ug/L		Y	Y
CrEX-1	Cr-Ex-15-91510	12/23/2014	EPA:200.7	Zinc	2320	ug/L		Y	Y
CrEX-1	Cr-Ex-15-91506	12/21/2014	EPA:200.7	Zinc	3263	ug/L		Y	Y
CrEX-1	Cr-Ex-15-90404	11/3/2014	EPA:200.8	Arsenic	0.83	ug/L		Y	Y
CrEX-1	CR-EX-15-90410	11/12/2014	EPA:200.8	Arsenic	0.84	ug/L		Y	Y
CrEX-1	Cr-Ex-15-90408	11/24/2014	EPA:200.8	Arsenic	0.86	ug/L		Y	Y
CrEX-1	CR-EX-15-90405	11/7/2014	EPA:200.8	Arsenic	0.86	ug/L		Y	Y
CrEX-1	Cr-Ex-15-90954	11/19/2014	EPA:200.8	Arsenic	0.92	ug/L		Y	Y
CrEX-1	Cr-Ex-15-90407	11/25/2014	EPA:200.8	Arsenic	0.98	ug/L		Y	Y
CrEX-1	Cr-Ex-15-91503	12/18/2014	EPA:200.8	Cadmium	1.0	ug/L	U	N	Y
CrEX-1	Cr-Ex-15-91507	12/19/2014	EPA:200.8	Cadmium	1.0	ug/L	U	N	Y
CrEX-1	Cr-Ex-15-91501	12/20/2014	EPA:200.8	Cadmium	1.0	ug/L	U	N	Y
CrEX-1	Cr-Ex-15-91506	12/21/2014	EPA:200.8	Cadmium	1.0	ug/L	U	N	Y
CrEX-1	Cr-Ex-15-91488	12/22/2014	EPA:200.8	Cadmium	1.0	ug/L	U	N	Y
CrEX-1	Cr-Ex-15-91510	12/23/2014	EPA:200.8	Cadmium	1.0	ug/L	U	N	Y
CrEX-1	Cr-Ex-15-90404	11/3/2014	EPA:200.8	Chromium	170	ug/L		Y	Y
CrEX-1	CR-EX-15-90414	11/17/2014	EPA:200.8	Chromium	171	ug/L		Y	Y
CrEX-1	Cr-Ex-15-90954	11/19/2014	EPA:200.8	Chromium	175	ug/L		Y	Y
CrEX-1	CR-EX-15-90405	11/7/2014	EPA:200.8	Chromium	176	ug/L		Y	Y
CrEX-1	CR-EX-15-90410	11/12/2014	EPA:200.8	Chromium	179	ug/L		Y	Y
CrEX-1	CR-EX-15-90411	11/14/2014	EPA:200.8	Chromium	181	ug/L		Y	Y
CrEX-1	Cr-Ex-15-91501	12/20/2014	EPA:200.8	Cobalt	1.0	ug/L	U	N	Y
CrEX-1	Cr-Ex-15-91506	12/21/2014	EPA:200.8	Cobalt	1.0	ug/L	U	N	Y
CrEX-1	Cr-Ex-15-91488	12/22/2014	EPA:200.8	Cobalt	1.0	ug/L	U	N	Y
CrEX-1	Cr-Ex-15-91510	12/23/2014	EPA:200.8	Cobalt	1.0	ug/L	U	N	Y
CrEX-1	Cr-Ex-15-91503	12/18/2014	EPA:200.8	Cobalt	1.1	ug/L		Y	Y
CrEX-1	CR-EX-15-91505	12/11/2014	EPA:200.8	Cobalt	1.6	ug/L		Y	Y
CrEX-1	Cr-Ex-15-91503	12/18/2014	EPA:200.8	Copper	1.0	ug/L	U	N	Y
CrEX-1	Cr-Ex-15-91507	12/19/2014	EPA:200.8	Copper	1.0	ug/L	U	N	Y
CrEX-1	Cr-Ex-15-91501	12/20/2014	EPA:200.8	Copper	1.0	ug/L	U	N	Y

Table 1. CrEX-1 water qualtiy data from 2014. NMWQCC 20.6.2.3103 metals. Source: IntellusNM

Location	Sample ID	Date	Analytical Method	Parameter	Result	Units	Lab Qualifier	Detected	Filtered
CrEX-1	Cr-Ex-15-91506	12/21/2014	EPA:200.8	Copper	1.0	ug/L	U	N	Y
CrEX-1	Cr-Ex-15-91488	12/22/2014	EPA:200.8	Copper	1.0	ug/L	U	N	Y
CrEX-1	Cr-Ex-15-91510	12/23/2014	EPA:200.8	Copper	1.0	ug/L	U	N	Y
CrEX-1	Cr-Ex-15-91503	12/18/2014	EPA:200.8	Lead	0.20	ug/L	U	N	Y
CrEX-1	Cr-Ex-15-91507	12/19/2014	EPA:200.8	Lead	0.20	ug/L	U	N	Y
CrEX-1	Cr-Ex-15-91506	12/21/2014	EPA:200.8	Lead	0.20	ug/L	U	N	Y
CrEX-1	Cr-Ex-15-91488	12/22/2014	EPA:200.8	Lead	0.20	ug/L	U	N	Y
CrEX-1	Cr-Ex-15-91510	12/23/2014	EPA:200.8	Lead	0.20	ug/L	U	N	Y
CrEX-1	Cr-Ex-15-91501	12/20/2014	EPA:200.8	Lead	0.98	ug/L		Y	Y
CrEX-1	Cr-Ex-14-86835	9/23/2014	EPA:200.8	Mercury	0.05	ug/L	U	N	N
CrEX-1	Cr-Ex-14-86836	9/23/2014	EPA:200.8	Mercury	0.05	ug/L	U	N	N
CrEX-1	Cr-Ex-14-86838	9/23/2014	EPA:200.8	Mercury	0.05	ug/L	U	N	N
CrEX-1	Cr-Ex-14-86845	9/29/2014	EPA:200.8	Mercury	0.05	ug/L	U	N	N
CrEX-1	Cr-Ex-14-86846	9/29/2014	EPA:200.8	Mercury	0.05	ug/L	U	N	N
CrEX-1	Cr-Ex-14-86847	9/29/2014	EPA:200.8	Mercury	0.05	ug/L	U	N	N
CrEX-1	Cr-Ex-15-91487	12/16/2014	EPA:200.8	Molybdenum	1.0	ug/L		Y	Y
CrEX-1	CR-EX-15-91500	12/13/2014	EPA:200.8	Molybdenum	1.1	ug/L		Y	Y
CrEX-1	Cr-Ex-15-91503	12/18/2014	EPA:200.8	Molybdenum	1.1	ug/L		Y	Y
CrEX-1	Cr-Ex-15-91501	12/20/2014	EPA:200.8	Molybdenum	1.1	ug/L		Y	Y
CrEX-1	CR-EX-15-91508	12/13/2014	EPA:200.8	Molybdenum	1.1	ug/L		Y	Y
CrEX-1	Cr-Ex-15-91509	12/16/2014	EPA:200.8	Molybdenum	1.2	ug/L		Y	Y
CrEX-1	Cr-Ex-15-90408	11/24/2014	EPA:200.8	Nickel	4.0	ug/L		Y	Y
CrEX-1	Cr-Ex-15-91509	12/16/2014	EPA:200.8	Nickel	4.2	ug/L		Y	Y
CrEX-1	Cr-Ex-15-90954	11/19/2014	EPA:200.8	Nickel	4.2	ug/L		Y	Y
CrEX-1	Cr-Ex-15-91506	12/21/2014	EPA:200.8	Nickel	4.3	ug/L		Y	Y
CrEX-1	Cr-Ex-15-90404	11/3/2014	EPA:200.8	Nickel	4.3	ug/L		Y	Y
CrEX-1	CR-EX-15-90411	11/14/2014	EPA:200.8	Nickel	4.5	ug/L		Y	Y
CrEX-1	Cr-Ex-15-90404	11/3/2014	EPA:200.8	Selenium	1.3	ug/L		Y	Y
CrEX-1	CR-EX-15-90411	11/14/2014	EPA:200.8	Selenium	1.3	ug/L		Y	Y
CrEX-1	CR-EX-15-90410	11/12/2014	EPA:200.8	Selenium	1.3	ug/L		Y	Y
CrEX-1	Cr-Ex-15-90408	11/24/2014	EPA:200.8	Selenium	1.3	ug/L		Y	Y
CrEX-1	CR-EX-15-90405	11/7/2014	EPA:200.8	Selenium	1.4	ug/L		Y	Y
CrEX-1	CR-EX-15-90414	11/17/2014	EPA:200.8	Selenium	1.5	ug/L		Y	Y
CrEX-1	Cr-Ex-15-91503	12/18/2014	EPA:200.8	Silver	1	ug/L	U	N	Y
CrEX-1	Cr-Ex-15-91507	12/19/2014	EPA:200.8	Silver	1	ug/L	U	N	Y
CrEX-1	Cr-Ex-15-91501	12/20/2014	EPA:200.8	Silver	1	ug/L	U	N	Y
CrEX-1	Cr-Ex-15-91506	12/21/2014	EPA:200.8	Silver	1	ug/L	U	N	Y
CrEX-1	Cr-Ex-15-91488	12/22/2014	EPA:200.8	Silver	1	ug/L	U	N	Y
CrEX-1	Cr-Ex-15-91510	12/23/2014	EPA:200.8	Silver	1	ug/L	U	N	Y
CrEX-1	Cr-Ex-15-91509	12/16/2014	EPA:200.8	Uranium	0.78	ug/L		Y	Y
CrEX-1	Cr-Ex-15-90406	10/27/2014	EPA:200.8	Uranium	0.79	ug/L		Y	Y
CrEX-1	Cr-Ex-15-91488	12/22/2014	EPA:200.8	Uranium	0.79	ug/L		Y	Y
CrEX-1	CR-EX-15-91508	12/13/2014	EPA:200.8	Uranium	0.92	ug/L		Y	Y
CrEX-1	Cr-Ex-15-90953	12/8/2014	EPA:200.8	Uranium	0.97	ug/L		Y	Y
CrEX-1	Cr-Ex-15-90409	12/3/2014	EPA:200.8	Uranium	1.0	ug/L		Y	Y
CrEX-1	Cr-Ex-15-90944	11/19/2014	EPA:245.2	Mercury	0.20	ug/L	U	N	N
CrEX-1	Cr-Ex-15-91012	11/19/2014	EPA:245.2	Mercury	0.20	ug/L	U	N	N

Table 2. CrEX-1 water qualtiy data from 2014. NMWQCC 20.6.2.3103 general inorganics and radiologicals. Source: IntellusNM

Location	Sample ID	Date	Analytical Method	Parameter	Result	Units	Lab Qualifier	Detected	Filtered
CrEX-1	CR-EX-15-90432	11/17/2014	EPA:300.0	Chloride	15.8	mg/L		Y	N
CrEX-1	Cr-Ex-15-90433	10/29/2014	EPA:300.0	Chloride	15.9	mg/L		Y	N
CrEX-1	Cr-Ex-15-90426	11/24/2014	EPA:300.0	Chloride	17.0	mg/L		Y	N
CrEX-1	Cr-Ex-15-90425	11/25/2014	EPA:300.0	Chloride	17.4	mg/L		Y	N
CrEX-1	Cr-Ex-15-90944	11/19/2014	EPA:300.0	Chloride	19.3	mg/L		Y	N
CrEX-1	Cr-Ex-15-91012	11/19/2014	EPA:300.0	Chloride	30.4	mg/L		Y	N
CrEX-1	Cr-Ex-14-86840	9/10/2014	EPA:300.0	Fluoride	0.64	mg/L		Y	N
CrEX-1	Cr-Ex-15-91489	12/20/2014	EPA:300.0	Fluoride	0.65	mg/L		Y	N
CrEX-1	Cr-Ex-15-91499	12/23/2014	EPA:300.0	Fluoride	0.65	mg/L		Y	N
CrEX-1	Cr-Ex-14-86842	9/10/2014	EPA:300.0	Fluoride	0.66	mg/L		Y	N
CrEX-1	Cr-Ex-15-91492	12/18/2014	EPA:300.0	Fluoride	0.69	mg/L		Y	N
CrEX-1	Cr-Ex-15-90425	11/25/2014	EPA:300.0	Fluoride	0.72	mg/L		Y	N
CrEX-1	CR-EX-15-90427	11/7/2014	EPA:300.0	Sulfate	22	mg/L		Y	N
CrEX-1	Cr-Ex-15-90426	11/24/2014	EPA:300.0	Sulfate	22	mg/L		Y	N
CrEX-1	Cr-Ex-15-90425	11/25/2014	EPA:300.0	Sulfate	22	mg/L		Y	N
CrEX-1	CR-EX-15-90431	11/14/2014	EPA:300.0	Sulfate	22	mg/L		Y	N
CrEX-1	CR-EX-15-90430	11/12/2014	EPA:300.0	Sulfate	23	mg/L		Y	N
CrEX-1	CR-EX-15-90432	11/17/2014	EPA:300.0	Sulfate	23	mg/L		Y	N
CrEX-1	Cr-Ex-15-90944	11/19/2014	EPA:335.4	Cyanide (Total)	0.005	mg/L	U	N	N
CrEX-1	Cr-Ex-15-91012	11/19/2014	EPA:335.4	Cyanide (Total)	0.005	mg/L	U	N	N
CrEX-1	Cr-Ex-15-90944	11/19/2014	EPA:350.1	Ammonia as Nitrogen	0.03	mg/L	J	Y	N
CrEX-1	Cr-Ex-15-91012	11/19/2014	EPA:350.1	Ammonia as Nitrogen	0.04	mg/L	J	Y	N
CrEX-1	Cr-Ex-15-90944	11/19/2014	EPA:351.2	Total Kjeldahl Nitrogen	0.1	mg/L	U	N	N
CrEX-1	Cr-Ex-15-91012	11/19/2014	EPA:351.2	Total Kjeldahl Nitrogen	0.1	mg/L	U	N	N
CrEX-1	Cr-Ex-15-90958	11/19/2014	EPA:300.0	Nitrate (as N)	2.9	mg/L		Y	N
CrEX-1	CR-EX-15-90432	11/17/2014	EPA:300.0	Nitrate (as N)	3.0	mg/L		Y	N
CrEX-1	Cr-Ex-15-90947	12/1/2014	EPA:300.0	Nitrate (as N)	3.1	mg/L		Y	N
CrEX-1	Cr-Ex-15-90425	11/25/2014	EPA:300.0	Nitrate (as N)	3.2	mg/L		Y	N
CrEX-1	Cr-Ex-15-90426	11/24/2014	EPA:300.0	Nitrate (as N)	3.2	mg/L		Y	N
CrEX-1	Cr-Ex-15-90949	12/8/2014	EPA:300.0	Nitrate (as N)	3.4	mg/L		Y	N
CrEX-1	Cr-Ex-15-91012	11/19/2014	EPA:903.1	Radium-226	1.0	pCi/L		Y	N
CrEX-1	Cr-Ex-15-90944	11/19/2014	EPA:903.1	Radium-226	1.1	pCi/L		Y	N
CrEX-1	Cr-Ex-15-91012	11/19/2014	EPA:904	Radium-228	0.42	pCi/L	U	N	N
CrEX-1	Cr-Ex-15-90944	11/19/2014	EPA:904	Radium-228	0.89	pCi/L		Y	N

Table 3. CrEX-1 water qualtiy data from 2014. Volatile and semi-volatile organics and perchlorate. Source: IntellusNM

Location	Sample ID	Date	Analytical Method	Parameter	Result	Units	Lab Qualifier	Detected	Filtered	Detection Limit
CrEX-1	Cr-Ex-15-90944	11/19/2014	SW-846:6850	Perchlorate	0.14	ug/L	J	Y	N	0.2
CrEX-1	Cr-Ex-15-91012	11/19/2014	SW-846:6850	Perchlorate	0.20	ug/L	U	N	N	0.2
CrEX-1	Cr-Ex-15-91486	12/15/2014	SW-846:6850	Perchlorate	0.75	ug/L		Y	N	0.2
CrEX-1	Cr-Ex-15-91485	12/22/2014	SW-846:6850	Perchlorate	0.80	ug/L		Y	N	0.2
CrEX-1	Cr-Ex-15-90944	11/19/2014	SW-846:8081B	Aldrin	0.022	ug/L	U	N	N	0.02
CrEX-1	Cr-Ex-15-91012	11/19/2014	SW-846:8081B	Aldrin	0.022	ug/L	U	N	N	0.02
CrEX-1	Cr-Ex-15-90944	11/19/2014	SW-846:8081B	BHC[alpha-]	0.022	ug/L	U	N	N	0.02
CrEX-1	Cr-Ex-15-91012	11/19/2014	SW-846:8081B	BHC[alpha-]	0.022	ug/L	U	N	N	0.02
CrEX-1	Cr-Ex-15-90944	11/19/2014	SW-846:8081B	BHC[beta-]	0.022	ug/L	U	N	N	0.02
CrEX-1	Cr-Ex-15-91012	11/19/2014	SW-846:8081B	BHC[beta-]	0.022	ug/L	U	N	N	0.02
CrEX-1	Cr-Ex-15-90944	11/19/2014	SW-846:8081B	BHC[delta-]	0.022	ug/L	U	N	N	0.02
CrEX-1	Cr-Ex-15-91012	11/19/2014	SW-846:8081B	BHC[delta-]	0.022	ug/L	U	N	N	0.02
CrEX-1	Cr-Ex-15-90944	11/19/2014	SW-846:8081B	BHC[gamma-]	0.022	ug/L	U	N	N	0.02
CrEX-1	Cr-Ex-15-91012	11/19/2014	SW-846:8081B	BHC[gamma-]	0.022	ug/L	U	N	N	0.02
CrEX-1	Cr-Ex-15-90944	11/19/2014	SW-846:8081B	Chlordane[alpha-]	0.022	ug/L	U	N	N	0.02
CrEX-1	Cr-Ex-15-91012	11/19/2014	SW-846:8081B	Chlordane[alpha-]	0.022	ug/L	U	N	N	0.02
CrEX-1	Cr-Ex-15-90944	11/19/2014	SW-846:8081B	Chlordane[gamma-]	0.022	ug/L	U	N	N	0.02
CrEX-1	Cr-Ex-15-91012	11/19/2014	SW-846:8081B	Chlordane[gamma-]	0.022	ug/L	U	N	N	0.02
CrEX-1	Cr-Ex-15-90944	11/19/2014	SW-846:8081B	DDD[4,4'-]	0.043	ug/L	U	N	N	0.04
CrEX-1	Cr-Ex-15-91012	11/19/2014	SW-846:8081B	DDD[4,4'-]	0.044	ug/L	U	N	N	0.04
CrEX-1	Cr-Ex-15-90944	11/19/2014	SW-846:8081B	DDE[4,4'-]	0.043	ug/L	U	N	N	0.04
CrEX-1	Cr-Ex-15-91012	11/19/2014	SW-846:8081B	DDE[4,4'-]	0.044	ug/L	U	N	N	0.04
CrEX-1	Cr-Ex-15-90944	11/19/2014	SW-846:8081B	DDT[4,4'-]	0.043	ug/L	U	N	N	0.04
CrEX-1	Cr-Ex-15-91012	11/19/2014	SW-846:8081B	DDT[4,4'-]	0.044	ug/L	U	N	N	0.04
CrEX-1	Cr-Ex-15-90944	11/19/2014	SW-846:8081B	Dieldrin	0.043	ug/L	U	N	N	0.04
CrEX-1	Cr-Ex-15-91012	11/19/2014	SW-846:8081B	Dieldrin	0.044	ug/L	U	N	N	0.04
CrEX-1	Cr-Ex-15-90944	11/19/2014	SW-846:8081B	Endosulfan I	0.022	ug/L	U	N	N	0.02
CrEX-1	Cr-Ex-15-91012	11/19/2014	SW-846:8081B	Endosulfan I	0.022	ug/L	U	N	N	0.02
CrEX-1	Cr-Ex-15-90944	11/19/2014	SW-846:8081B	Endosulfan II	0.043	ug/L	U	N	N	0.04
CrEX-1	Cr-Ex-15-91012	11/19/2014	SW-846:8081B	Endosulfan II	0.044	ug/L	U	N	N	0.04
CrEX-1	Cr-Ex-15-90944	11/19/2014	SW-846:8081B	Endosulfan Sulfate	0.043	ug/L	U	N	N	0.04
CrEX-1	Cr-Ex-15-91012	11/19/2014	SW-846:8081B	Endosulfan Sulfate	0.044	ug/L	U	N	N	0.04
CrEX-1	Cr-Ex-15-90944	11/19/2014	SW-846:8081B	Endrin	0.043	ug/L	U	N	N	0.04
CrEX-1	Cr-Ex-15-91012	11/19/2014	SW-846:8081B	Endrin	0.044	ug/L	U	N	N	0.04
CrEX-1	Cr-Ex-15-90944	11/19/2014	SW-846:8081B	Endrin Aldehyde	0.043	ug/L	U	N	N	0.04
CrEX-1	Cr-Ex-15-91012	11/19/2014	SW-846:8081B	Endrin Aldehyde	0.044	ug/L	U	N	N	0.04
CrEX-1	Cr-Ex-15-90944	11/19/2014	SW-846:8081B	Endrin Ketone	0.043	ug/L	U	N	N	0.04
CrEX-1	Cr-Ex-15-91012	11/19/2014	SW-846:8081B	Endrin Ketone	0.044	ug/L	U	N	N	0.04
CrEX-1	Cr-Ex-15-90944	11/19/2014	SW-846:8081B	Heptachlor	0.022	ug/L	U	N	N	0.02
CrEX-1	Cr-Ex-15-91012	11/19/2014	SW-846:8081B	Heptachlor	0.022	ug/L	U	N	N	0.02
CrEX-1	Cr-Ex-15-90944	11/19/2014	SW-846:8081B	Heptachlor Epoxide	0.022	ug/L	U	N	N	0.02
CrEX-1	Cr-Ex-15-91012	11/19/2014	SW-846:8081B	Heptachlor Epoxide	0.022	ug/L	U	N	N	0.02
CrEX-1	Cr-Ex-15-90944	11/19/2014	SW-846:8081B	Methoxychlor[4,4'-]	0.215	ug/L	U	N	N	0.22
CrEX-1	Cr-Ex-15-91012	11/19/2014	SW-846:8081B	Methoxychlor[4,4'-]	0.217	ug/L	U	N	N	0.22
CrEX-1	Cr-Ex-15-90944	11/19/2014	SW-846:8081B	Toxaphene (Technical Grade)	0.538	ug/L	U	N	N	0.54
CrEX-1	Cr-Ex-15-91012	11/19/2014	SW-846:8081B	Toxaphene (Technical Grade)	0.543	ug/L	U	N	N	0.54
CrEX-1	Cr-Ex-15-90944	11/19/2014	SW-846:8082	Aroclor-1016	0.106	ug/L	U	N	N	0.11
CrEX-1	Cr-Ex-15-91012	11/19/2014	SW-846:8082	Aroclor-1016	0.115	ug/L	U	N	N	0.12
CrEX-1	Cr-Ex-15-90944	11/19/2014	SW-846:8082	Aroclor-1221	0.106	ug/L	U	N	N	0.11
CrEX-1	Cr-Ex-15-91012	11/19/2014	SW-846:8082	Aroclor-1221	0.115	ug/L	U	N	N	0.12
CrEX-1	Cr-Ex-15-90944	11/19/2014	SW-846:8082	Aroclor-1232	0.106	ug/L	U	N	N	0.11
CrEX-1	Cr-Ex-15-91012	11/19/2014	SW-846:8082	Aroclor-1232	0.115	ug/L	U	N	N	0.12
CrEX-1	Cr-Ex-15-90944	11/19/2014	SW-846:8082	Aroclor-1242	0.106	ug/L	U	N	N	0.11
CrEX-1	Cr-Ex-15-91012	11/19/2014	SW-846:8082	Aroclor-1242	0.115	ug/L	U	N	N	0.12
CrEX-1	Cr-Ex-15-90944	11/19/2014	SW-846:8082	Aroclor-1248	0.106	ug/L	U	N	N	0.11
CrEX-1	Cr-Ex-15-91012	11/19/2014	SW-846:8082	Aroclor-1248	0.115	ug/L	U	N	N	0.12
CrEX-1	Cr-Ex-15-90944	11/19/2014	SW-846:8082	Aroclor-1254	0.106	ug/L	U	N	N	0.11
CrEX-1	Cr-Ex-15-91012	11/19/2014	SW-846:8082	Aroclor-1254	0.115	ug/L	U	N	N	0.12
CrEX-1	Cr-Ex-15-90944	11/19/2014	SW-846:8082	Aroclor-1260	0.106	ug/L	U	N	N	0.11
CrEX-1	Cr-Ex-15-91012	11/19/2014	SW-846:8082	Aroclor-1260	0.115	ug/L	U	N	N	0.12
CrEX-1	Cr-Ex-15-90944	11/19/2014	SW-846:8082	Aroclor-1262	0.106	ug/L	U	N	N	0.11
CrEX-1	Cr-Ex-15-91012	11/19/2014	SW-846:8082	Aroclor-1262	0.115	ug/L	U	N	N	0.12
CrEX-1	Cr-Ex-15-90944	11/19/2014	SW-846:8260B	Acetone	10	ug/L	U	N	N	10.0
CrEX-1	Cr-Ex-15-91012	11/19/2014	SW-846:8260B	Acetone	10	ug/L	U	N	N	10.0

Table 3. CrEX-1 water qualtiy data from 2014. Volatile and semi-volatile organics and perchlorate. Source: IntellusNM

Location	Sample ID	Date	Analytical Method	Parameter	Result	Units	Lab Qualifier	Detected	Filtered	Detection Limit
CrEX-1	Cr-Ex-15-90944	11/19/2014	SW-846:8260B	Acetonitrile	25	ug/L	U	N	N	25.0
CrEX-1	Cr-Ex-15-91012	11/19/2014	SW-846:8260B	Acetonitrile	25	ug/L	U	N	N	25.0
CrEX-1	Cr-Ex-15-90944	11/19/2014	SW-846:8260B	Acrolein	5	ug/L	U	N	N	5.0
CrEX-1	Cr-Ex-15-91012	11/19/2014	SW-846:8260B	Acrolein	5	ug/L	U	N	N	5.0
CrEX-1	Cr-Ex-15-90944	11/19/2014	SW-846:8260B	Acrylonitrile	5	ug/L	U	N	N	5.0
CrEX-1	Cr-Ex-15-91012	11/19/2014	SW-846:8260B	Acrylonitrile	5	ug/L	U	N	N	5.0
CrEX-1	Cr-Ex-15-90944	11/19/2014	SW-846:8260B	Benzene	1	ug/L	U	N	N	1.0
CrEX-1	Cr-Ex-15-91012	11/19/2014	SW-846:8260B	Benzene	1	ug/L	U	N	N	1.0
CrEX-1	Cr-Ex-15-90944	11/19/2014	SW-846:8260B	Bromobenzene	1	ug/L	U	N	N	1.0
CrEX-1	Cr-Ex-15-91012	11/19/2014	SW-846:8260B	Bromobenzene	1	ug/L	U	N	N	1.0
CrEX-1	Cr-Ex-15-90944	11/19/2014	SW-846:8260B	Bromochloromethane	1	ug/L	U	N	N	1.0
CrEX-1	Cr-Ex-15-91012	11/19/2014	SW-846:8260B	Bromochloromethane	1	ug/L	U	N	N	1.0
CrEX-1	Cr-Ex-15-90944	11/19/2014	SW-846:8260B	Bromodichloromethane	1	ug/L	U	N	N	1.0
CrEX-1	Cr-Ex-15-91012	11/19/2014	SW-846:8260B	Bromodichloromethane	1	ug/L	U	N	N	1.0
CrEX-1	Cr-Ex-15-90944	11/19/2014	SW-846:8260B	Bromoform	1	ug/L	U	N	N	1.0
CrEX-1	Cr-Ex-15-91012	11/19/2014	SW-846:8260B	Bromoform	1	ug/L	U	N	N	1.0
CrEX-1	Cr-Ex-15-90944	11/19/2014	SW-846:8260B	Bromomethane	1	ug/L	U	N	N	1.0
CrEX-1	Cr-Ex-15-91012	11/19/2014	SW-846:8260B	Bromomethane	1	ug/L	U	N	N	1.0
CrEX-1	Cr-Ex-15-90944	11/19/2014	SW-846:8260B	Butanol[1-]	50	ug/L	U	N	N	50
CrEX-1	Cr-Ex-15-91012	11/19/2014	SW-846:8260B	Butanol[1-]	50	ug/L	U	N	N	50
CrEX-1	Cr-Ex-15-90944	11/19/2014	SW-846:8260B	Butanone[2-]	5	ug/L	U	N	N	5.0
CrEX-1	Cr-Ex-15-91012	11/19/2014	SW-846:8260B	Butanone[2-]	5	ug/L	U	N	N	5.0
CrEX-1	Cr-Ex-15-90944	11/19/2014	SW-846:8260B	Butylbenzene[n-]	1	ug/L	U	N	N	1.0
CrEX-1	Cr-Ex-15-91012	11/19/2014	SW-846:8260B	Butylbenzene[n-]	1	ug/L	U	N	N	1.0
CrEX-1	Cr-Ex-15-90944	11/19/2014	SW-846:8260B	Butylbenzene[sec-]	1	ug/L	U	N	N	1.0
CrEX-1	Cr-Ex-15-91012	11/19/2014	SW-846:8260B	Butylbenzene[sec-]	1	ug/L	U	N	N	1.0
CrEX-1	Cr-Ex-15-90944	11/19/2014	SW-846:8260B	Butylbenzene[tert-]	1	ug/L	U	N	N	1.0
CrEX-1	Cr-Ex-15-91012	11/19/2014	SW-846:8260B	Butylbenzene[tert-]	1	ug/L	U	N	N	1.0
CrEX-1	Cr-Ex-15-90944	11/19/2014	SW-846:8260B	Carbon Disulfide	5	ug/L	U	N	N	5.0
CrEX-1	Cr-Ex-15-91012	11/19/2014	SW-846:8260B	Carbon Disulfide	5	ug/L	U	N	N	5.0
CrEX-1	Cr-Ex-15-90944	11/19/2014	SW-846:8260B	Carbon Tetrachloride	1	ug/L	U	N	N	1.0
CrEX-1	Cr-Ex-15-91012	11/19/2014	SW-846:8260B	Carbon Tetrachloride	1	ug/L	U	N	N	1.0
CrEX-1	Cr-Ex-15-90944	11/19/2014	SW-846:8260B	Chloro-1,3-butadiene[2-]	1	ug/L	U	N	N	1.0
CrEX-1	Cr-Ex-15-91012	11/19/2014	SW-846:8260B	Chloro-1,3-butadiene[2-]	1	ug/L	U	N	N	1.0
CrEX-1	Cr-Ex-15-90944	11/19/2014	SW-846:8260B	Chloro-1-propene[3-]	5	ug/L	U	N	N	5.0
CrEX-1	Cr-Ex-15-91012	11/19/2014	SW-846:8260B	Chloro-1-propene[3-]	5	ug/L	U	N	N	5.0
CrEX-1	Cr-Ex-15-90944	11/19/2014	SW-846:8260B	Chlorobenzene	1	ug/L	U	N	N	1.0
CrEX-1	Cr-Ex-15-91012	11/19/2014	SW-846:8260B	Chlorobenzene	1	ug/L	U	N	N	1.0
CrEX-1	Cr-Ex-15-90944	11/19/2014	SW-846:8260B	Chlorodibromomethane	1	ug/L	U	N	N	1.0
CrEX-1	Cr-Ex-15-91012	11/19/2014	SW-846:8260B	Chlorodibromomethane	1	ug/L	U	N	N	1.0
CrEX-1	Cr-Ex-15-90944	11/19/2014	SW-846:8260B	Chloroethane	1	ug/L	U	N	N	1.0
CrEX-1	Cr-Ex-15-91012	11/19/2014	SW-846:8260B	Chloroethane	1	ug/L	U	N	N	1.0
CrEX-1	Cr-Ex-15-90944	11/19/2014	SW-846:8260B	Chloroethyl vinyl ether[2-]	5	ug/L	U	N	N	5.0
CrEX-1	Cr-Ex-15-91012	11/19/2014	SW-846:8260B	Chloroethyl vinyl ether[2-]	5	ug/L	U	N	N	5.0
CrEX-1	Cr-Ex-15-90944	11/19/2014	SW-846:8260B	Chloroform	1	ug/L	U	N	N	1.0
CrEX-1	Cr-Ex-15-91012	11/19/2014	SW-846:8260B	Chloroform	1	ug/L	U	N	N	1.0
CrEX-1	Cr-Ex-15-90944	11/19/2014	SW-846:8260B	Chloromethane	1	ug/L	U	N	N	1.0
CrEX-1	Cr-Ex-15-91012	11/19/2014	SW-846:8260B	Chloromethane	1	ug/L	U	N	N	1.0
CrEX-1	Cr-Ex-15-90944	11/19/2014	SW-846:8260B	Chlorotoluene[2-]	1	ug/L	U	N	N	1.0
CrEX-1	Cr-Ex-15-91012	11/19/2014	SW-846:8260B	Chlorotoluene[2-]	1	ug/L	U	N	N	1.0
CrEX-1	Cr-Ex-15-90944	11/19/2014	SW-846:8260B	Chlorotoluene[4-]	1	ug/L	U	N	N	1.0
CrEX-1	Cr-Ex-15-91012	11/19/2014	SW-846:8260B	Chlorotoluene[4-]	1	ug/L	U	N	N	1.0
CrEX-1	Cr-Ex-15-90944	11/19/2014	SW-846:8260B	Dibromo-3-Chloropropane[1,2-]	1	ug/L	U	N	N	1.0
CrEX-1	Cr-Ex-15-91012	11/19/2014	SW-846:8260B	Dibromo-3-Chloropropane[1,2-]	1	ug/L	U	N	N	1.0
CrEX-1	Cr-Ex-15-90944	11/19/2014	SW-846:8260B	Dibromoethane[1,2-]	1	ug/L	U	N	N	1.0
CrEX-1	Cr-Ex-15-91012	11/19/2014	SW-846:8260B	Dibromoethane[1,2-]	1	ug/L	U	N	N	1.0
CrEX-1	Cr-Ex-15-90944	11/19/2014	SW-846:8260B	Dibromomethane	1	ug/L	U	N	N	1.0
CrEX-1	Cr-Ex-15-91012	11/19/2014	SW-846:8260B	Dibromomethane	1	ug/L	U	N	N	1.0
CrEX-1	Cr-Ex-15-90944	11/19/2014	SW-846:8260B	Dichlorobenzene[1,2-]	1	ug/L	U	N	N	1.0
CrEX-1	Cr-Ex-15-91012	11/19/2014	SW-846:8260B	Dichlorobenzene[1,2-]	1	ug/L	U	N	N	1.0
CrEX-1	Cr-Ex-15-90944	11/19/2014	SW-846:8260B	Dichlorobenzene[1,3-]	1	ug/L	U	N	N	1.0
CrEX-1	Cr-Ex-15-91012	11/19/2014	SW-846:8260B	Dichlorobenzene[1,3-]	1	ug/L	U	N	N	1.0
CrEX-1	Cr-Ex-15-90944	11/19/2014	SW-846:8260B	Dichlorobenzene[1,4-]	1	ug/L	U	N	N	1.0
CrEX-1	Cr-Ex-15-91012	11/19/2014	SW-846:8260B	Dichlorobenzene[1,4-]	1	ug/L	U	N	N	1.0

Table 3. CrEX-1 water qualtiy data from 2014. Volatile and semi-volatile organics and perchlorate. Source: IntellusNM

Location	Sample ID	Date	Analytical Method	Parameter	Result	Units	Lab Qualifier	Detected	Filtered	Detection Limit
CrEX-1	Cr-Ex-15-90944	11/19/2014	SW-846:8260B	Dichlorodifluoromethane	1	ug/L	U	N	N	1.0
CrEX-1	Cr-Ex-15-91012	11/19/2014	SW-846:8260B	Dichlorodifluoromethane	1	ug/L	U	N	N	1.0
CrEX-1	Cr-Ex-15-90944	11/19/2014	SW-846:8260B	Dichloroethane[1,1-]	1	ug/L	U	N	N	1.0
CrEX-1	Cr-Ex-15-91012	11/19/2014	SW-846:8260B	Dichloroethane[1,1-]	1	ug/L	U	N	N	1.0
CrEX-1	Cr-Ex-15-90944	11/19/2014	SW-846:8260B	Dichloroethane[1,2-]	1	ug/L	U	N	N	1.0
CrEX-1	Cr-Ex-15-91012	11/19/2014	SW-846:8260B	Dichloroethane[1,2-]	1	ug/L	U	N	N	1.0
CrEX-1	Cr-Ex-15-90944	11/19/2014	SW-846:8260B	Dichloroethene[1,1-]	1	ug/L	U	N	N	1.0
CrEX-1	Cr-Ex-15-91012	11/19/2014	SW-846:8260B	Dichloroethene[1,1-]	1	ug/L	U	N	N	1.0
CrEX-1	Cr-Ex-15-90944	11/19/2014	SW-846:8260B	Dichloroethene[cis-1,2-]	1	ug/L	U	N	N	1.0
CrEX-1	Cr-Ex-15-91012	11/19/2014	SW-846:8260B	Dichloroethene[cis-1,2-]	1	ug/L	U	N	N	1.0
CrEX-1	Cr-Ex-15-90944	11/19/2014	SW-846:8260B	Dichloroethene[trans-1,2-]	1	ug/L	U	N	N	1.0
CrEX-1	Cr-Ex-15-91012	11/19/2014	SW-846:8260B	Dichloroethene[trans-1,2-]	1	ug/L	U	N	N	1.0
CrEX-1	Cr-Ex-15-90944	11/19/2014	SW-846:8260B	Dichloropropane[1,2-]	1	ug/L	U	N	N	1.0
CrEX-1	Cr-Ex-15-91012	11/19/2014	SW-846:8260B	Dichloropropane[1,2-]	1	ug/L	U	N	N	1.0
CrEX-1	Cr-Ex-15-90944	11/19/2014	SW-846:8260B	Dichloropropane[1,3-]	1	ug/L	U	N	N	1.0
CrEX-1	Cr-Ex-15-91012	11/19/2014	SW-846:8260B	Dichloropropane[1,3-]	1	ug/L	U	N	N	1.0
CrEX-1	Cr-Ex-15-90944	11/19/2014	SW-846:8260B	Dichloropropane[2,2-]	1	ug/L	U	N	N	1.0
CrEX-1	Cr-Ex-15-91012	11/19/2014	SW-846:8260B	Dichloropropane[2,2-]	1	ug/L	U	N	N	1.0
CrEX-1	Cr-Ex-15-90944	11/19/2014	SW-846:8260B	Dichloropropene[1,1-]	1	ug/L	U	N	N	1.0
CrEX-1	Cr-Ex-15-91012	11/19/2014	SW-846:8260B	Dichloropropene[1,1-]	1	ug/L	U	N	N	1.0
CrEX-1	Cr-Ex-15-90944	11/19/2014	SW-846:8260B	Dichloropropene[cis-1,3-]	1	ug/L	U	N	N	1.0
CrEX-1	Cr-Ex-15-91012	11/19/2014	SW-846:8260B	Dichloropropene[cis-1,3-]	1	ug/L	U	N	N	1.0
CrEX-1	Cr-Ex-15-90944	11/19/2014	SW-846:8260B	Dichloropropene[trans-1,3-]	1	ug/L	U	N	N	1.0
CrEX-1	Cr-Ex-15-91012	11/19/2014	SW-846:8260B	Dichloropropene[trans-1,3-]	1	ug/L	U	N	N	1.0
CrEX-1	Cr-Ex-15-90944	11/19/2014	SW-846:8260B	Diethyl Ether	1	ug/L	U	N	N	1.0
CrEX-1	Cr-Ex-15-91012	11/19/2014	SW-846:8260B	Diethyl Ether	1	ug/L	U	N	N	1.0
CrEX-1	Cr-Ex-15-90944	11/19/2014	SW-846:8260B	Ethyl Methacrylate	5	ug/L	U	N	N	5.0
CrEX-1	Cr-Ex-15-91012	11/19/2014	SW-846:8260B	Ethyl Methacrylate	5	ug/L	U	N	N	5.0
CrEX-1	Cr-Ex-15-90944	11/19/2014	SW-846:8260B	Ethylbenzene	1	ug/L	U	N	N	1.0
CrEX-1	Cr-Ex-15-91012	11/19/2014	SW-846:8260B	Ethylbenzene	1	ug/L	U	N	N	1.0
CrEX-1	Cr-Ex-15-90944	11/19/2014	SW-846:8260B	Hexachlorobutadiene	1	ug/L	U	N	N	1.0
CrEX-1	Cr-Ex-15-91012	11/19/2014	SW-846:8260B	Hexachlorobutadiene	1	ug/L	U	N	N	1.0
CrEX-1	Cr-Ex-15-90944	11/19/2014	SW-846:8260B	Hexanone[2-]	5	ug/L	U	N	N	5.0
CrEX-1	Cr-Ex-15-91012	11/19/2014	SW-846:8260B	Hexanone[2-]	5	ug/L	U	N	N	5.0
CrEX-1	Cr-Ex-15-90944	11/19/2014	SW-846:8260B	Iodomethane	5	ug/L	U	N	N	5.0
CrEX-1	Cr-Ex-15-91012	11/19/2014	SW-846:8260B	Iodomethane	5	ug/L	U	N	N	5.0
CrEX-1	Cr-Ex-15-90944	11/19/2014	SW-846:8260B	Isobutyl alcohol	50	ug/L	U	N	N	50
CrEX-1	Cr-Ex-15-91012	11/19/2014	SW-846:8260B	Isobutyl alcohol	50	ug/L	U	N	N	50
CrEX-1	Cr-Ex-15-90944	11/19/2014	SW-846:8260B	Isopropylbenzene	1	ug/L	U	N	N	1.0
CrEX-1	Cr-Ex-15-91012	11/19/2014	SW-846:8260B	Isopropylbenzene	1	ug/L	U	N	N	1.0
CrEX-1	Cr-Ex-15-90944	11/19/2014	SW-846:8260B	Isopropyltoluene[4-]	1	ug/L	U	N	N	1.0
CrEX-1	Cr-Ex-15-91012	11/19/2014	SW-846:8260B	Isopropyltoluene[4-]	1	ug/L	U	N	N	1.0
CrEX-1	Cr-Ex-15-90944	11/19/2014	SW-846:8260B	Methacrylonitrile	5	ug/L	U	N	N	5.0
CrEX-1	Cr-Ex-15-91012	11/19/2014	SW-846:8260B	Methacrylonitrile	5	ug/L	U	N	N	5.0
CrEX-1	Cr-Ex-15-90944	11/19/2014	SW-846:8260B	Methyl Methacrylate	5	ug/L	U	N	N	5.0
CrEX-1	Cr-Ex-15-91012	11/19/2014	SW-846:8260B	Methyl Methacrylate	5	ug/L	U	N	N	5.0
CrEX-1	Cr-Ex-15-90944	11/19/2014	SW-846:8260B	Methyl tert-Butyl Ether	1	ug/L	U	N	N	1.0
CrEX-1	Cr-Ex-15-91012	11/19/2014	SW-846:8260B	Methyl tert-Butyl Ether	1	ug/L	U	N	N	1.0
CrEX-1	Cr-Ex-15-90944	11/19/2014	SW-846:8260B	Methyl-2-pentanone[4-]	5	ug/L	U	N	N	5.0
CrEX-1	Cr-Ex-15-91012	11/19/2014	SW-846:8260B	Methyl-2-pentanone[4-]	5	ug/L	U	N	N	5.0
CrEX-1	Cr-Ex-15-90944	11/19/2014	SW-846:8260B	Methylene Chloride	10	ug/L	U	N	N	10
CrEX-1	Cr-Ex-15-91012	11/19/2014	SW-846:8260B	Methylene Chloride	10	ug/L	U	N	N	10
CrEX-1	Cr-Ex-15-90944	11/19/2014	SW-846:8260B	Naphthalene	1	ug/L	U	N	N	1.0
CrEX-1	Cr-Ex-15-91012	11/19/2014	SW-846:8260B	Naphthalene	1	ug/L	U	N	N	1.0
CrEX-1	Cr-Ex-15-90944	11/19/2014	SW-846:8260B	Propionitrile	5	ug/L	U	N	N	5.0
CrEX-1	Cr-Ex-15-91012	11/19/2014	SW-846:8260B	Propionitrile	5	ug/L	U	N	N	5.0
CrEX-1	Cr-Ex-15-90944	11/19/2014	SW-846:8260B	Propylbenzene[1-]	1	ug/L	U	N	N	1.0
CrEX-1	Cr-Ex-15-91012	11/19/2014	SW-846:8260B	Propylbenzene[1-]	1	ug/L	U	N	N	1.0
CrEX-1	Cr-Ex-15-90944	11/19/2014	SW-846:8260B	Styrene	1	ug/L	U	N	N	1.0
CrEX-1	Cr-Ex-15-91012	11/19/2014	SW-846:8260B	Styrene	1	ug/L	U	N	N	1.0
CrEX-1	Cr-Ex-15-90944	11/19/2014	SW-846:8260B	Tetrachloroethane[1,1,1,2-]	1	ug/L	U	N	N	1.0
CrEX-1	Cr-Ex-15-91012	11/19/2014	SW-846:8260B	Tetrachloroethane[1,1,1,2-]	1	ug/L	U	N	N	1.0
CrEX-1	Cr-Ex-15-90944	11/19/2014	SW-846:8260B	Tetrachloroethane[1,1,2,2-]	1	ug/L	U	N	N	1.0
CrEX-1	Cr-Ex-15-91012	11/19/2014	SW-846:8260B	Tetrachloroethane[1,1,2,2-]	1	ug/L	U	N	N	1.0

Table 3. CrEX-1 water qualtiy data from 2014. Volatile and semi-volatile organics and perchlorate. Source: IntellusNM

Location	Sample ID	Date	Analytical Method	Parameter	Result	Units	Lab Qualifier	Detected	Filtered	Detection Limit
CrEX-1	Cr-Ex-15-90944	11/19/2014	SW-846:8260B	Tetrachloroethene	1	ug/L	U	N	N	1.0
CrEX-1	Cr-Ex-15-91012	11/19/2014	SW-846:8260B	Tetrachloroethene	1	ug/L	U	N	N	1.0
CrEX-1	Cr-Ex-15-90944	11/19/2014	SW-846:8260B	Trichloro-1,2,2-trifluoroethane[1,1,2-]	5	ug/L	U	N	N	5.0
CrEX-1	Cr-Ex-15-91012	11/19/2014	SW-846:8260B	Trichloro-1,2,2-trifluoroethane[1,1,2-]	5	ug/L	U	N	N	5.0
CrEX-1	Cr-Ex-15-90944	11/19/2014	SW-846:8260B	Trichlorobenzene[1,2,3-]	1	ug/L	U	N	N	1.0
CrEX-1	Cr-Ex-15-91012	11/19/2014	SW-846:8260B	Trichlorobenzene[1,2,3-]	1	ug/L	U	N	N	1.0
CrEX-1	Cr-Ex-15-90944	11/19/2014	SW-846:8260B	Trichlorobenzene[1,2,4-]	1	ug/L	U	N	N	1.0
CrEX-1	Cr-Ex-15-91012	11/19/2014	SW-846:8260B	Trichlorobenzene[1,2,4-]	1	ug/L	U	N	N	1.0
CrEX-1	Cr-Ex-15-90944	11/19/2014	SW-846:8260B	Trichloroethane[1,1,1-]	1	ug/L	U	N	N	1.0
CrEX-1	Cr-Ex-15-91012	11/19/2014	SW-846:8260B	Trichloroethane[1,1,1-]	1	ug/L	U	N	N	1.0
CrEX-1	Cr-Ex-15-90944	11/19/2014	SW-846:8260B	Trichloroethane[1,1,2-]	1	ug/L	U	N	N	1.0
CrEX-1	Cr-Ex-15-91012	11/19/2014	SW-846:8260B	Trichloroethane[1,1,2-]	1	ug/L	U	N	N	1.0
CrEX-1	Cr-Ex-15-90944	11/19/2014	SW-846:8260B	Trichloroethene	1	ug/L	U	N	N	1.0
CrEX-1	Cr-Ex-15-91012	11/19/2014	SW-846:8260B	Trichloroethene	1	ug/L	U	N	N	1.0
CrEX-1	Cr-Ex-15-90944	11/19/2014	SW-846:8260B	Trichlorofluoromethane	1	ug/L	U	N	N	1.0
CrEX-1	Cr-Ex-15-91012	11/19/2014	SW-846:8260B	Trichlorofluoromethane	1	ug/L	U	N	N	1.0
CrEX-1	Cr-Ex-15-90944	11/19/2014	SW-846:8260B	Trichloropropane[1,2,3-]	1	ug/L	U	N	N	1.0
CrEX-1	Cr-Ex-15-91012	11/19/2014	SW-846:8260B	Trichloropropane[1,2,3-]	1	ug/L	U	N	N	1.0
CrEX-1	Cr-Ex-15-90944	11/19/2014	SW-846:8260B	Trimethylbenzene[1,2,4-]	1	ug/L	U	N	N	1.0
CrEX-1	Cr-Ex-15-91012	11/19/2014	SW-846:8260B	Trimethylbenzene[1,2,4-]	1	ug/L	U	N	N	1.0
CrEX-1	Cr-Ex-15-90944	11/19/2014	SW-846:8260B	Trimethylbenzene[1,3,5-]	1	ug/L	U	N	N	1.0
CrEX-1	Cr-Ex-15-91012	11/19/2014	SW-846:8260B	Trimethylbenzene[1,3,5-]	1	ug/L	U	N	N	1.0
CrEX-1	Cr-Ex-15-90944	11/19/2014	SW-846:8260B	Vinyl acetate	5	ug/L	U	N	N	5.0
CrEX-1	Cr-Ex-15-91012	11/19/2014	SW-846:8260B	Vinyl acetate	5	ug/L	U	N	N	5.0
CrEX-1	Cr-Ex-15-90944	11/19/2014	SW-846:8260B	Vinyl Chloride	1	ug/L	U	N	N	1.0
CrEX-1	Cr-Ex-15-91012	11/19/2014	SW-846:8260B	Vinyl Chloride	1	ug/L	U	N	N	1.0
CrEX-1	Cr-Ex-15-90944	11/19/2014	SW-846:8260B	Xylene[1,2-]	1	ug/L	U	N	N	1.0
CrEX-1	Cr-Ex-15-91012	11/19/2014	SW-846:8260B	Xylene[1,2-]	1	ug/L	U	N	N	1.0
CrEX-1	Cr-Ex-15-90944	11/19/2014	SW-846:8260B	Xylene[1,3-]+Xylene[1,4-]	2	ug/L	U	N	N	2.0
CrEX-1	Cr-Ex-15-91012	11/19/2014	SW-846:8260B	Xylene[1,3-]+Xylene[1,4-]	2	ug/L	U	N	N	2.0
CrEX-1	Cr-Ex-15-90944	11/19/2014	SW-846:8270D	Acenaphthene	1.08	ug/L	U	N	N	1.1
CrEX-1	Cr-Ex-15-91012	11/19/2014	SW-846:8270D	Acenaphthene	1.11	ug/L	U	N	N	1.1
CrEX-1	Cr-Ex-15-90944	11/19/2014	SW-846:8270D	Acenaphthylene	1.08	ug/L	U	N	N	1.1
CrEX-1	Cr-Ex-15-91012	11/19/2014	SW-846:8270D	Acenaphthylene	1.11	ug/L	U	N	N	1.1
CrEX-1	Cr-Ex-15-90944	11/19/2014	SW-846:8270D	Aniline	10.8	ug/L	U	N	N	10.8
CrEX-1	Cr-Ex-15-91012	11/19/2014	SW-846:8270D	Aniline	11.1	ug/L	U	N	N	11.1
CrEX-1	Cr-Ex-15-90944	11/19/2014	SW-846:8270D	Anthracene	1.08	ug/L	U	N	N	1.1
CrEX-1	Cr-Ex-15-91012	11/19/2014	SW-846:8270D	Anthracene	1.11	ug/L	U	N	N	1.1
CrEX-1	Cr-Ex-15-90944	11/19/2014	SW-846:8270D	Atrazine	10.8	ug/L	U	N	N	10.8
CrEX-1	Cr-Ex-15-91012	11/19/2014	SW-846:8270D	Atrazine	11.1	ug/L	U	N	N	11.1
CrEX-1	Cr-Ex-15-90944	11/19/2014	SW-846:8270D	Azobenzene	10.8	ug/L	U	N	N	10.8
CrEX-1	Cr-Ex-15-91012	11/19/2014	SW-846:8270D	Azobenzene	11.1	ug/L	U	N	N	11.1
CrEX-1	Cr-Ex-15-90944	11/19/2014	SW-846:8270D	Benzidine	10.8	ug/L	U	N	N	10.8
CrEX-1	Cr-Ex-15-91012	11/19/2014	SW-846:8270D	Benzidine	11.1	ug/L	U	N	N	11.1
CrEX-1	Cr-Ex-15-90944	11/19/2014	SW-846:8270D	Benzo(a)anthracene	1.08	ug/L	U	N	N	1.1
CrEX-1	Cr-Ex-15-91012	11/19/2014	SW-846:8270D	Benzo(a)anthracene	1.11	ug/L	U	N	N	1.1
CrEX-1	Cr-Ex-15-90944	11/19/2014	SW-846:8270D	Benzo(a)pyrene	1.08	ug/L	U	N	N	1.1
CrEX-1	Cr-Ex-15-91012	11/19/2014	SW-846:8270D	Benzo(a)pyrene	1.11	ug/L	U	N	N	1.1
CrEX-1	Cr-Ex-15-90944	11/19/2014	SW-846:8270D	Benzo(b)fluoranthene	1.08	ug/L	U	N	N	1.1
CrEX-1	Cr-Ex-15-91012	11/19/2014	SW-846:8270D	Benzo(b)fluoranthene	1.11	ug/L	U	N	N	1.1
CrEX-1	Cr-Ex-15-90944	11/19/2014	SW-846:8270D	Benzo(g,h,i)perylene	1.08	ug/L	U	N	N	1.1
CrEX-1	Cr-Ex-15-91012	11/19/2014	SW-846:8270D	Benzo(g,h,i)perylene	1.11	ug/L	U	N	N	1.1
CrEX-1	Cr-Ex-15-90944	11/19/2014	SW-846:8270D	Benzo(k)fluoranthene	1.08	ug/L	U	N	N	1.1
CrEX-1	Cr-Ex-15-91012	11/19/2014	SW-846:8270D	Benzo(k)fluoranthene	1.11	ug/L	U	N	N	1.1
CrEX-1	Cr-Ex-15-90944	11/19/2014	SW-846:8270D	Benzoic Acid	21.5	ug/L	U	N	N	21.5
CrEX-1	Cr-Ex-15-91012	11/19/2014	SW-846:8270D	Benzoic Acid	22.2	ug/L	U	N	N	22.2
CrEX-1	Cr-Ex-15-90944	11/19/2014	SW-846:8270D	Benzyl Alcohol	10.8	ug/L	U	N	N	10.8
CrEX-1	Cr-Ex-15-91012	11/19/2014	SW-846:8270D	Benzyl Alcohol	11.1	ug/L	U	N	N	11.1
CrEX-1	Cr-Ex-15-90944	11/19/2014	SW-846:8270D	Bis(2-chloroethoxy)methane	10.8	ug/L	U	N	N	10.8
CrEX-1	Cr-Ex-15-91012	11/19/2014	SW-846:8270D	Bis(2-chloroethoxy)methane	11.1	ug/L	U	N	N	11.1
CrEX-1	Cr-Ex-15-90944	11/19/2014	SW-846:8270D	Bis(2-chloroethyl)ether	10.8	ug/L	U	N	N	10.8
CrEX-1	Cr-Ex-15-91012	11/19/2014	SW-846:8270D	Bis(2-chloroethyl)ether	11.1	ug/L	U	N	N	11.1
CrEX-1	Cr-Ex-15-90944	11/19/2014	SW-846:8270D	Bis(2-ethylhexyl)phthalate	10.8	ug/L	U	N	N	10.8
CrEX-1	Cr-Ex-15-91012	11/19/2014	SW-846:8270D	Bis(2-ethylhexyl)phthalate	11.1	ug/L	U	N	N	11.1
CrEX-1	Cr-Ex-15-90944	11/19/2014	SW-846:8270D	Bromophenyl-phenylether[4-]	10.8	ug/L	U	N	N	10.8

Table 3. CrEX-1 water qualtiy data from 2014. Volatile and semi-volatile organics and perchlorate. Source: IntellusNM

Location	Sample ID	Date	Analytical Method	Parameter	Result	Units	Lab Qualifier	Detected	Filtered	Detection Limit
CrEX-1	Cr-Ex-15-91012	11/19/2014	SW-846:8270D	Bromophenyl-phenylether[4-]	11.1	ug/L	U	N	N	11.1
CrEX-1	Cr-Ex-15-90944	11/19/2014	SW-846:8270D	Butylbenzylphthalate	10.8	ug/L	U	N	N	10.8
CrEX-1	Cr-Ex-15-91012	11/19/2014	SW-846:8270D	Butylbenzylphthalate	11.1	ug/L	U	N	N	11.1
CrEX-1	Cr-Ex-15-90944	11/19/2014	SW-846:8270D	Chloro-3-methylphenol[4-]	10.8	ug/L	U	N	N	10.8
CrEX-1	Cr-Ex-15-91012	11/19/2014	SW-846:8270D	Chloro-3-methylphenol[4-]	11.1	ug/L	U	N	N	11.1
CrEX-1	Cr-Ex-15-90944	11/19/2014	SW-846:8270D	Chloroaniline[4-]	10.8	ug/L	U	N	N	10.8
CrEX-1	Cr-Ex-15-91012	11/19/2014	SW-846:8270D	Chloroaniline[4-]	11.1	ug/L	U	N	N	11.1
CrEX-1	Cr-Ex-15-90944	11/19/2014	SW-846:8270D	Chloronaphthalene[2-]	1.08	ug/L	U	N	N	1.1
CrEX-1	Cr-Ex-15-91012	11/19/2014	SW-846:8270D	Chloronaphthalene[2-]	1.11	ug/L	U	N	N	1.1
CrEX-1	Cr-Ex-15-90944	11/19/2014	SW-846:8270D	Chlorophenol[2-]	10.8	ug/L	U	N	N	10.8
CrEX-1	Cr-Ex-15-91012	11/19/2014	SW-846:8270D	Chlorophenol[2-]	11.1	ug/L	U	N	N	11.1
CrEX-1	Cr-Ex-15-90944	11/19/2014	SW-846:8270D	Chlorophenyl-phenyl[4-] Ether	10.8	ug/L	U	N	N	10.8
CrEX-1	Cr-Ex-15-91012	11/19/2014	SW-846:8270D	Chlorophenyl-phenyl[4-] Ether	11.1	ug/L	U	N	N	11.1
CrEX-1	Cr-Ex-15-90944	11/19/2014	SW-846:8270D	Chrysene	1.08	ug/L	U	N	N	1.1
CrEX-1	Cr-Ex-15-91012	11/19/2014	SW-846:8270D	Chrysene	1.11	ug/L	U	N	N	1.1
CrEX-1	Cr-Ex-15-90944	11/19/2014	SW-846:8270D	Dibenz(a,h)anthracene	1.08	ug/L	U	N	N	1.1
CrEX-1	Cr-Ex-15-91012	11/19/2014	SW-846:8270D	Dibenz(a,h)anthracene	1.11	ug/L	U	N	N	1.1
CrEX-1	Cr-Ex-15-90944	11/19/2014	SW-846:8270D	Dibenzofuran	10.8	ug/L	U	N	N	10.8
CrEX-1	Cr-Ex-15-91012	11/19/2014	SW-846:8270D	Dibenzofuran	11.1	ug/L	U	N	N	11.1
CrEX-1	Cr-Ex-15-90944	11/19/2014	SW-846:8270D	Dichlorobenzene[1,2-]	10.8	ug/L	U	N	N	10.8
CrEX-1	Cr-Ex-15-91012	11/19/2014	SW-846:8270D	Dichlorobenzene[1,2-]	11.1	ug/L	U	N	N	11.1
CrEX-1	Cr-Ex-15-90944	11/19/2014	SW-846:8270D	Dichlorobenzene[1,3-]	10.8	ug/L	U	N	N	10.8
CrEX-1	Cr-Ex-15-91012	11/19/2014	SW-846:8270D	Dichlorobenzene[1,3-]	11.1	ug/L	U	N	N	11.1
CrEX-1	Cr-Ex-15-90944	11/19/2014	SW-846:8270D	Dichlorobenzene[1,4-]	10.8	ug/L	U	N	N	10.8
CrEX-1	Cr-Ex-15-91012	11/19/2014	SW-846:8270D	Dichlorobenzene[1,4-]	11.1	ug/L	U	N	N	11.1
CrEX-1	Cr-Ex-15-90944	11/19/2014	SW-846:8270D	Dichlorobenzidine[3,3'-]	10.8	ug/L	U	N	N	10.8
CrEX-1	Cr-Ex-15-91012	11/19/2014	SW-846:8270D	Dichlorobenzidine[3,3'-]	11.1	ug/L	U	N	N	11.1
CrEX-1	Cr-Ex-15-90944	11/19/2014	SW-846:8270D	Dichlorophenol[2,4-]	10.8	ug/L	U	N	N	10.8
CrEX-1	Cr-Ex-15-91012	11/19/2014	SW-846:8270D	Dichlorophenol[2,4-]	11.1	ug/L	U	N	N	11.1
CrEX-1	Cr-Ex-15-90944	11/19/2014	SW-846:8270D	Diethylphthalate	10.8	ug/L	U	N	N	10.8
CrEX-1	Cr-Ex-15-91012	11/19/2014	SW-846:8270D	Diethylphthalate	11.1	ug/L	U	N	N	11.1
CrEX-1	Cr-Ex-15-90944	11/19/2014	SW-846:8270D	Dimethyl Phthalate	10.8	ug/L	U	N	N	10.8
CrEX-1	Cr-Ex-15-91012	11/19/2014	SW-846:8270D	Dimethyl Phthalate	11.1	ug/L	U	N	N	11.1
CrEX-1	Cr-Ex-15-90944	11/19/2014	SW-846:8270D	Dimethylphenol[2,4-]	10.8	ug/L	U	N	N	10.8
CrEX-1	Cr-Ex-15-91012	11/19/2014	SW-846:8270D	Dimethylphenol[2,4-]	11.1	ug/L	U	N	N	11.1
CrEX-1	Cr-Ex-15-90944	11/19/2014	SW-846:8270D	Di-n-butylphthalate	10.8	ug/L	U	N	N	10.8
CrEX-1	Cr-Ex-15-91012	11/19/2014	SW-846:8270D	Di-n-butylphthalate	11.1	ug/L	U	N	N	11.1
CrEX-1	Cr-Ex-15-90944	11/19/2014	SW-846:8270D	Dinitro-2-methylphenol[4,6-]	10.8	ug/L	U	N	N	10.8
CrEX-1	Cr-Ex-15-91012	11/19/2014	SW-846:8270D	Dinitro-2-methylphenol[4,6-]	11.1	ug/L	U	N	N	11.1
CrEX-1	Cr-Ex-15-90944	11/19/2014	SW-846:8270D	Dinitrophenol[2,4-]	21.5	ug/L	U	N	N	21.5
CrEX-1	Cr-Ex-15-91012	11/19/2014	SW-846:8270D	Dinitrophenol[2,4-]	22.2	ug/L	U	N	N	22.2
CrEX-1	Cr-Ex-15-90944	11/19/2014	SW-846:8270D	Dinitrotoluene[2,4-]	10.8	ug/L	U	N	N	10.8
CrEX-1	Cr-Ex-15-91012	11/19/2014	SW-846:8270D	Dinitrotoluene[2,4-]	11.1	ug/L	U	N	N	11.1
CrEX-1	Cr-Ex-15-90944	11/19/2014	SW-846:8270D	Dinitrotoluene[2,6-]	10.8	ug/L	U	N	N	10.8
CrEX-1	Cr-Ex-15-91012	11/19/2014	SW-846:8270D	Dinitrotoluene[2,6-]	11.1	ug/L	U	N	N	11.1
CrEX-1	Cr-Ex-15-90944	11/19/2014	SW-846:8270D	Di-n-octylphthalate	10.8	ug/L	U	N	N	10.8
CrEX-1	Cr-Ex-15-91012	11/19/2014	SW-846:8270D	Di-n-octylphthalate	11.1	ug/L	U	N	N	11.1
CrEX-1	Cr-Ex-15-90944	11/19/2014	SW-846:8270D	Dinoseb	10.8	ug/L	U	N	N	10.8
CrEX-1	Cr-Ex-15-91012	11/19/2014	SW-846:8270D	Dinoseb	11.1	ug/L	U	N	N	11.1
CrEX-1	Cr-Ex-15-90944	11/19/2014	SW-846:8270D	Dioxane[1,4-]	10.8	ug/L	U	N	N	10.8
CrEX-1	Cr-Ex-15-91012	11/19/2014	SW-846:8270D	Dioxane[1,4-]	11.1	ug/L	U	N	N	11.1
CrEX-1	Cr-Ex-15-90944	11/19/2014	SW-846:8270D	Diphenylamine	10.8	ug/L	U	N	N	10.8
CrEX-1	Cr-Ex-15-91012	11/19/2014	SW-846:8270D	Diphenylamine	11.1	ug/L	U	N	N	11.1
CrEX-1	Cr-Ex-15-90944	11/19/2014	SW-846:8270D	Fluoranthene	1.08	ug/L	U	N	N	1.1
CrEX-1	Cr-Ex-15-91012	11/19/2014	SW-846:8270D	Fluoranthene	1.11	ug/L	U	N	N	1.1
CrEX-1	Cr-Ex-15-90944	11/19/2014	SW-846:8270D	Fluorene	1.08	ug/L	U	N	N	1.1
CrEX-1	Cr-Ex-15-91012	11/19/2014	SW-846:8270D	Fluorene	1.11	ug/L	U	N	N	1.1
CrEX-1	Cr-Ex-15-90944	11/19/2014	SW-846:8270D	Hexachlorobenzene	10.8	ug/L	U	N	N	10.8
CrEX-1	Cr-Ex-15-91012	11/19/2014	SW-846:8270D	Hexachlorobenzene	11.1	ug/L	U	N	N	11.1
CrEX-1	Cr-Ex-15-90944	11/19/2014	SW-846:8270D	Hexachlorobutadiene	10.8	ug/L	U	N	N	10.8
CrEX-1	Cr-Ex-15-91012	11/19/2014	SW-846:8270D	Hexachlorobutadiene	11.1	ug/L	U	N	N	11.1
CrEX-1	Cr-Ex-15-90944	11/19/2014	SW-846:8270D	Hexachlorocyclopentadiene	10.8	ug/L	U	N	N	10.8
CrEX-1	Cr-Ex-15-91012	11/19/2014	SW-846:8270D	Hexachlorocyclopentadiene	11.1	ug/L	U	N	N	11.1
CrEX-1	Cr-Ex-15-90944	11/19/2014	SW-846:8270D	Hexachloroethane	10.8	ug/L	U	N	N	10.8
CrEX-1	Cr-Ex-15-91012	11/19/2014	SW-846:8270D	Hexachloroethane	11.1	ug/L	U	N	N	11.1
CrEX-1	Cr-Ex-15-90944	11/19/2014	SW-846:8270D	Indeno(1,2,3-cd)pyrene	1.08	ug/L	U	N	N	1.1

Table 3. CrEX-1 water qualtiy data from 2014. Volatile and semi-volatile organics and perchlorate. Source: IntellusNM

Location	Sample ID	Date	Analytical Method	Parameter	Result	Units	Lab Qualifier	Detected	Filtered	Detection Limit
CrEX-1	Cr-Ex-15-91012	11/19/2014	SW-846:8270D	Indeno(1,2,3-cd)pyrene	1.11	ug/L	U	N	N	1.1
CrEX-1	Cr-Ex-15-90944	11/19/2014	SW-846:8270D	Isophorone	10.8	ug/L	U	N	N	10.8
CrEX-1	Cr-Ex-15-91012	11/19/2014	SW-846:8270D	Isophorone	11.1	ug/L	U	N	N	11.1
CrEX-1	Cr-Ex-15-90944	11/19/2014	SW-846:8270D	Methylnaphthalene[1-]	1.08	ug/L	U	N	N	1.1
CrEX-1	Cr-Ex-15-91012	11/19/2014	SW-846:8270D	Methylnaphthalene[1-]	1.11	ug/L	U	N	N	1.1
CrEX-1	Cr-Ex-15-90944	11/19/2014	SW-846:8270D	Methylnaphthalene[2-]	1.08	ug/L	U	N	N	1.1
CrEX-1	Cr-Ex-15-91012	11/19/2014	SW-846:8270D	Methylnaphthalene[2-]	1.11	ug/L	U	N	N	1.1
CrEX-1	Cr-Ex-15-90944	11/19/2014	SW-846:8270D	Methylphenol[2-]	10.8	ug/L	U	N	N	10.8
CrEX-1	Cr-Ex-15-91012	11/19/2014	SW-846:8270D	Methylphenol[2-]	11.1	ug/L	U	N	N	11.1
CrEX-1	Cr-Ex-15-90944	11/19/2014	SW-846:8270D	Methylphenol[4-]	10.8	ug/L	U	N	N	10.8
CrEX-1	Cr-Ex-15-91012	11/19/2014	SW-846:8270D	Methylphenol[4-]	11.1	ug/L	U	N	N	11.1
CrEX-1	Cr-Ex-15-90944	11/19/2014	SW-846:8270D	Naphthalene	1.08	ug/L	U	N	N	1.1
CrEX-1	Cr-Ex-15-91012	11/19/2014	SW-846:8270D	Naphthalene	1.11	ug/L	U	N	N	1.1
CrEX-1	Cr-Ex-15-90944	11/19/2014	SW-846:8270D	Nitroaniline[2-]	10.8	ug/L	U	N	N	10.8
CrEX-1	Cr-Ex-15-91012	11/19/2014	SW-846:8270D	Nitroaniline[2-]	11.1	ug/L	U	N	N	11.1
CrEX-1	Cr-Ex-15-90944	11/19/2014	SW-846:8270D	Nitroaniline[3-]	10.8	ug/L	U	N	N	10.8
CrEX-1	Cr-Ex-15-91012	11/19/2014	SW-846:8270D	Nitroaniline[3-]	11.1	ug/L	U	N	N	11.1
CrEX-1	Cr-Ex-15-90944	11/19/2014	SW-846:8270D	Nitroaniline[4-]	10.8	ug/L	U	N	N	10.8
CrEX-1	Cr-Ex-15-91012	11/19/2014	SW-846:8270D	Nitroaniline[4-]	11.1	ug/L	U	N	N	11.1
CrEX-1	Cr-Ex-15-90944	11/19/2014	SW-846:8270D	Nitrobenzene	10.8	ug/L	U	N	N	10.8
CrEX-1	Cr-Ex-15-91012	11/19/2014	SW-846:8270D	Nitrobenzene	11.1	ug/L	U	N	N	11.1
CrEX-1	Cr-Ex-15-90944	11/19/2014	SW-846:8270D	Nitrophenol[2-]	10.8	ug/L	U	N	N	10.8
CrEX-1	Cr-Ex-15-91012	11/19/2014	SW-846:8270D	Nitrophenol[2-]	11.1	ug/L	U	N	N	11.1
CrEX-1	Cr-Ex-15-90944	11/19/2014	SW-846:8270D	Nitrophenol[4-]	10.8	ug/L	U	N	N	10.8
CrEX-1	Cr-Ex-15-91012	11/19/2014	SW-846:8270D	Nitrophenol[4-]	11.1	ug/L	U	N	N	11.1
CrEX-1	Cr-Ex-15-90944	11/19/2014	SW-846:8270D	Nitrosodiethylamine[N-]	10.8	ug/L	U	N	N	10.8
CrEX-1	Cr-Ex-15-91012	11/19/2014	SW-846:8270D	Nitrosodiethylamine[N-]	11.1	ug/L	U	N	N	11.1
CrEX-1	Cr-Ex-15-90944	11/19/2014	SW-846:8270D	Nitrosodimethylamine[N-]	10.8	ug/L	U	N	N	10.8
CrEX-1	Cr-Ex-15-91012	11/19/2014	SW-846:8270D	Nitrosodimethylamine[N-]	11.1	ug/L	U	N	N	11.1
CrEX-1	Cr-Ex-15-90944	11/19/2014	SW-846:8270D	Nitroso-di-n-butylamine[N-]	10.8	ug/L	U	N	N	10.8
CrEX-1	Cr-Ex-15-91012	11/19/2014	SW-846:8270D	Nitroso-di-n-butylamine[N-]	11.1	ug/L	U	N	N	11.1
CrEX-1	Cr-Ex-15-90944	11/19/2014	SW-846:8270D	Nitroso-di-n-propylamine[N-]	10.8	ug/L	U	N	N	10.8
CrEX-1	Cr-Ex-15-91012	11/19/2014	SW-846:8270D	Nitroso-di-n-propylamine[N-]	11.1	ug/L	U	N	N	11.1
CrEX-1	Cr-Ex-15-90944	11/19/2014	SW-846:8270D	Nitrosopyrrolidine[N-]	10.8	ug/L	U	N	N	10.8
CrEX-1	Cr-Ex-15-91012	11/19/2014	SW-846:8270D	Nitrosopyrrolidine[N-]	11.1	ug/L	U	N	N	11.1
CrEX-1	Cr-Ex-15-90944	11/19/2014	SW-846:8270D	Oxybis(1-chloropropane)[2,2'-]	10.8	ug/L	U	N	N	10.8
CrEX-1	Cr-Ex-15-91012	11/19/2014	SW-846:8270D	Oxybis(1-chloropropane)[2,2'-]	11.1	ug/L	U	N	N	11.1
CrEX-1	Cr-Ex-15-90944	11/19/2014	SW-846:8270D	Pentachlorobenzene	10.8	ug/L	U	N	N	10.8
CrEX-1	Cr-Ex-15-91012	11/19/2014	SW-846:8270D	Pentachlorobenzene	11.1	ug/L	U	N	N	11.1
CrEX-1	Cr-Ex-15-90944	11/19/2014	SW-846:8270D	Pentachlorophenol	10.8	ug/L	U	N	N	10.8
CrEX-1	Cr-Ex-15-91012	11/19/2014	SW-846:8270D	Pentachlorophenol	11.1	ug/L	U	N	N	11.1
CrEX-1	Cr-Ex-15-90944	11/19/2014	SW-846:8270D	Phenanthrene	1.08	ug/L	U	N	N	1.1
CrEX-1	Cr-Ex-15-91012	11/19/2014	SW-846:8270D	Phenanthrene	1.11	ug/L	U	N	N	1.1
CrEX-1	Cr-Ex-15-90944	11/19/2014	SW-846:8270D	Phenol	10.8	ug/L	U	N	N	10.8
CrEX-1	Cr-Ex-15-91012	11/19/2014	SW-846:8270D	Phenol	11.1	ug/L	U	N	N	11.1
CrEX-1	Cr-Ex-15-90944	11/19/2014	SW-846:8270D	Pyrene	1.08	ug/L	U	N	N	1.1
CrEX-1	Cr-Ex-15-91012	11/19/2014	SW-846:8270D	Pyrene	1.11	ug/L	U	N	N	1.1
CrEX-1	Cr-Ex-15-90944	11/19/2014	SW-846:8270D	Pyridine	10.8	ug/L	U	N	N	10.8
CrEX-1	Cr-Ex-15-91012	11/19/2014	SW-846:8270D	Pyridine	11.1	ug/L	U	N	N	11.1
CrEX-1	Cr-Ex-15-90944	11/19/2014	SW-846:8270D	Tetrachlorobenzene[1,2,4,5]	10.8	ug/L	U	N	N	10.8
CrEX-1	Cr-Ex-15-91012	11/19/2014	SW-846:8270D	Tetrachlorobenzene[1,2,4,5]	11.1	ug/L	U	N	N	11.1
CrEX-1	Cr-Ex-15-90944	11/19/2014	SW-846:8270D	Tetrachlorophenol[2,3,4,6-]	10.8	ug/L	U	N	N	10.8
CrEX-1	Cr-Ex-15-91012	11/19/2014	SW-846:8270D	Tetrachlorophenol[2,3,4,6-]	11.1	ug/L	U	N	N	11.1
CrEX-1	Cr-Ex-15-90944	11/19/2014	SW-846:8270D	Trichlorobenzene[1,2,4-]	10.8	ug/L	U	N	N	10.8
CrEX-1	Cr-Ex-15-91012	11/19/2014	SW-846:8270D	Trichlorobenzene[1,2,4-]	11.1	ug/L	U	N	N	11.1
CrEX-1	Cr-Ex-15-90944	11/19/2014	SW-846:8270D	Trichlorophenol[2,4,5-]	10.8	ug/L	U	N	N	10.8
CrEX-1	Cr-Ex-15-91012	11/19/2014	SW-846:8270D	Trichlorophenol[2,4,5-]	11.1	ug/L	U	N	N	11.1
CrEX-1	Cr-Ex-15-90944	11/19/2014	SW-846:8270D	Trichlorophenol[2,4,6-]	10.8	ug/L	U	N	N	10.8
CrEX-1	Cr-Ex-15-91012	11/19/2014	SW-846:8270D	Trichlorophenol[2,4,6-]	11.1	ug/L	U	N	N	11.1

ENCLOSURE 7

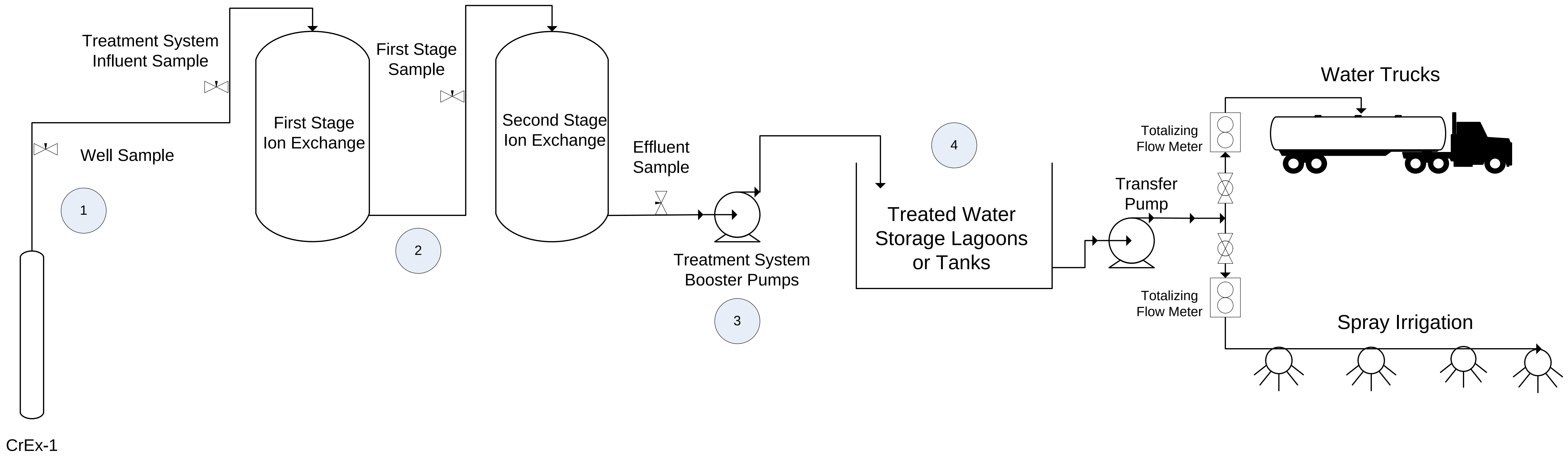
Ion Exchange (IX) Treatment System Schematic and IX Technical Specifications

ENV-DO-15-0245

LA-UR-15-26789

Date: September 3, 2015

LANL CrEx-1 Chromium
Ion Exchange Treatment System



Point 1 Chromium Extraction Wells CrEx-1 & CrEx-3	Point 2 Ion Exchange Treatment Trains	Point 3 Treatment System Booster Pumps	Point 4 Treated Water Storage Lagoons	Comments
100 GPM	3 trains each well	2 pumps (incl spare)	6 single-lined lagoons	There are two identical treatment systems, one at CrEx-1 and one at R-28.

USFilter

ION EXCHANGE

USF A-284 ANION RESIN

Description:

USF A-284 is a strong base Type I gel anion resin consisting of a styrene divinylbenzene matrix. The general appearance is a hard spherical bead which is amber in color. This resin has the ability to remove anions and weak acids from aqueous solutions, such as carbonic and silicic acids. This resin is particularly well-suited for low silica effluent requirements.

Chemical Properties

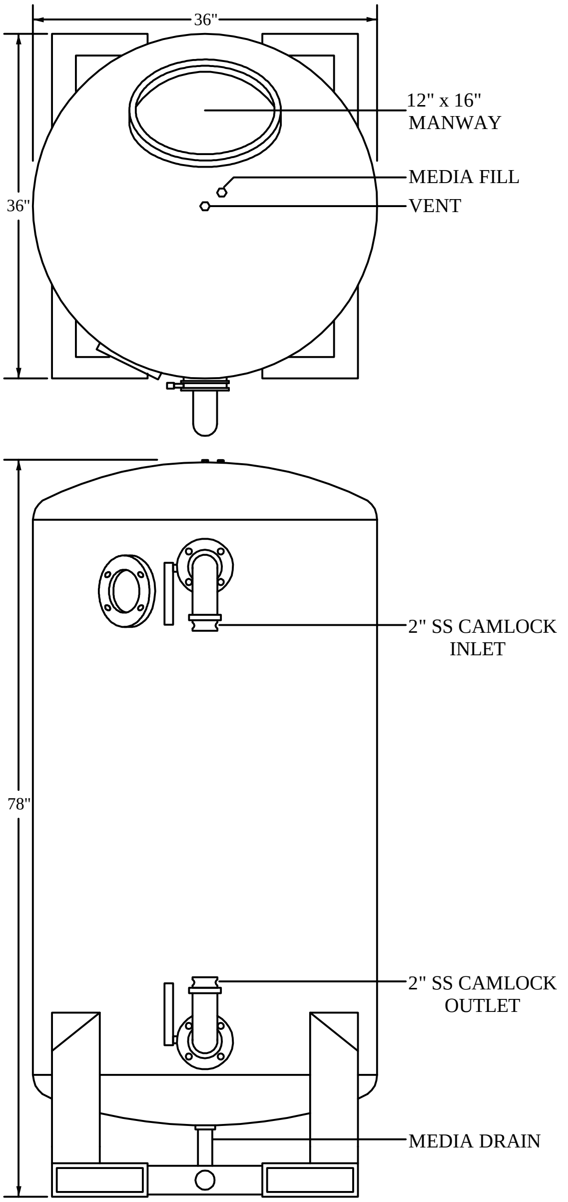
Ionic Form (as shipped)	Chloride
Moisture Content	43 - 48% (Cl form)
Exchange Capacity	1.4 meq / ml minimum (Cl form)
Kinetics	> 15 megohm (USFilter Kinetics Test)

Physical Properties

Particle Screen Sizing	
+16 Mesh	5% maximum
-50 Mesh	1% maximum
Effective Size	0.45 - 0.60 mm
Whole Beads (%)	90 minimum
Shipping Weight	44 lbs. / cu. ft.

Operating Conditions

Operating pH Range	0 to 14
Service Flow Rate	2 - 4 gpm / cu. ft.
Regenerant Flow Rate	0.25 - 0.5 gpm / cu. ft.
Rinse Flow Rate	0.25 - 0.5 gpm / cu ft. initially, then 1.5 gpm / cu. ft.
Rinse Volume	60 - 75 gallons / cu. ft.
Maximum Operating Temperature	140^{o}F



SERVICE FLOW RATE:	25-75gpm
MAX. OPERATING PRESSURE:	100psig
MAX. OPERATING TEMPERATURE:	110°F
WEIGHT (EMPTY):	1,815lbs
WEIGHT (FULL):	3,500lbs

STD: BORDER-0106-8X11A

INTL REF:

BAR = 1" AT PLOT SCALE

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DESIGNER	DATE
CHECKER	DATE
ENGINEER	DATE
MANAGER	DATE
FILE:	
SCALE:	

TITLE

CLIENT

SIEMENS

Water Technologies
Roseville, MN
651-638-1300 Fax 651-633-5074

PROJECT

CODE

DRAWING

SHEET
OF

REV

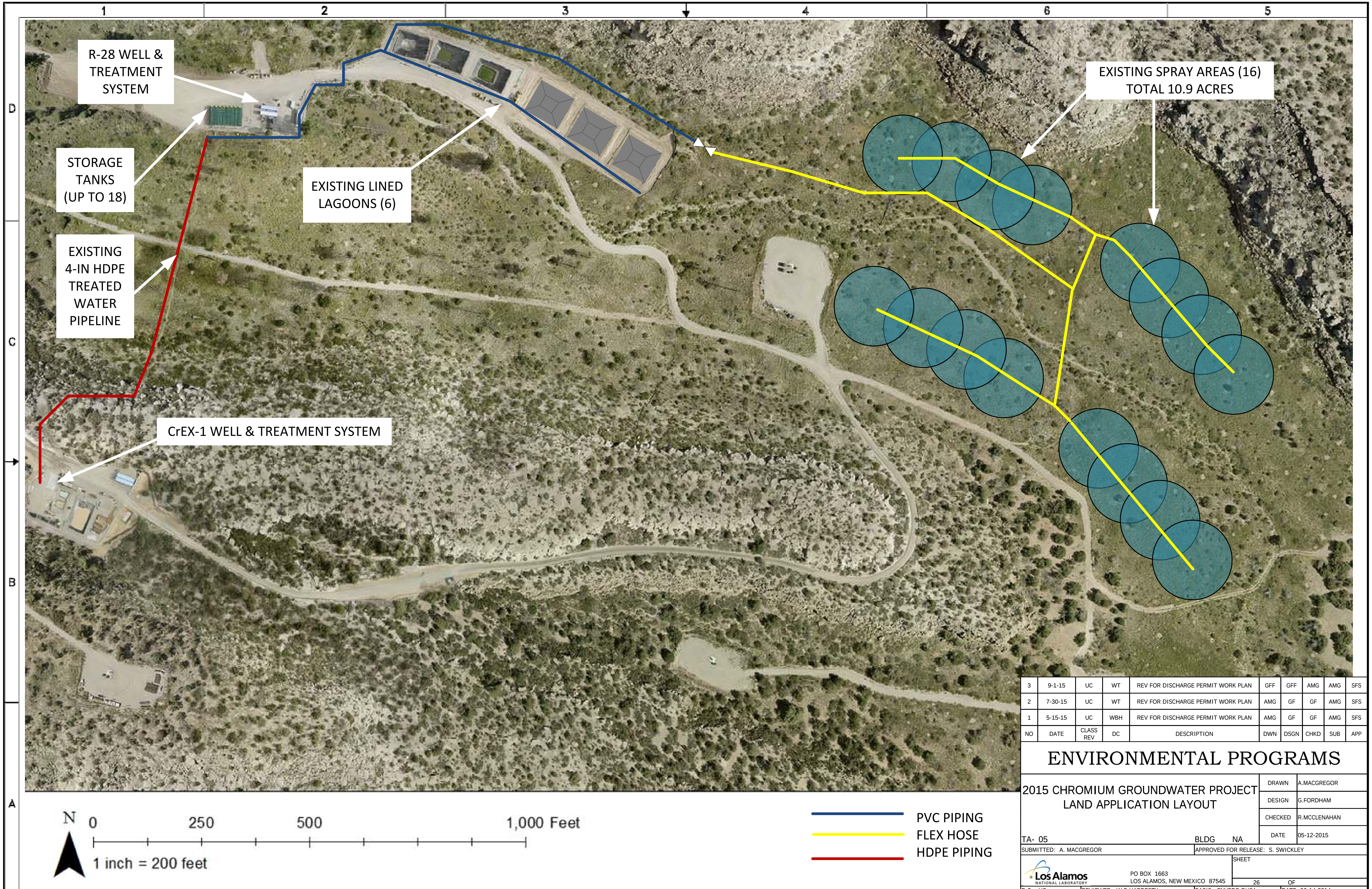
ENCLOSURE 8

Map of project components: wells, treatment, piping, storage, and irrigation areas

ENV-DO-15-0245

LA-UR-15-26789

Date: September 3, 2015



NO	DATE	CLASS REV	DC	DESCRIPTION	DWN	DSGN	CHKD	SUB	APP
3	9-1-15	UC	WT	REV FOR DISCHARGE PERMIT WORK PLAN	GFF	GFF	AMG	AMG	SFS
2	7-30-15	UC	WT	REV FOR DISCHARGE PERMIT WORK PLAN	AMG	GF	GF	AMG	SFS
1	5-15-15	UC	WBH	REV FOR DISCHARGE PERMIT WORK PLAN	AMG	GF	GF	AMG	SFS

ENVIRONMENTAL PROGRAMS

2015 CHROMIUM GROUNDWATER PROJECT
LAND APPLICATION LAYOUT

DRAWN A.MACGREGOR
DESIGN G.FORDHAM
CHECKED R.MCCLENAHAN
DATE 05-12-2015

TA- 05 BLDG NA

SUBMITTED: A. MACGREGOR
APPROVED FOR RELEASE: S. SWICKLEY

Los Alamos NATIONAL LABORATORY
PO BOX 1663
LOS ALAMOS, NEW MEXICO 87545

SHEET 26 OF

D.C.: UC
REVIEWER: W B HARDESTY
BASIS: ENVPRO DUSA
DATE: 06-14-2014

PROJECT ID 14P-0036
DRAWING NO SK-00915
ESR NO NA
REV 3

ENCLOSURE 9

Land application sites signage

ENV-DO-15-0245

LA-UR-15-26789

Date: September 3, 2015

SPRAY

NO SPRAY

ZONE 1